MOSQUITO DENSITY IN URBAN KERALA: A STUDY TO CALCULATE LARVAL INDICES IN MUNICIPAL AREA OF PERINTHALMANNA

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ABSTRACT

Introduction: *Mosquito borne diseases are a major public health problem in Kerala. Mosquito density assessed by larval surveys are easier and quicker to perform. The larval indices are an important practical predictor of outbreaks of mosquito borne disease and are valuable in taking preventive measures.*
Objectives: *This study is done to calculate standardized larval indices namely House Index, Container Index and Breteau Index and to identify the major breeding sources of mosquitoes in the residential environment in the municipal town of Perinthalmanna, Kerala.*
Methods: *A cross-sectional study selecting 25 houses randomly from the 6 wards of Municipality under the field practice area of Urban Training Centre, MES Medical College Perinthalmanna. Every water holding container indoors and outdoors were counted and searched for larval presence and noted on a pretested format.*
Results and Discussion: *In this study, 167 houses were surveyed in 8 days. 97.6% (163 houses) were found to have potential sources for mosquito breeding. All the entomological indices were found to be above the critical level. House Index = 25.15%; Container Index = 10.36%; Breteau Index = 73.05% showing high chances for outbreaks of mosquito borne diseases.*
Conclusions: *The area is prone for mosquito borne disease outbreaks like dengue fever and therefore warrants interventions for prevention.*

Key Words: Vector survey, breeding sites, containers, House Index, Container Index, Breteau Index.

INTRODUCTION

"Vector Borne Diseases: Small Bite, Big Threat" was the World Health Day theme for the year 2014.Vector borne diseases have been on the rise in the last few years with epidemics reported in many countries. Vector borne diseases form a major public health problem in Kerala too. The incidences are increasing alarmingly due to many factors including uncontrolled urbanization and development that supports increase in artificial collections of water which are favorite sites for breeding of mosquitoes.

We have been at constant war with the mosquitoes since the 1950s as part of the malaria control programme. After initial success now the war seems at loss as the mosquito density has increased in the past two decades leading to epidemics of hitherto unheard diseases like dengue fever and Chikungunya in Kerala. The increase in mosquito density can be attributed to high density of population, urbanization, developmental activities and improper waste disposal. These factors along with the usual heavy monsoons and hot humid weather have made this area ideal for mosquitoes to breed. For controlling this, National Vector Borne Disease Control Programme was implemented in India which has a three pronged approach: (1) disease management (2) integrated vector management and (3) supportive interventions like Behavioural Change Communication, Public Private Partnership and Operational Research.

Mosquitoes generally require about seven to eight days for completing their life cycle and emergence as adults from eggs laid in water collections. Any containers, natural or artificial that can accumulate water for the above period of time can be a potential breeding habitat for aedes mosquitoes or anopheles mosquitoes. These containers can be indoors or outdoors. The main indoor breeding sites are earthen pots for water storage, concrete water storage tanks, uncovered water storage tanks or

metal drums, flower vases, saucers under the ornamental plant pots, soft drink bottles, water trays of refrigerators with automatic defrosting and air conditioners, plastic containers. The main outdoor breeding sites are tree holes, bamboo stumps, leaf axils, earthen pots, discarded bottles or tins, discarded tyres, metal drums for water storage, rain barrels, clogged up roof gutters, coconut shells or husks, latex cups in rubber plantations, canoes and small fishing boats, cocoa husks or pods[1]. Even stagnant water bodies can become a breeding habitat. Culex mosquitoes generally breed in dirty water collections like drains, ditches, uncovered latrine tanks, etc.

Entomological surveillance is used to determine the geographical distribution of major breeding sites and pinpoint high risk areas; forecast impending outbreaks; obtain relative measurements of the vector population over time and facilitate appropriate and timely decisions regarding interventions; recognize changes in vector density, distribution and vectorial capacity and to plan for vector control strategies and also to evaluate effectiveness of control programmes.

