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Research Article

A Study on Larval Indices of Aedes and Risk for Dengue Outbreak in a Rural Area of Thrissur District, Kerala

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A B S T R A C T

Background: Mosquitoes are one of the deadliest animals in the world. Their ability to carry and spread disease to humans' cause millions of deaths every year. Knowledge regarding the bionomics of mosquito is utmost important for developing control measures. Dengue is one of the most important and fastest re-emerging arboviral diseases, with 2.5 billion people living in areas of risk. The larval indices are easy to assess and gives the mosquito density.

Objective: This study was done to calculate standardized larval indices over a period of 5 months, to determine the major breeding sources for mosquitoes, to study the seasonal trends in larval indices in a rural residential area under Kaiparambu Panchayat of Thrissur district, Kerala.

Methods: A cross sectional study was conducted over a period of 5 months (June-October) in the houses under ARCH (Amala Rural Community health) programme of Amala Institute of Medical Sciences-Kaiparambu panchayat of Thrissur district. A house to house survey was done and every water holding container-indoor and outdoor were counted, searched for larval presence, collected and assessed. Each Larvae collected was examined and species identified. Descriptive statistics was done manually to quantify the percentage of positive containers obtained.

Result: A total of 581 houses were surveyed, 223 had larval presence. The entomological indices were respectively accounted as Container Index=29.03; House Index=49.1; Breteau Index=80.3 in June and CI=19.8; HI=32.6; BI=34.7 in October. There was seasonal variation in the indices. The commonest species of mosquito identified was Aedes albopictus.

Conclusion: The area has high risk for mosquito borne disease outbreaks, with seasonal variations and rainfall patterns. With adequate preventive measures, it can be avoided.

Keywords: Aedes, Breeding Sites, Dengue, Larval Indices, Season, Thrissur

Introduction

Mosquitoes are one of the deadliest animals in the world. Their carry and spread disease to humans causes millions of deaths annually. In 2015 malaria alone caused 4,38,000 deaths. The worldwide incidence of dengue has risen 30-fold in the three decades gone by. Zika, dengue, chikungunya, and yellow fever are all transmitted to humans by the *Aedes aegypti* mosquito. More than half of the world's population live in areas where this mosquito species is present. Dengue is considered as a serious public health problem with about 2.5 billion people worldwide at risk.[1] Dengue is caused by several closely related viruses, DENV 1,2,3,4. It is a manmade disease, as the vectors breed in containers both natural and man-made both in and around the house.[2] In India, dengue fever and dengue haemorrhagic fever have been reported in different parts, including South India.[3] India had as many as 87000 cases with around 150 deaths in 2017; Kerala had 18900 cases with almost 35 deaths.[4] Over the years, the reported cases of dengue have been increasing in Kerala. Kerala is now hyper endemic for dengue with presence of multiple serotypes, high rates of co-infection and local genomic evolution of viral strains.[5] The major species of Aedes mosquito include Aedes aegypti and A. albopictus. The dengue virus is passed on to humans through the bite of infective female Aedes mosquito. Flight range studies suggest that most Aedes aegypti may spend their lifetime in or around houses where they turn into adults. This means that people move the virus within and between communities and places.[6]

The density of dengue mosquito fluctuates with temperature, rainfall and humidity. Dengue infections were generally conspicuous during or after heavy rainfall as an outcome of increased vector population. Aedes aegypti is a dominant species which shows wide geographic distribution in both tropical and temperate zones.[7] Additionally, the potential and frequency for epidemics has risen because of hyperendemicity of dengue. Any containers, natural or artificial that can accumulate fresh water is a breeding site for Aedes mosquitoes. These can be indoors or outdoors. Surveillance on Ae. aegypti density is important in determining factors related to dengue transmission, in order to prioritize areas and seasons for vector control. Selection of appropriate surveillance strategies are based upon outcome/ objective, also taking into consideration time, resources, and infestation levels. Vector surveillance is required to sustain the control measures and detect any increase in vector density.

The most used indicators for vector surveillance are:

Larval Surveys

House index (HI): Percentage of houses infested with larvae and/or pupae.

Container Index (CI): Percentage of water-holding containers infested with larvae or pupae.

