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Breeding preferences of Aedes mosquitoes during monsoon in a Gram Panchayat of Thrissur district, Kerala-India

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ABSTRACT

Background and Objectives

Kerala is witnessing an alarming rise in the spread of infectious diseases particularly dengue. Entomological surveillance is a very important tool for the prevention and control of dengue.The study has been planned with the objectives to understand the breeding preferences of Aedes mosquitoes in rural areas and to study the standardized larval indices of Aedes mosquitoes to stratify the area based on risk.

Methods

A Cross sectional study was conducted from June to August in Velur panchayat under the field practice area of Amala Institute of Medical sciences. From the total of 18 wards, 2 wards are randomly selected. From each ward 225 houses were selected from the list of houses provided.

Results

A total of 450 houses were surveyed over 3 months of these 149 houses were found to be infested. A total of 1175 wet containers 267 were found to be positive. All the entomological indices are above critical level in June but in July and August HI and BI were found to be above critical level, CI were found to be moderate level. The common positive breeding sites, wet and dry containers were found to be plastic containers, coconut shells etc. The predominant species identified was *A. albopictus*

Interpretation and Conclusion

Community participation with an integrated approach including intensive source reduction, health education and entomological surveillance is the optimal strategy in all places where vector indices are high

Keywords: A. *aegypti; A. albopictus*; Breeding habits; Source reduction; Surveillance

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INTRODUCTION

Dengue is the most widely distributed and fastest spreading epidemic prone mosquito-borne infectious disease known to man. The incidence of dengue has grown dramatically around the world in recent decades. Dengue is now endemic in more than 100 countries in regions of Africa, the Americas, the Eastern Mediterranean, South-East Asia and the Western Pacific. It has started spreading to new areas, including Europe, and explosive outbreaks are occurring. About half of the world's population is now at risk of dengue with an estimated 100–400 million infections occurring each year.[1] In India dengue fever and dengue haemorrhagic fever have been reported in different parts, including south India. India had 193,245 cases and 346 deaths in 2021.Kerala had 3251 cases and 27 deaths. In 2022 Kerala had 4468 cases and 58 deaths Over the years the reported cases of dengue have been increasing in Kerala. Kerala is now hyperendemic for dengue with multiple serotypes, high rate of co-infection and local genomic evolution of viral strain.[2]Dengue is caused by arbovirus which belongs to the Flaviviridae family. It is transmitted through the bite of infective female aedes mosquitoes of the species Aedes aegypti and Aedes albopictus. There are four distinct but closely related serotypes of the virus that cause dengue (DENV-1, DENV-2, DENV-3, DENV-4). Recovery from infection with one serotype provides lifelong homogenous immunity to the type that infect you but instead may exacerbate subsequent infection.[3] Dengue is spread through a human to mosquito to human cycle of transmission with Aedes aegypti as the primary vector and Aedes albopictus as the secondary vector. Aedes aegypti is confined only to certain urban areas while Aedes albopictus is widely distributed both in urban and rural areas. The arrival of aedes albopictus has been correlated with the decline in the abundance and distribution of Aedes aegypti.[4] Aedes albopictus is a competent vector of many viruses including dengue fever. Its life cycle is closely associated with human habitat in the artificial accumulation of water among human dwellings such as water found in discarded tin, coconut shell, barrel, tires, Flower vases Etc. Entomological survey is used to determine changes in the geographical distribution and density of the vector, identify breeding sites, provide information for the factors related to disease transmission and prioritize areas and seasons for vector control. Surveillance of aedes larvae is a very important component of the prevention control strategy and should be undertaken at regular intervals. The only method of controlling dengue is to combat the vector mosquito through source reduction and environment management with community participation. This will be done through a combined approach by motivating panchayat raj institutions and mobilising people. Health education at field level is a pivotal role in controlling dengue. Practical display at field level catches their attention and motivates the public to maintain source reduction activities around them. The objectives of the study are:

- To assess the predominant species of Aedes mosquitoes during monsoon period in a rural area of Thrissur district.
- To determine the breeding sites of Aedes mosquitoes in a rural area of Thrissur district during monsoon season
- To utilize the Aedes larval indices over three months (Monsoon) as a risk-area stratifying tool