A number of methods are available for detecting or monitoring immature and adult population of mosquitoes of which LARVAL SURVEYS are more commonly done as it is less labour intensive and easier. Though PUPAL SURVEYS and ADULT SURVEYS can be conducted using methods like human landing collections, ovitraps, sticky paper traps, and adult indices like mosquito density, biting density and sporozoite rate can be calculated, these are more time consuming and labour intensive than larval survey. The results are also less satisfying in comparison to larval surveys. LARVAL SURVEYS are quick and easy to conduct and are valuable predictors of outbreaks of diseases.

Entomological surveillance has been standardized on different indices based on simple determination of presence or absence of larvae in containers or in the premises of surveyed house[2]. Thus various *larval indices* can be calculated namely HOUSE INDEX, CONTAINER INDEX, BRETEAU INDEX.

House Index (HI) denotes percentage of houses or premises positive for mosquito larvae. HI is extremely important for epidemiological purposes as it indicates potential for spread of diseases. However, HI does not take into account number of larvae positive containers in a house. Similarly, **Container Index (CI)** denotes only percentage of water holding containers positive for larvae. **Breteau Index (BI)** on the other hand establishes relation between positive containers and number of houses. It denotes the number of positive containers per 100 houses inspected in an area. Hence it is the most useful single index for estimating vector density in a location.

House Index and Breteau Index are commonly used for determination of priority areas for vector control activities to prevent outbreaks. Generally, 10% and 5% are taken as critical levels for House Index and Breteau Index respectively beyond which epidemics are likely to occur. If the BI is above 50%, it is considered a very high risk area and between 5 – 50% is considered as moderate risk[3]. These larval indices are used to predict the outbreak of mosquito borne diseases and take preventive measures.

This study aims at finding out the larval indices in the municipal area of Perinthalmanna town in Kerala which comes under the field practice area of MES Medical College. The valuable data thus obtained shall be used for planning and conducting vector control activities to prevent mosquito borne disease outbreaks. The results will also serve for evaluating the effectiveness of the mosquito control measures undertaken so far in the area.

OBJECTIVES

1. To calculate important vector (larval) indices namely House Index, Container Index and Breteau Index in the urban field practice area of MES Medical College, Perinthalmanna.
2. To determine the major breeding sources for mosquitoes in the peridomestic environment in the above area.

METHODOLOGY

Study Area: The study was conducted in 6 wards under the field practice area of Urban Health Training Centre, MES Medical College, Perinthalmanna.

Study Design: This study was conducted as a Cross Sectional survey

Sampling Technique: Houses were selected randomly from each of the six wards taking each ward as a cluster.

Sample Size: A total of 150 houses, taking randomly 25 houses from each ward.

Study Period: The study was conducted in 8 days during October 8th to 18th, 2014.

Man Power: The survey was done by two teams - one intern accompanied by a staff (Health Inspector / medico-social worker) trained for the study in each team.

Method: 25 houses were randomly selected from each ward. Each team covered 10 houses a day and the survey was completed in 8 days. After getting the consent from the head of the house, the premises of the house are meticulously searched for all possible water collections and containers both indoors and outdoors. Details regarding potential mosquito breeding sites and those positive for larval presence are collected and entered on a pretested Performa. Care was taken to search both indoors and per domestic area for manmade breeding habitats like cement cisterns, cement tanks, metal containers, plastic drums, plastic containers, metal drums, grinding stones, mud pots, bottles, discarded containers, flowerpots, flower vases, tyres, water pumps, latex cups, polythene sheets, flowerpot trays and also the natural breeding sites like coconut shells, tree-holes, plant axils, coconut leaf-thatched sheets, fallen spathes or bracts[4].

All containers containing any volume of water were considered as potential breeding sites. Every accessible water-holding container in and around the house was meticulously searched for the presence of immature mosquitoes. Every water-holding container was categorized according to the type of container or breeding site mentioned in the format. Larval presence was identified by the wriggling movement was also noted. Houses with one or more positive containers were noted.

