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Research Article

Post Flood Dengue Vector Surveillance-An Experience from Ernakulum District of Kerala, India in 2018

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A B S T R A C T

Introduction: Floods increase the transmission of water and vector borne diseases. In August 2018, severe floods affected the south Indian state Kerala. Present study was conducted in Ernakulam district of Kerala.

Objectives: (i) To determine the major breeding sources for mosquitoes in the peri-domestic area (ii) to identify the species of mosquitoes and (iii) to analyse the vector (larval) indices.

Material and Methods: A cross-sectional descriptive study was conducted in Ernakulam district of Kerala by using a mix method. Data was collected from 15th to 30th September, 2018 by House to House survey, Review of IDSP records and interview of key health officials of the district. Larval survey was done in 525 houses selected from 11 purposively selected areas. Data was entered and objective wise analysis was done by using Microsoft Excel and data was presented in number and percentages.

Result: Ernakulam district is endemic for dengue fever. Out of total 1580 containers inspected maximum were of plastic (35.7%), followed by metals (21.9%) and plastic drums (9.9%). House Index ranged from 2 - 18 percent. Container Index ranged from 0.6 - 6.3 percent. Breatu Index ranged from 1.8 - 24.8 percent. Out of total 51 mosquitoes, 33 (64.7%) were Aedes Albopictus, 4 (7.8%) were Aedes Pseudotaeniatus, 5 (9.8%) were Armigeres Subalbatus and 9 (17.6%) were Culex Quinquefasciatus.

Conclusion: High level of all the vector indices and plenty of empty containers is responsible for endemicity of dengue and it can give rise to outbreak at any point of time.

Keywords: Dengue, Aedes Aegypti, Vector Indices, Breatu Index, Dengue Transmission, Ernakulum

Introduction

Major vector-borne diseases account for 17% of the global burden of communicable diseases and claim more than 700,000 lives every year. The burden is highest in tropical and subtropical areas.[1] The incidence of dengue has grown

dramatically around the world in recent decades. The actual numbers of dengue cases are underreported and many cases are misclassified. One recent estimate indicates 390 million dengue infections per year (95% credible interval 284-528 million), of which 96 million (67-136 million) manifest clinically.[2] Vector borne diseases form a major Public Health problem in Kerala. 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.[3]

Dengue virus is transmitted by female mosquitoes mainly of the species *Aedes Aegypti* and, to a lesser extent, *Ae. Albopictus.*[2]

Surveillance on *Aedes 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. Additionally, vector surveillance is required to sustain the control measures and detect any increase in vector density.[1] The most used indicators for vector surveillance are House Index (HI), Container Index (CI) and Breatu Index (BI).[1]

In the month of August 2018, severe floods affected the south Indian state Kerala, due to unusually high rainfall during the monsoon season.[4] Floods can potentially increase the transmission of water and vector borne diseases: Floods may indirectly lead to an increase in vector-borne diseases through the expansion in the number and range of vector habitats. Standing water caused by heavy rainfall or overflow of rivers can act as breeding sites for mosquitoes, and therefore enhance the potential for exposure of the disaster-affected population and emergency workers to infections such as dengue, malaria and West Nile fever.[5] Present study was conducted in Ernakulam district of Kerala in post flood period for analysis of the situation for surveillance of Dengue.

Objective

- To determine the major breeding sources for mosquitoes in the peri-domestic area.
- To identify the species of the mosquito.
- To analyse important vector (larval) indices.

Material & Method

Ernakulam district was under Red Alert due to flood after a heavy rain in Kerala in the month of August 2018.Many places near Periyar River were nearly 10 to 20 ft submerged under water. Several relief camps were established .Many organizations e.g WHO, NDRF, NDMA and Doctors from Tamilnadu worked together to combat the post flood situation.

The central team consisting of one public health specialist, Microbiologist and entomologist was also deputed in the districts from 1st September 2018 and it continued up to 30th September for hand holding surveillance. The team worked in closed liaison with District surveillance officer and District Epidemiological officer. The team used to give daily feedback to the state Authorities with face to face discussion.

A cross-sectional descriptive study was conducted in Ernakulam district of Kerala. Study was conducted by using a mix method. Data was collected from 15th to 30th September, 2018. Data was collected by House to House survey, Review of IDSP records and interview of key health officials of the district. Larval survey was done by house to house survey in 525 houses. A total of 525 houses were selected from 11 purposively selected areas. A total of 50 houses were selected from each of 10 areas and 25 houses were selected from 1 area. Houses were selected by using Simple Random Sampling. Study was conducted after taking permission from District Health Officer, District and State Epidemiologist.

Data was entered and objective wise analysis was done by using Microsoft Excel and data was presented in number and percentages.

Mosquito Larval Surveys

For larval surveys, the basic sampling unit was the house or premise, which was systematically searched for water holding containers. Containers were examined for the presence of Aedes mosquito larvae and pupae.