Methodology

The Local Self Government permission was taken from the Velur Panchayat following which the study was conducted. As there were no human study participants involved, did not seek ethical clearance for the purpose of conduct of study.A Community based cross sectional study was conducted in the Velur Panchayath, field practice area of Rural Health Training centre of Amala Institute of Medical Sciences for the period of three months from June to August 2022(Monsoon). Two wards were randomly selected from the total of 18 wards in Velur panchayath in Thrissur.The study was conducted as a series of house-to-house surveys in selected wards of Velur panchayath under the field practice area of the department of community medicine, Amala institute of Medical Sciences Thrissur Kerala. The survey was conducted during the month of June, July, August 2022(Monsoon) The houses from the ward 1 and 2 were selected randomly and each house to house survey covers a minimum of 150 houses every month. The team consists of postgraduate students, undergraduate students, health inspectors under the guidance of an Entomologist.Standard entomological techniques were used for the survey The tools used included a survey form, pipettes, plastic bottles, test tubes, cotton and a flashlight.

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After getting the consent from the house owners, the premises of each house were searched thoroughly both indoor and outdoor, and from each positive container, the larvae were pipetted into a plastic bottle and were brought to the laboratory for identification. The number of dry containers (container with no traces of water) , wet container (container with wet or with minimum amount of water) and positive container (container which harbors larval form of mosquitoes) were also noted and recorded in a survey form. The adult mosquitoes from indoor and outdoor were collected using test tubes and cotton.The larval survey data were calculated and analysed in terms of different larval survey indices such as Breteau index, House Index and Container index.The calculation of larval indices is based on the following mathematical formula:

Breteau Index (BI) = $\frac{\text{No of positive containers x100}}{\text{No of houses inspected}}$

House Index (HI) = $\frac{\text{No of houses infested x100}}{\text{No of house inspected}}$

Container Index (CI) = $\frac{\text{No of positive containers x100}}{\text{No of containers inspected}}$

Results

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

Table 1. Number and type of containers from June to August

Containers	June		July		August	
	Wet	Dry	Wet	Dry	Wet	Dry
Plastic containers	145	55	202	91	220	58
Coconut shell	51	40	50	90	102	57
Flower pot	63	40	41	36	30	70
Earthen pot	10	4	24	5	16	10
Tire	9	13	8	12	11	7
Egg shell	18	10	10	15	19	9
Tarpaulin sheet	12	7	17	4	11	6
Barrel	4	3	10	4	18	4
Steel	5	3	6	2	4	2
Shoes	1	0	1	1	2	2
Banana leaf	0	0	0	0	1	1
Indoor plant pot	8	0	6	0	5	0
Refrigerator tray	20	20	10	10	5	5
Total	346	195	385	270	444	231

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Table .2 Number and type of containers with larval presence from June to August

Containers	June		July		August	
	Wet	Positive (%)	Wet	Positive (%)	Wet	Positive (%)
Plastic containers	145	33(22.7)	202	38(18.8)	220	32(14.5)
Coconut shell	51	10(19.6)	50	11(22)	102	14(13.7)
Flower pot	63	16(25.3)	41	15(36.5)	30	6(20)
Earthen pot	10	5(50)	24	3(12.5)	16	7(43.7)
Egg shell	18	2(11.1)	10	4(40)	19	5(26.3)
Tire	9	7(77.7)	8	5(62.5)	11	4(36.3)
Tarpaulin sheet	12	2(16.6)	17	4(23.5)	11	3(27.2)
Barrel	4	1(25)	10	5(50)	18	9(50)
Steel items	5	3(60)	6	1(16.6)	4	2(50)
Shoe	1	1(100)	1	1(100)	2	1(50)
Banana leaf	0	0	0	0	1	1(100)
Refrigerator tray	20	6(30)	10	2(20)	5	1(20)
Indoor plant pot	8	4(50)	6	1(16.6)	5	2(40)
Total	346	90	385	90	444	87