Breteau Index (BI): Number of positive containers per 100 houses inspected.

Pupae Surveys

Pupa index (PI): Number of pupae per 100 houses inspected.

Adult Surveys

Estimating adult population density using ovitraps, sticky traps, human landing collections.[7]

Generally, larval stage surveillance is best suitable. Critical levels for HI, BI are taken as 10%, 5% 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.[8] Despite various efforts for eradication, a lot of countries are still affected. When it comes to susceptibility for dengue outbreaks, India tops the chart. Major factors responsible include conducive climate and environment for breeding of the vector, lack of adequate water supply leading to container storage, poverty, Illiteracy, ignorance leading to poor sanitary conditions. The high population density further worsens the issue.[2]

Rainfall: The rainfall amount in the State decreases towards the south with decrease of height of Western Ghats. The southernmost district of Thiruvananthapuram where Western Ghats are nearest to the sea coast and its average height is also least in the State receives minimum amount of rainfall. The southwest monsoon sets-over the southern parts of the State by about 1st June and extends over the entire State by 5th June. June and July are the rainiest months, each accounting individually to about 23% of annual rainfall.[9]

Objectives

- To determine the standardized larval indices (CI, HI, BI) over a period of 5 months in a rural area of Thrissur district, Kerala.
- To determine the major breeding sources for mosquitoes in a rural area of Thrissur district, Kerala.
- To assess the seasonal trends in larval indices from June to October in a rural area of Thrissur district, Kerala.

Materials and Methods

A cross sectional survey was conducted in 581 houses in Kaiparambu panchayat of Thrissur district under the ARCH programme of Amala institute of medical sciences, Thrissur during June 2018 to October 2018.

A house to house survey was done by a team consisting of 5 undergraduate medical students, 1 post-graduate student, 1 medico social worker,1 staff, 1 health inspector, 1 entomologist. The study covered the time period extending from the monsoon and post monsoon. The group of 10

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covered 581 houses over a period of 5 months. Pipettes, plastic bottles, plastic bags, a specimen test tube with stoppers, pens, a label and a flashlight were used to collect specimens as shown in figure 4. After attaining consent from the house owners, the premises of each house were searched thoroughly both indoor and outdoor and from each positive container, the larva was pipetted into a plastic cup/ plastic bag and were brought to the laboratory for identification. The type of positive containers, larval presence was entered on a pretested proforma.

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.[2]

- 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.

Data Analysis

Descriptive analysis was done manually to calculate the larval indices and the proportion of different types of containers.

Result

In this study, a total of 581 houses were surveyed over a period of 5 months (June-112; July-60; August-128; September-137 and October-144). 223 (38%) houses had positive containers. The potential vector breeding sites which were identified during the survey are given in Table 1. Different types of containers were identified as shown in Figure 1.

The no. of positive containers among the wet containers in each month as are given in Table 2. The most common site for vector breeding as per the survey was identified to be plastic buckets (33.8%) and the least was grinding stone (0.67%). 11.7% of fridge trays showed larval presence. It is an important indoor vector breeding site. The larval indices for each month are shown in Table 3.

All the larval indices calculated were above the critical level for risk of outbreak of mosquito borne diseases especially Dengue. The trend in the vector indices over the 5 months are depicted in Figure 3. Aedes albopictus was the most common species identified.

Table 1.Number and type of containers from June - October 2018

Container	June		July		August		September		October	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Plastic bucket	95	49	52	10	126	21	105	58	60	10
other plastics	53	10	28	5	92	24	88	20	43	10
Rubber tyre	15	0	20	5	30	5	68	10	41	5
Coconut shell	69	10	32	8	65	11	57	13	13	16
Egg shell	9	0	0	0	12	2	51	5	24	8
Flower pot	22	5	11	5	12	6	10	40	6	0
Earthen pot	36	5	19	2	27	10	0	0	4	0
Bottles	55	15	4	2	23	0	0	0	50	43
Fridge tray	7	0	0	0	5	0	4	0	1	0
Tarpaulin sheet	7	0	2	0	12	0	5	0	4	0
Tin	12	0	0	1	4	0	0	0	6	0
Banana leaf	0	0	0	0	5	0	0	0	0	0
Grinding stone	1	0	1	0	0	0	0	0	0	0
Total	381	94	169	38	413	79	388	146	252	92

