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Impending dengue outbreak: An assessment on mosquito density, diversity and awareness

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Abstract
Repeated outbreaks of vector borne diseases necessitate a study on the diversity and abundance. This study was to determine species composition, relative abundance and habitat characteristics of mosquitoes. A cross-sectional entomological survey was carried out in 140 households, rural area of Thrissur district. Larvae and adult mosquitoes were collected and the species were identified. Knowledge regarding mosquito breeding and dengue were assessed using a questionnaire. A total of 140 houses were taken up for survey from which 190 positive containers were obtained. The species identified during larval and adult stages from indoors and outdoors were Aedes albopictus, and breeding habitats included more of plastic containers followed by coconut shells. House Index, Container Index and Breteau Index were 67%, 35% and 135 respectively, which were above critical level. The indices have direct relevance to disease transmission and calls for urgent need to institute appropriate measures.

Keywords: Aedes mosquito, awareness, breeding, mosquito larva, larval indices

1. Introduction
Mosquitoes are responsible for the transmission of many important pathogens. The *Aedes* mosquito transmits some the world's life-threatening and debilitating mosquito-borne diseases such as dengue, yellow fever and chikungunya [1]. The spatial distribution and density of mosquitoes are influenced by climatic and topographic factors, in addition to the effects of man-made changes in the environment. Rainfall, temperature and relative humidity contribute to environmental factors, while currently manmade habitats seem to play a major role in influencing mosquito population density [2].

Furthermore, with specific respect to *Aedes* species, the influence of human activity has been significant in their increased abundance. Rapid urbanization, inappropriate waste management and increased use of single use plastic have all contributed to creation of breeding grounds for *Aedes* mosquitoes. *Aedes albopictus*, primarily seen in the rural areas, has markedly adapted to the newer environments and has emerged as a major threat in rural and peri-urban areas.

In order to develop strategic measures to control the spread and transmission of mosquito borne diseases, a good understanding of the abundance and distribution of mosquito vectors with transmission patterns of the disease is needed [2]. Evaluation of larval mosquito habitats in terms of their species composition and density is of paramount importance for their control. Density of mosquito is often assessed using Larval indices, which include House Index (HI), Container Index (CI) and Breteau Index (BI). Larval surveys are less time-consuming and more efficient when compared to adult surveys. Larval surveys help predict outbreak of diseases like Dengue and Chikungunya given the previous incidence in the area. Critical levels are prescribed for HI and BI (5% and 20 respectively), above which outbreaks are likely to occur.[3] The density as well as container preference of the mosquitoes need to be assessed in individual localities, so as to decide on appropriate preventive measures. Such preventive measures require a lot of cooperation from the general population; this emphasises the need to increase the public awareness regarding breeding of mosquitoes and the measures to prevent it. The current study was conducted to understand the species composition, relative abundance and habitat characteristics of mosquitoes during pre-monsoon season, as well as to assess the knowledge gap among the general population with regards to disease transmission by mosquitoes in a rural area in Kerala state, India.

2. Materials and Methods

A door to door survey was conducted in 140 house-holds, in Wards 4 and 5 of Kaiparamba panchayat in rural area of Thrissur district of Kerala. This area is a minor industrial setting involved in production of plastic utensils, with a significant population of migrant workers. The study was conducted in the month of May during the pre-monsoon season, and included methods to identify mosquito species both in adult and larval forms.

The selected houses were meticulously inspected indoors and outdoors for potential breeding sites of mosquito larvae, specifically of Genus *Aedes*. All containers with any amount of water were considered to be potential breeding sites. The containers were classified as dry (with no traces of water), wet containers (which showed even minimal amount of water) and positive containers (which harboured larval forms of mosquitoes). Larval collections were recorded in pre-designed survey forms and identified based on taxonomic keys. Larvae were collected using dipping and pipetting methods, from all positive containers in and around the houses, and were transported to the Department Laboratory. Adult mosquitoes were captured at rest by using test tubes, from both indoors as well as the immediate surroundings of the houses.