Table.4 Genera of mosquitoes identified

Adult Mosquito identified	June	July	August
Aedes aegypti	2	0	0
Aedes albopictus	12	11	13
Culex quinquefasciatus	4	7	7
Armigeres	5	3	4

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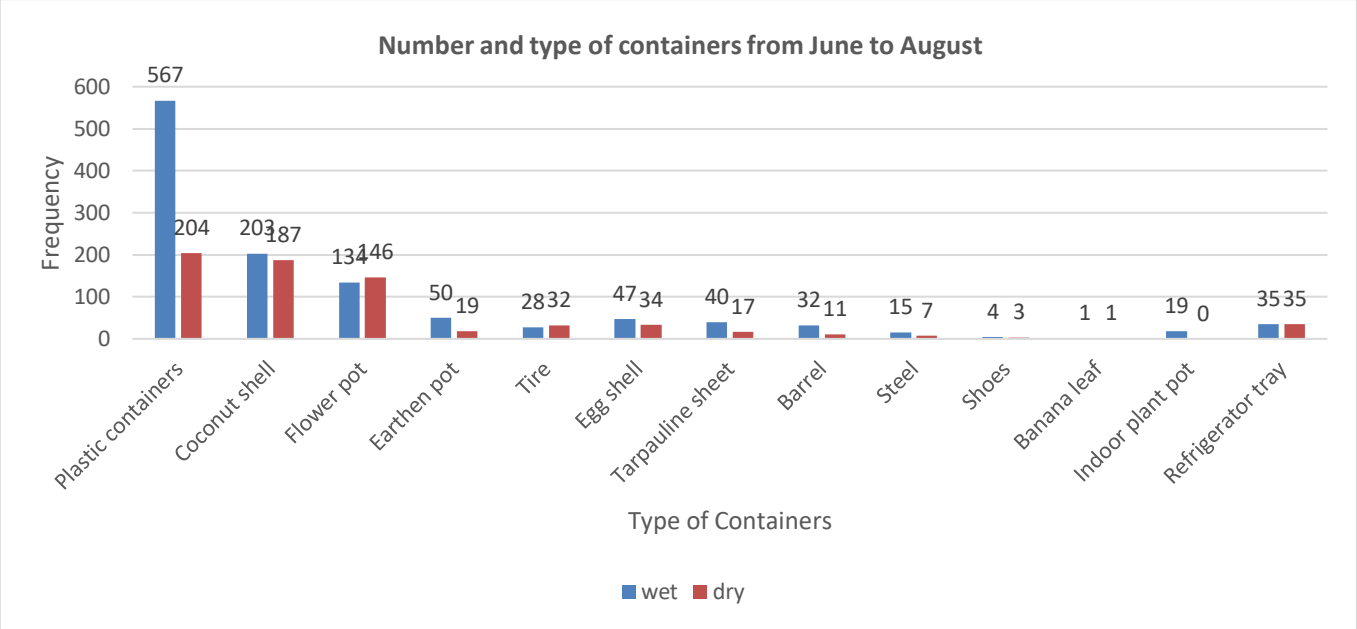