Every accessible water-holding container in and around the house was sampled for the presence of immature mosquitoes. Small containers (<20 litter capacity) were completely drained through a Steiner into a white larval sampling tray (25 × 20 × 4 cm) to collect larvae and pupae. Larger containers were sampled using a 250 ml larval dipper. Five dips were taken from the surface water of each container (four dips evenly spaced around the edges of the container and one at the centre). All the larvae and pupae were brought to the field laboratory in labeled containers. Every water-holding container was categorized according to the type of container, container function, shape, maximum capacity, volume of water in the container, and material and presence of a cover. House Index (HI), Container Index (CI) and Breatu Index (BI) were calculated. In the laboratory, III and IV instar larvae and all pupae were transferred to holding containers which were covered with permeable gauze. Each larva was individually reared and identified at the adult stage. Mosquitoes collected by the above methods were morphologically identified using standard keys.[6] Three indices were used to monitor Aedes Aegypti infection levels.

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Table 1.Indices to monitor *Aedes Aegypti* infection level

S. No.	Index	Definition	Formula to Calculate
1.	House Index (HI)	Percentage of houses infected with larvae and / or pupae	$\frac{\text{Number of Houses infected}}{\text{Number of Houses inspected}} \times 100$
2.	Container Index (CI)	Percentage of water holding containers infected with larvae or pupae	$\frac{\text{Number of positive containers}}{\text{Number of containers inspected}} \times 100$
3.	Breatu Index (BI)	Number of positive containers per 100 houses inspected	$\frac{\text{Number of positive containers}}{\text{Number of Houses inspected}} \times 100$

Result

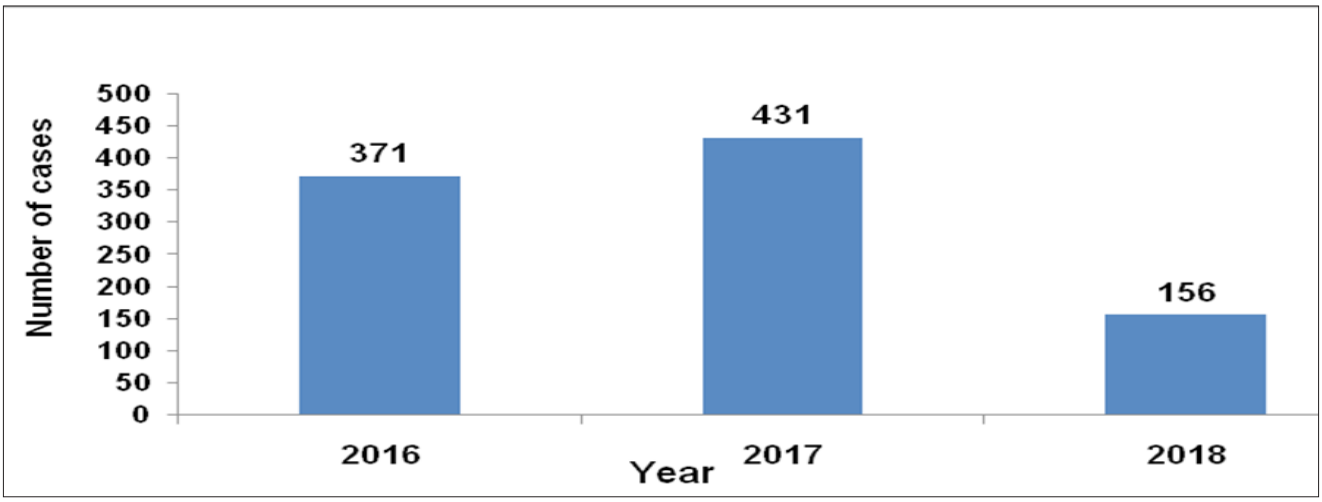

Figure 1.Year wise reporting of cases of dengue from Ernakulum district

Total number of cases of dengue reported to District Surveillance Unit (DSU) of Ernakulum was 371 and 431 during year 2016 and 2017. From January to September, 2018 a total of 156 cases of dengue were reported (Figure 1). In Ernakulam district there is consistency in reporting of cases of dengue throughout the year. This makes dengue endemic in Ernakulam district.