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Table 2.Number and type of containers with larval presence from June-October 2018

Container	June		July		August		September		October	
	Wet	Positive (%)	Wet	Positive (%)	Wet	Positive (%)	Wet	Positive (%)	Wet	Positive (%)
Plastic bucket	95	31 (32.6)	52	10 (19.2)	126	19 (15)	105	24 (22.8)	60	16 (26.6)
other plastics	53	19 (35.8)	28	5 (17.8)	92	13 (14.1)	88	4 (4.5)	43	6 (13.9)
Rubber tyre	15	4 (26.6)	20	6 (30)	30	7 (23.3)	68	8 (11.7)	41	12 (29.2)
Coconut shell	69	710.1)	32	4 (12.5)	65	12 (18.4)	57	5 (8.7)	13	0 (0)
Egg shell	9	2 (22.2)	0	0 (0)	12	0 (0)	51	2 (3.9)	24	3 (12.5)
Flower pot	22	12 (54.5)	11	1 (9)	12	5 (41.6)	10	2 (20)	6	0 (0)
Earthen pot	36	2 (5.5)	19	7 (36.8)	27	3 (11.1)	0	0 (0)	4	0 (0)
Bottles	55	7 (12.7)	4	2 (50)	23	4 (17.3)	0	0 (0)	50	7 (14)
Fridge tray	7	1 (14.2)	0	0 (0)	5	0 (0)	4	0 (0)	1	1 (100)
Tarpaulin sheet	7	1 (14.2)	2	1 (50)	12	1 (8.3)	5	3 (60)	4	3 (75)
Tin	12	4 (33.3)	0	0 (0)	4	3 (75)	0	0 (0)	6	2 (33.3)
Banana leaf	0	0 (0)	0	0 (0)	5	2 (40)	0	0 (0)	0	0 (0)
Grinding stone	1	1 (100)	1	1 (100)	0	0 (0)	0	0 (0)	0	0 (0)
Total	381	91 (23.8)	169	37 (21.8)	413	69 (16.7)	388	48 (12.3)	252	50 (19.8)

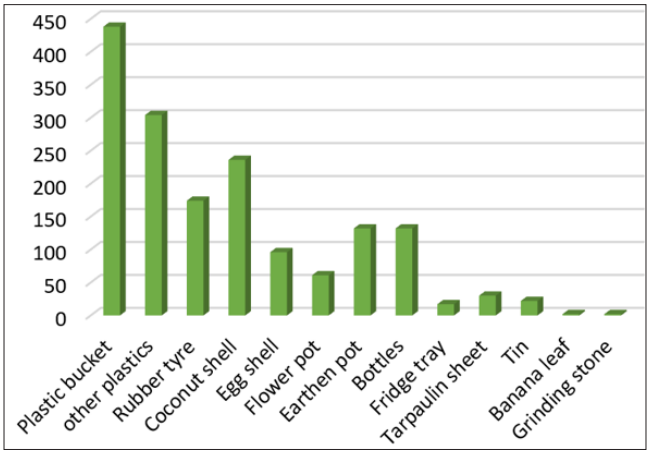

Figure 1.Type of containers

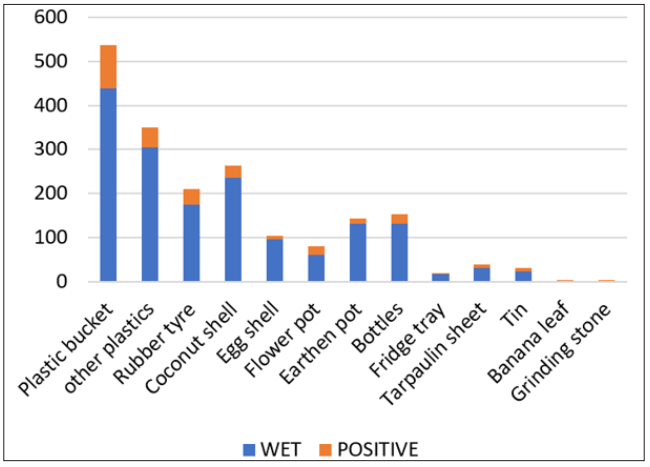

Figure 2.Containers

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Table 3.CI, HI, BI of June-October 2018

Month	CI (%)	HI (%)	BI (%)
June	23.88	49.1	81.25
July	21.8	40	61.6
August	16.7	32	53.9
September	12.3	40.8	35
October	19.8	32.6	34.7

CI=Container index, HI=House index, BI=Breteau index.