Figure :1 : Number and Type of containers from June to August

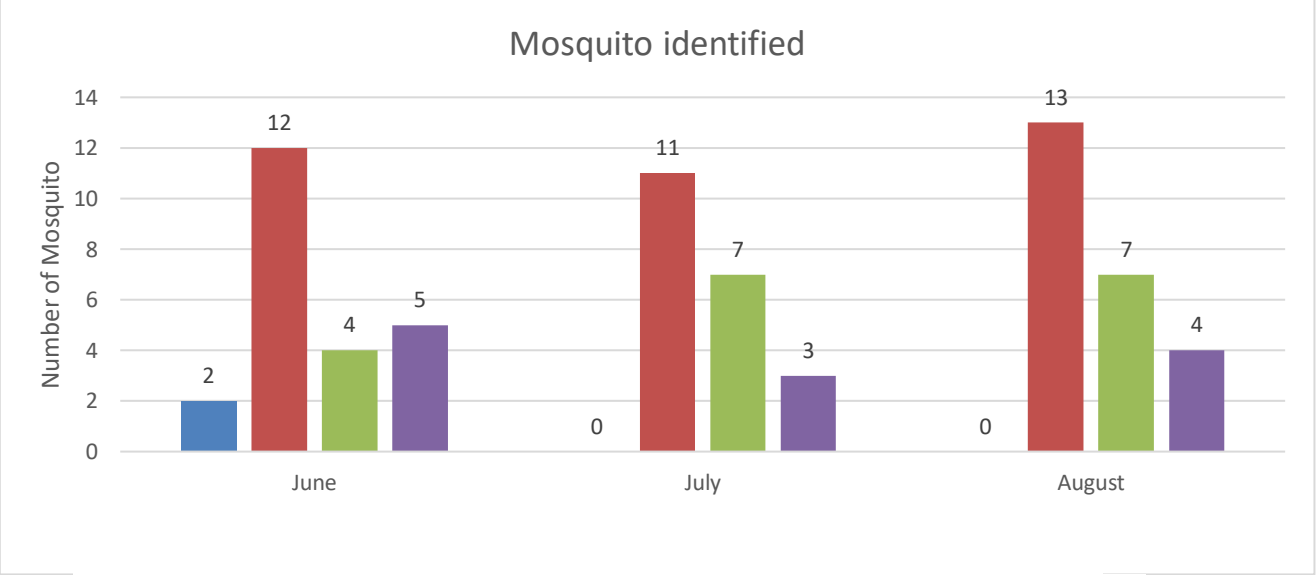

Figure :4 : Mosquitoes identified with genera and species

RESULTS

In this study, a total of 450 houses were surveyed over a period of three months; a minimum of 150 houses were covered each month. Of these 450 houses, 149 houses were found to be infested. A total of 1871 potential containers (both wet and dry) were identified, of which 1175 were wet or water holding of which 267(22.7%) were found positive. Table.1 shows the different potential containers outdoor and indoor respectively. Number of wet containers during the months of June, July, August was 346 ,385, 444 and of these, 90 (26.01), 90 (23.3) and 87 (19.5) of the respective months were found to have larval breeding. The containers were emptied and placed upside down. Figure 2 shows the number of positive containers over three months. The proportion of the positive containers were tires (57.1%), barrels

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(46.8%), steel items(40%) , indoor plant pots (36.8%) , earthen pots (30%) , flower pots (27.6%), refrigerator tray (25.7%) , egg shells (23.4%) followed by tarpaulin sheets (22.5%) , plastic containers (18.1%) and coconut shells (17.2%).