Table 1: The breeding sites positive containers

Breeding sites	Positive containers	Wet containers	Dry containers	% Positivity of wet containers
A) Out Door				
Plastic containers	87	204	153	42.65
Coconut shells	31	74	40	41.89
Earthen Pots	8	45	98	17.78
Metal containers	4	30	12	13.33
Tarpaulin sheet	12	20	3	60.00
Tyres	8	23	12	34.78
Glass containers	2	10	3	20.00
Others	8	29		27.59
B) Indoor				
Refrigerator trays	14	60	50	23.33
Flower vases	6	57	0	10.53

S and indoors (N=552)

Fig 1: Common containers identified as mosquito breeding sites (a) Grinding stone, (b) Water barrel, (c) Tyre; (d) Garden ornament (e) Discarded paint bucket (f) Refrigerator tray (g) Plastic jerry can (h) Plastic sheet

All the collected larvae, both indoors and outdoors, were found to be of *Aedes albopictus* when raised in the Barraud Cage. The adult mosquitoes captured were mostly *Aedes albopictus*, followed by *Culex quinqefaciatus* and *Armigeres* mosquitoes (25, 7 and 5 in number respectively).

The knowledge gap was assessed among 140 respondents from the houses surveyed. Of them, 137(97.8%) had heard about Dengue, however only 10% knew how dengue was transmitted. The respondents had limited knowledge with regard to breeding sites of dengue vector, only 21(15%) responded correctly and most of the respondents did not seem to know the name of the vector species which causes dengue; 124 (88.6%) did not answer the question. The knowledge assessed among the participants has been depicted in Table 2.

Table 2: Knowledge assessment in study population (N=140)

Knowledge questions		Yes (%)	No (%)
Q1.	Have you heard of Dengue?	137 (97.8%)	3 (2.2%)
Q2.	Do you know how dengue is transmitted?	14 (10.0%)	126 (90.0%)
Q3.	Breeding sites for Dengue vectors?	21 (15.0%)	119 (85.0%)
Q4.	Can you name the species of the vector?	16 (11.4%)	124 (88.6%)

3. Discussions

This study showed that the larval indices were high even during the pre-monsoon period. Furthermore, there were a large number of dry containers which can become potential breeding sites for Aedes mosquitoes following the rains. It may also be noted that the study found larvae of *Aedes albopictus* in a rural area, which is as expected; however, the fact that *Aedes albopictus* larvae were obtained from artificial containers such as plastic buckets and glass containers was an unusual finding [6].

The comparison of the present study indices are made with other related studies from Kerala. The larval indices obtained from the present study of Thrissur were comparatively higher from the studies in Thiruvanathapuram, which was done during the pre-monsoon and monsoon seasons and Malapuram, which was mostly done early post monsoon season in the month of October [7, 8]. The House Index of present study 67%, when compared to House Index of Thiruvananthapuram study (13%), shows a steep increase [7]. Similarly, the findings of Perithalmanna, Malapuram district the House Index was 25%, which is again comparatively low compared to the present study.[8] The container Index of the present study (35%) was also higher compared to studies at Thiruvananthapuram (13%) and Malappuram (10% [7, 8] Even the values of Breteau Index was considerably high in the current study (135) when valued with the other study findings of Thiruvananthapuram (16) and Malappuram (73) [7, 8] All of these convey that the high values obtained from the current study could predict a dengue outbreak in this area. The Larval indices were high when compared to studies done in Mumbai and Tiruchipalli [9, 10]. [Figure 2]

The common breeding sites for Aedes mosquito in our study were plastic containers, coconut shells, tarpaulin sheets, earthen pots, metal containers and tyres. Similar were the common containers in a study in Bangalore, which included unused grinding stones, flower pots, drums, barrels, rubber tyres and cement tanks [11]. The current study shows that discarded plastic containers were a major source of breeding for *Aedes* mosquitoes; this advocates the emphasis to reduce, reuse and recycle of plastics.