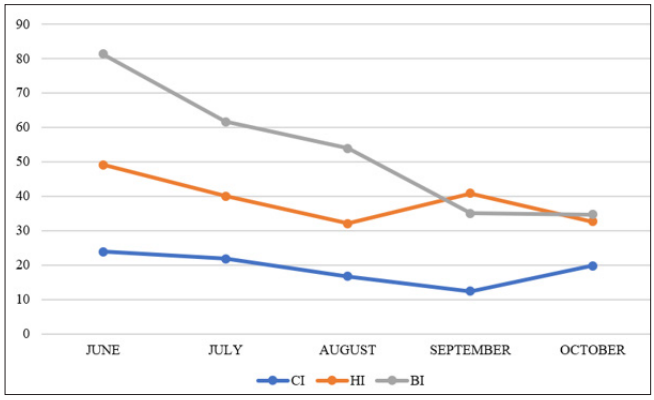

Figure 3.Trends in vector indices

Figure 4.Vector survey- inspection of containers, collection of larvae

Discussion

Our study showed that out of 581 houses surveyed, a total of 223 houses showed larval presence. The most common site of vector breeding was identified as plastic buckets in our study. This was similar to a study done at Thiruvananthapuram[8,10] and Jammu in 2013.[11] In our study, 18.4% (295/1603) containers were positive for larval presence, while in a study conducted by Sekhon H et al.[2], a total of 48.7% containers were positive. The difference may be due to the longer time period of the study and the region where the study was conducted. Our study covered both the heavy monsoon and post monsoon period. The larval indices found in the above-mentioned study were- CI/HI/BI=58%, 48.75%, 10.18 respectively. A study conducted in a rural village in Maharashtra in 2006, found HI, CI, BI as 13.6%, 2.8%, 10.3 respectively.[12] 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.[13-15] Similar studies done in another endemic state recorded the HI, CI and BI as 53.90, 19.38 and 177.06, respectively.[16] 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.[17] A study conducted in yet another state endemic for dengue yielded similar results.[16] The major species identified were that of Aedes albopictus. It is also the commonest species of Aedes found in South India. Generally, Ae. aegypti is highly adapted to the domestic environment and, therefore, the abundance is positively correlated with increasing urbanization. On the other hand, the distribution of Ae. albopictus is associated with vegetation throughout rural and urban areas.[18-20] 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. Major wash off of the containers after the rainfall and increased awareness among the inhabitants might have led to a decrease in the larval indices over the 5-month period.

Conclusion

This study gives a very clear indication that the study area is highly prone and comes under priority II for vector borne disease like dengue fever. A potentially explosive outbreak can occur in this area especially during the monsoon season. Wet plastic buckets and other discarded plastic containers were a major source of vector breeding. There was a gradual decrease in the larval indices from June to October, mostly due to wash off by rains. Fridge trays and flower pots were a great indoor source of vector breeding. In the recent past, there has been confirmed cases of Dengue in the study area, with no deaths. This obviates the need for adequate vector control measures and increased awareness to the inhabitants regarding the need for clearing vector breeding sites and using personal protect ion during the time of

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monsoon. Clearing of water holding containers, emptying earthen pots after use, discarding old tyres by filling sand in them are some of the ways by which vector breeding can be prevented. A large hand in this matter has to be made both in terms of financial and public support from the rural local governing bodies.

Recommendation

Proper methods like health talks, introduction of dry days and proper cleaning of houses. It is recommended that such periodic cleaning takes place regularly on a regular basis in all Panchayath along with awareness classes. Since plastic containers and buckets were a major vector breeding source in our study, plastic waste management measures should be given utmost importance.

Conflicts of Interest: None

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