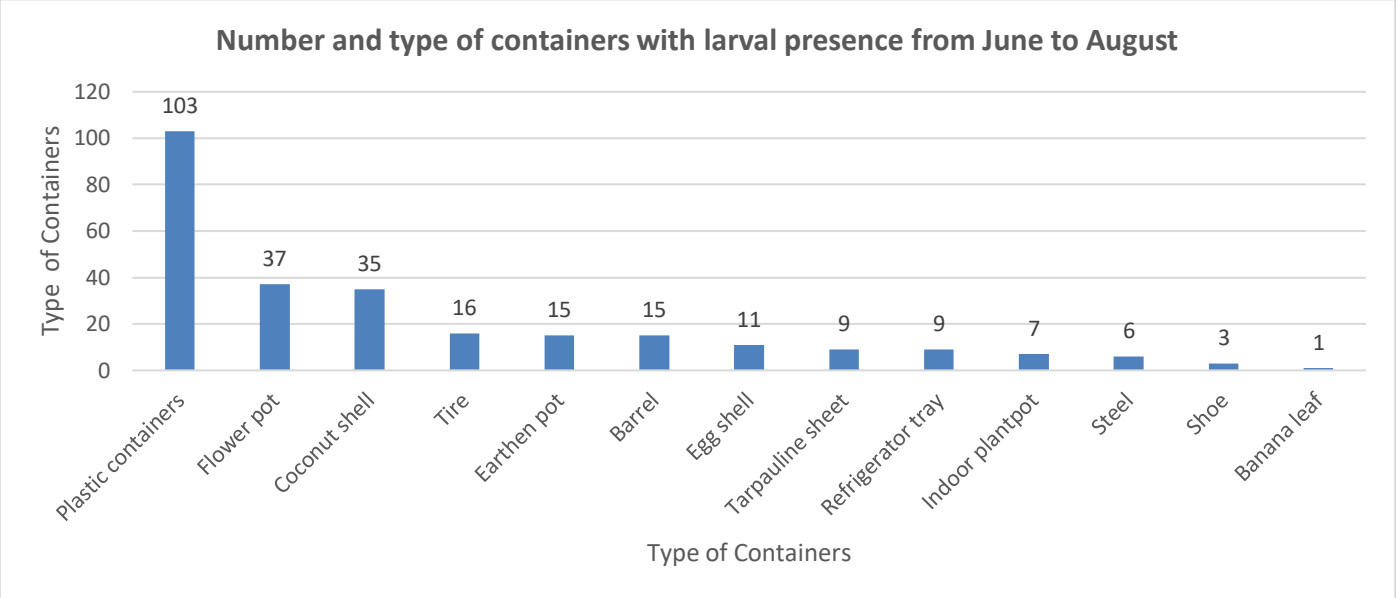

Figure :2 : Number and Type of containers with larval presence from June to August

In this study all the entomological indices were found to be above critical level in June (CI =26.01%, HI=34%, BI=60) In July and August Breteau index and House index were found to be above critical level, container index was found to be moderate level (CI =23.37% HI=42%, BI=60, July) August, CI=19.59% HI=23% BI=58). The larval indices for each month are given in table 3 and figure 3.The predominant species identified was *Aedes albopictus* both in adult collection and larval collection. Mixed breeding of *Aedes albopictus* and *Culex quinquefasciatus* were found in some containers.

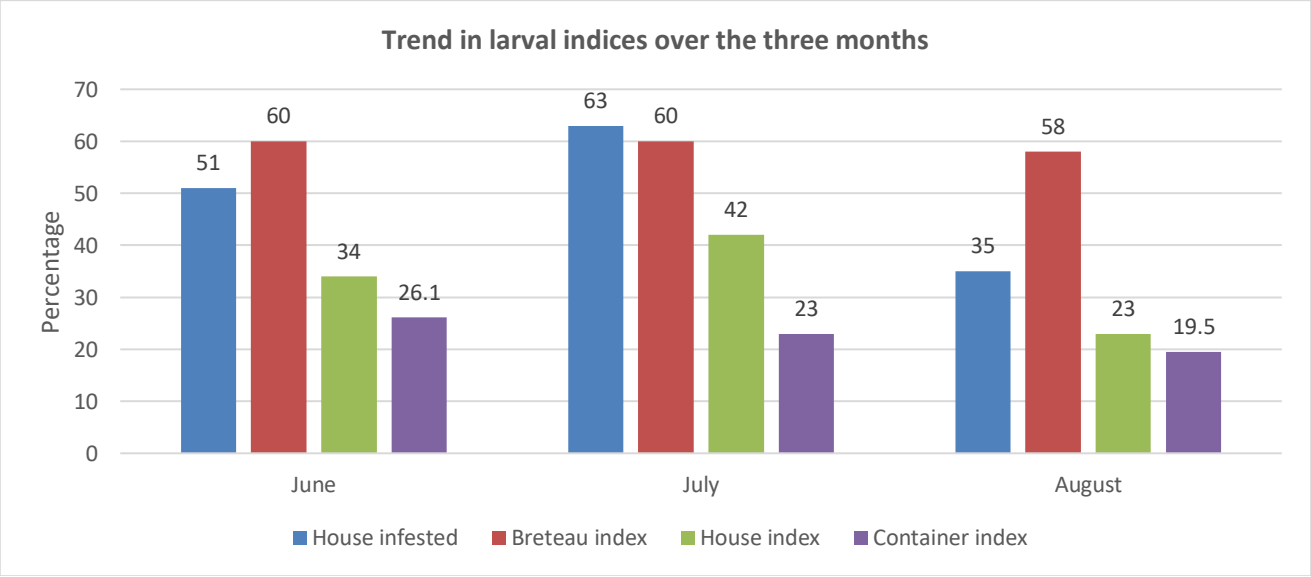

Figure :3 : Trend in larval indices over the three months

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Table.3 Trend in larval indices over the three months