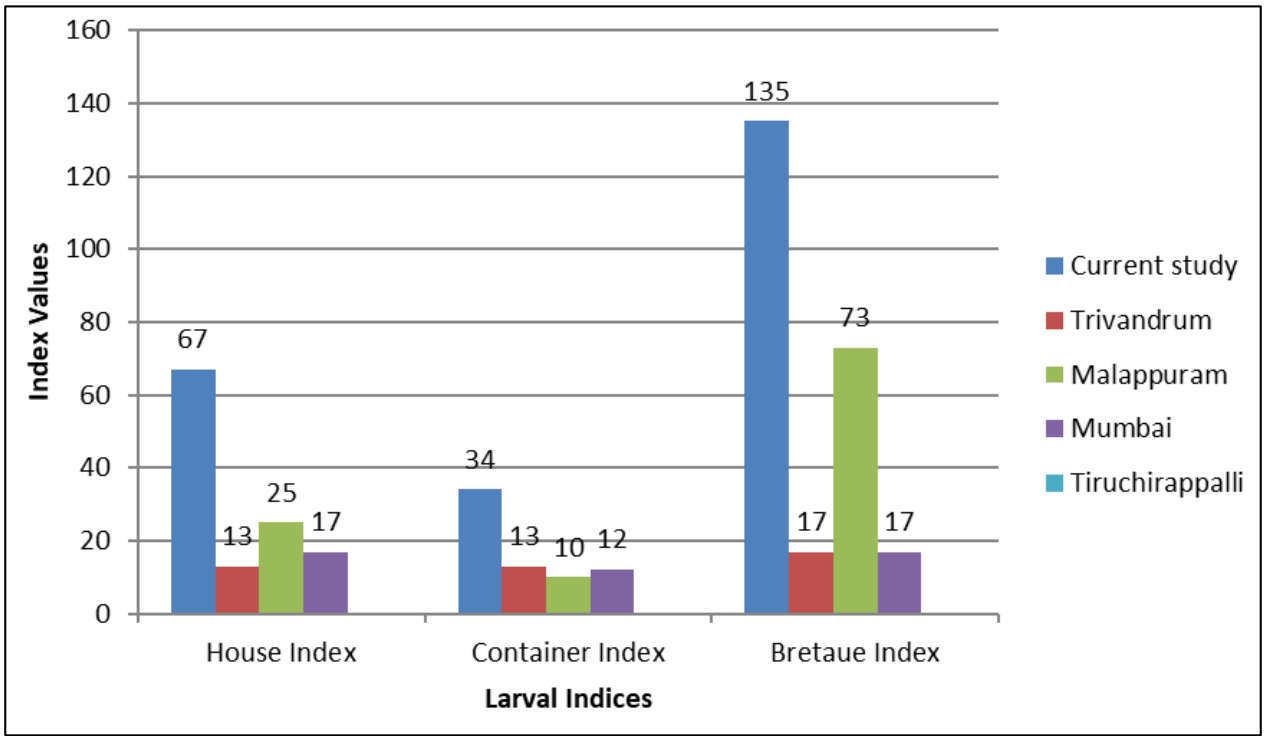

Fig 2: Comparison of Larval Indices from Various Studies

Regarding knowledge about transmission of dengue, the response of 10% of respondents were correct; the study in Ernakulam showed 64.6% of the respondents answered correctly that dengue is the transmitted by mosquitoes. With respect to knowledge regarding transmission of dengue and other mosquito borne diseases, 15% of respondents answered correctly on the site of breeding of mosquitoes in our study, while in the study done in Ernakulam 96% of answered correctly [12] As is evident, the knowledge level in our area was very poor. Interestingly, some of our respondents mentioned that mosquitoes breed in accumulated wastes and cow dung, and where unaware of the role of water in growth of mosquito larvae.

4. Conclusion

The study indicates that an impending outbreak of dengue was

likely in this population. The number of cases may only indicate the silence before the storm, demanding for surveillance to be conducted in a comprehensive way. The awareness among study population seemed to be limited, even after witnessing such outbreaks in nearby districts. This calls for strategies that focus on health education and entomological surveillance, that helps keeps a check on the dengue transmission.

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