A community action programmer was designed and implemented later to tackle the issue and to empower the house hold to take community action for mosquito control.

DATA ANALYSIS

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

RESULTS

In this study a total 167 houses were surveyed from the 6 wards coming in the field practice area of Urban Health Centre, MES Medical College. There were potential breeding sites (with or without larvae) in 163 houses (97.6%). Positive containers (with larvae) were present in 42 of these 167 houses showing a calculated **house Index of 25.15%** (95% confidence interval = 18.57 – 31.73)**.** Out of 1177 artificial water collections with potential for aedes breeding, larvae were identified in 122 leading to a calculated **Container Index of 10.36%** (95% C.I = 4.95 – 15.76)and **Breteau Index of 73.05**%(95% C.I = 68.46 – 81.59). This is depicted in Table no.1**.** All the entomological indices were found to be above the critical level for occurrence of out breaks of mosquito borne diseases.

Table 1: Calculation of mosquito larval indices

SURVEY RESULTS		LARVAL INDICES (95% CI)		
		House Index	Container Index	Breteau Index
Total Number of houses surveyed	**167**	(42/167x100)	(122/1177x100)	(122/167x100)
Number of houses positive for larvae	**42**			
Total Number of Potential Containers	**1177**	**25.15**	**10.36**	**73.05**
Number of containers positive for larvae	**122**	(95% CI = 18.57 – 31.73)	(95% CI = 4.95 – 15.76)	(95% CI = 68.46 -81.59)

The distribution of artificial water collections (sites or containers) with potential for breeding found on inspection of the houses and its premises and the proportion positive for larval breeding are shown in Table no.2. The distribution of houses with containers positive for larvae was not similar, with much greater mosquito densities in some households than others. The main potential containers with chances for mosquito breeding were flower pots (360), followed by tins (199) and coconut shells (197). The main source where actual breeding was detected in the peri-domestic area was discarded tins (17%) followed by coconut shells (15%) and discarded tyres (15%).

Sixty two stagnant water bodies like wells or ponds and 11 slow moving water channels were also noted during house to house survey. Various polluted water collections like Ditches (30); Drains (45); unsealed latrine tanks (2); Organic waste collections (38) were found in the premises during the study which are potential sites for culex mosquito breeding.

DISCUSSION

Comparison of the indices in our study with critical levels and those obtained in other similar studies has been depicted in Figure 1. The studies used for comparison are a survey at Parichaya colony, a residential area of Mumbai near International Seaport conducted in 2010[5]; a study done in Tiruchirapalli district of Tamil Nadu during 2012 -2013[6]and a study done in 4 panchayaths of Thiruvanathapuram namely, Nemam, Vizhinjam, Vellanad, Medical College area in 2014[7].Of these available studies all three indices were highest in Vizhinjam, a coastal area in Trivandrum[7], Kerala. Our study shows the second highest Breteau Index. In the survey at Parichaya colony, BI was found to be 17.24% in 2010[5]which is above the critical level of 5% but below 50%. In a study, Dengue vector prevalence and virus infection in a rural area in south India[8], Breteau index was found to be ranging from 9.05 to 45.49.The house index is comparable with most of the other studies referred. The HI in Parichaya colony (2010) was 16.7% whereas in Tiruchirapalli district (2012 -13) was 45%[6]. The Container

Index in our survey (10.36%) is similar to the index (12.5%) at Parichaya colony, Mumbai in 2010[5]. Our study shows lower container index (10.36%) than the 32.2% in Tiruchirapalli district of Tamil Nadu (2012 - 13)[6].

Vector borne diseases have been ruling the morbidity profile of Kerala for more than a decade. Vector control especially source reduction activities has been the main method for control of mosquitoes. Health education regarding the vector breeding and control strategies are being given regularly and through different media, but an evident disparity in knowledge and practice was noted in our study area following the community action programme. In spite of the high literacy rate and the health education activities conducted one out of four houses in these 167 houses surveyed, were positive for mosquito larvae. Both House Index and Breteau Index which are considered better predictors than container index are well above acceptable limits. The House Index of 25.15% is far above the safe limit 10% and container index 10.36% is at par with the cut off 10%. The BI is well above 50% and hence the area studied is at very high risk for epidemics[3]. In fact there had been an epidemic of chikungunya in the last decade and many cases of dengue are reported yearly especially during monsoon.