Months	House inspected	House infested	Breteau Index	House Index (%)	Container Index (%)
June	150	51	60	34	26.01
July	150	63	60	42	23.37
August	150	35	58	23.33	19.59

DISCUSSION

This study result shows that the larval indices are high during the study period. In our present study Breteau Index, House Index, Container Index were found to be 60, 34%, 26.1% in the month of June, 60, 42%, 23.37% in July, 58, 23.33%, 19.59% in August. A similar study by Amruthraj Radhakrishnan et al Ernakulam district Kerala, India Breteau Index, House Index, Container Index were found to be 67.13 ,34.72, 19.81 in June, 36.61, 22.80, 15.33, in July,32.93, 21.07, 12.20 in August.[5] Another study by Sasi MS *et al* in Thiruvananthapuram district of Kerala India all the indices were above critical level in the surveyed areas.[6] In both these studies and our present studies all the larval indices show high risk values in the study areas during the monsoon. This is mainly due to rain. Many containers around us like plastic containers, coconut shells, tyres, egg shells, tarpaulin sheets and plant pots get water logged and by increasing the breeding places of aedes mosquitoes. This may be the reason for high incidence of dengue fever in Kerala during monsoon. A similar study done by Lalthazuali et al in Malappuram district of Kerala India.[7] all the indices were found to be low to medium level because this study was done from September seventeen to October first during the post flood period.In our present study, 20 refrigerator trays were found water with 6 were positives in June, 10 refrigerator trays with two positives in July, and five refrigerator trays with one positive in august Similar study by Jesha MM et al mosquito density in urban Kerala,[8] 30 refrigerator tray were found water with 1 was positive in October. This difference may be due to the behavioural practices of the concerned people of different study areas. In our present study the most common species found was Aedes albopictus. It is supported by the study result of K Vijayakumar et al Thiruvananthapuram district, Kerala, India.[9] The distribution of Aedes albopictus is associated with vegetation throughout rural and urban areas.[10-12]A similar study done by Samuel et al in Thiruvananthapuram district Kerala, India most common species were *Aedes aegypti* and *Aedes albopictus*. In Kerala there is relatively thick vegetation in both urban and rural areas and this may be the reason for the similar distribution of species in both areas. Our study found that Aedes aegypti is very less in number compared to aedes albopictus. This may be due to the displacement of Aedes aegypti due to the increase in number of Aedes albopictus. In our present study 195,270,231, Dry containers were found in June, July and August. Similar study by "Anna Susan Paul A Study on larval Indices of Aedes and Risk for Dengue Outbreak in a Rural area of Thrissur Kerala 94,38,79 Dry containers were found in June, July, August.[13] Another Study by Mohamed Rafi M" observed trends of mosquito larval indices over a year in rural area of Thrissur Kerala" and 64,177,136 dry containers were found in June, July and August respectively.[14] The differences in the number of dry containers in the different areas may be due to the lack of awareness of the breeding habit of aedes mosquitoes among the local people. It has been established that dry containers will act as potential breeding sources during the onset of monsoon. In our

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present study plastic containers, coconut shells and flower pots were the common dry container as well as the common breeding sites. Their breeding ratio in our study was found to be 22.7% ,19.6 % ,25.3% in June 18.81%, 22% ,36.5% in July 14.54%,13.72% 20% in August.

CONCLUSION

The study result shows that the area is at high risk for Aedes mosquito borne diseases based on the breeding habit and vector indices. Hence an impending outbreak of dengue is likely to occur in this area in the presence of dengue viruses in the population. High percentage of dry containers in this area also supports high vector density in the monsoon period. In view of the above, it is felt that there is a need for adopting vector control measures in the pre monsoon period with focus on source reduction along with public health education and community participation. Community participation with an integrated approach including intensive source reduction, health education and entomological surveillance is the optimal strategy in all places where vector indices are high.

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