CONCLUSIONS

The study shows high larval indices well above the critical points. Thus it is evident that these areas are at very high risk for an outbreak of vector borne diseases and unless serious action is taken with community participation, we may have to take the brunt of explosive outbreaks of disease like dengue fever and repeated attacks of which attains severe forms like hemorrhagic dengue and shock syndrome. The study also concludes that the mosquito control activities are not effective in the area.

RECOMMENDATIONS

Further entomological studies to identify the type of mosquitoes are recommended. Further studies to depict time trend of the larval indices during

different seasons of the year are also recommended. Qualitative research to study why the community is not able to take effective measures are also required. Based on this study Health Education and Community action Plans with the help of Municipal Health authority are recommended to reduce mosquito density and there by prevent disease outbreaks.

LIMITATIONS

The study was conducted at the end of monsoon season which may have led to the high indices. Though the larvae present in small containers are presumably aedes mosquito larvae, the type of mosquito larvae could not be conclusively identified.

The study involved only 6 wards of the 34 in the municipality area and we presume the situations in other wards are similar.

ETHICAL CONCERNS

Ethical clearance was obtained from the Institutional Ethical Committee. During house to house survey individual consent was obtained from the house owners.

Table 2: Distribution of different collections with potential for aedes / anopheles breeding and proportion of containers with larvae

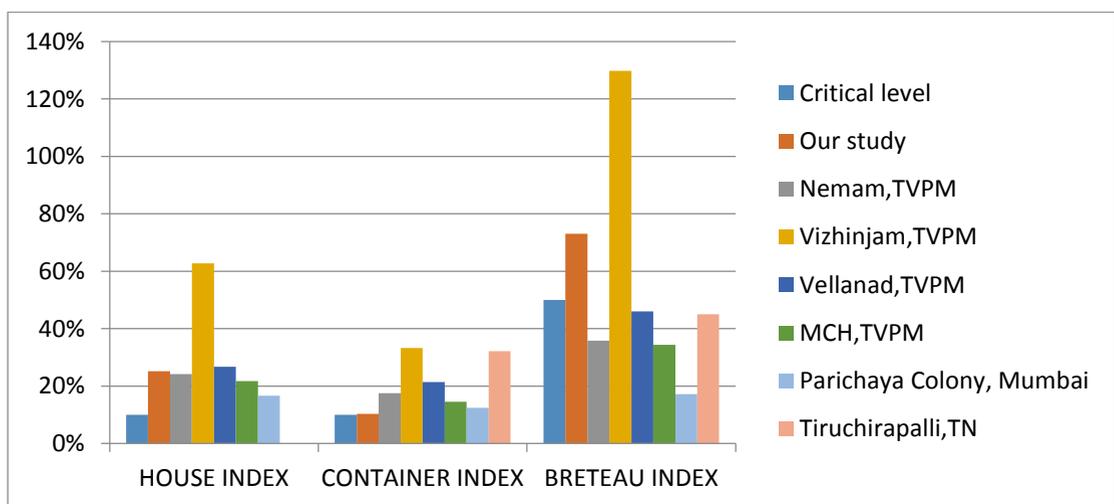| Type of artificial water collections	Potential water collections	Positive for larvae	Percentage of total +ve containers n=122
Tins	199	34	27.87
Coconut shells	197	30	24.59
Drums	76	10	8.19
Flowerpots	360	8	6.56
Tires	46	7	5.74
Earthenware pots	66	7	5.74
Fridge trays	30	1	0.82
Terrace	9	0	0
Tree holes	67	0	0
Others	127	25	20.49
TOTAL	**1177**	**122**	**100**

Figure No: 1. Comparison of larval indices in our study with critical level and other studies

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