Larval Survey

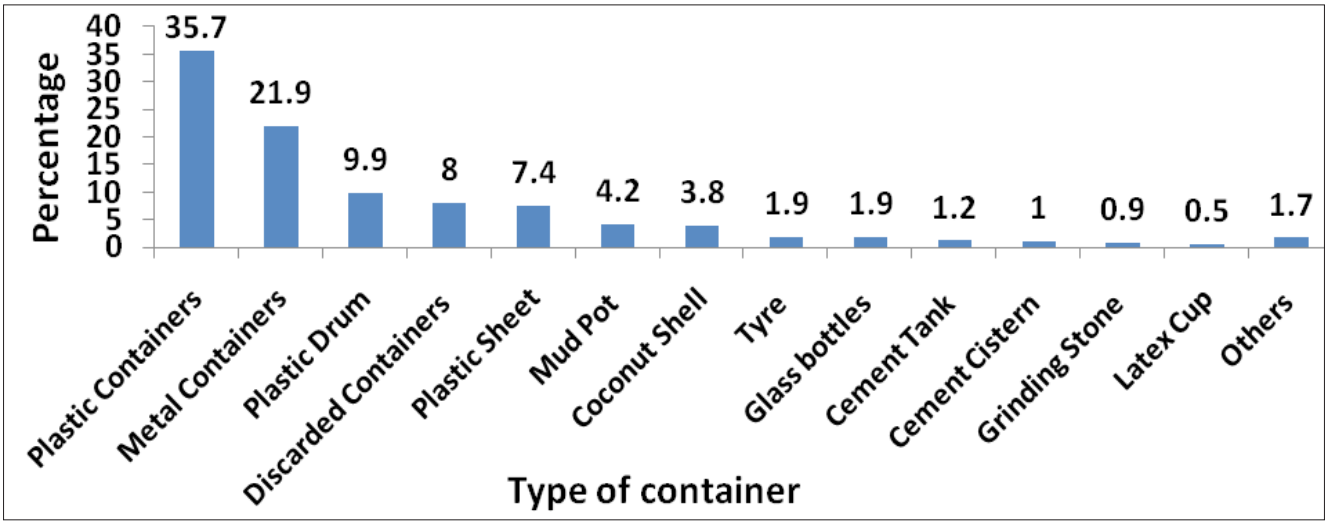

Figure 2.Type wise distribution of containers inspected (n=1580)

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Larval survey was done in eleven flood affected areas namely, Mallipuram CHC, Eloor PHC, Karumallor, Perumbavoor, VengoormCHC, Pizhala PHC, Moothakunnam CHC, Ramamangalam CHC, Kuttampuzha, Malayidamthuruthu (Aluva), Kunnakara (Aluva). Entomological survey was done in 525 houses. Larval density of Aedes mosquito in and around the houses was estimated. During the flood most of the houses were under water as the water level rose nearly five to ten feet. During the survey a total of 1580 number of containers were inspected with an average of 3 containers per house. Type wise distribution of containers is shown in Figure - 2. Out of total 1580 containers inspected maximum were of plastic containers (35.7%), followed by metal containers (21.9%) and plastic drums (9.9%). Plastic sheets used to cover the rubbish had accumulation of water due to rain water collection.

Nearly 75% of the houses had shallow wells. The top was not covered by nylon mesh or any other thing to prevent mosquito breeding. In many of the places continuous water supply was not available. Storage of water was noticed due to supply of water on alternate days. Locked houses posed a major problem as peri-domestic collection of water and larval concentration was more in those houses. Discarded containers were abundantly found and were filled with water.

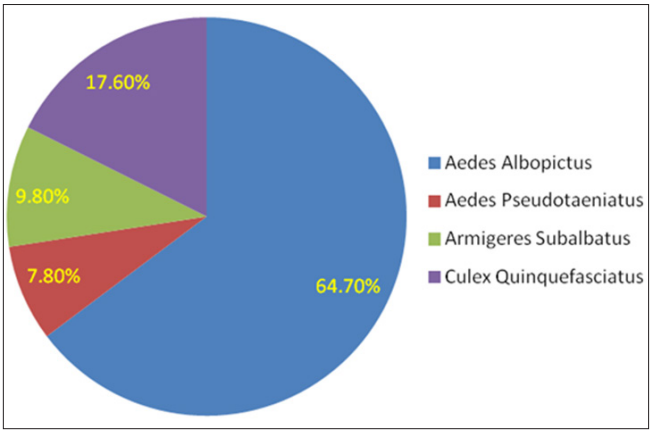

Figure 3.Species wise distribution of different species of mosquitoes

Table 1.Area wise distribution of vector indices to monitor *A. Aegypti* infection level

Place	Inspected		Infected with larvae and/ or pupae		Values are in percentage		
	Number of Houses	Number of Containers	Number of Houses	Number of Containers	House Index	Container Index	Breatu Index
Mallipuram CHC	25	92	2	2	8	1.7	6.3
Eloor PHC	50	155	5	7	10	4.5	14.0
Varapuzha Block FHC	50	152	4	5	8	3.4	10.3
Vengoor CHC	50	148	3	3	6	1.8	5.3
Vengoor PHC	50	155	5	6	10	3.9	12.1
CheraNallur Kadamakudi	50	148	6	6	12	4.3	12.7
Moothakunnam CHC	50	142	9	9	18	6.3	18.0
Ramamangalam CHC	50	152	3	3	6	2.0	6.0
Kothamangalam CHC	50	146	9	12	18	8.5	24.8
Aluva Muncipality	50	146	1	1	2	0.6	1.8
Kunnikara, Aluva	50	144	7	7	14	4.9	14.0

House Index ranged from 2-18 percent. Except in Alva Municipality area, all other 10 areas had House Index more than 5 percent. In Moothakunnam and Kothamangalam area it was highest 18 percent. Container Index ranged from 0.6-6.3 percent. Container Index was minimum i.e. 0.6 percent in Alva Municipality while in Moothakunnam CHC area it was maximum 6.3 percent. Breatu Index ranged from 1.8-24.8 percent. Brateu Index was minimum in Alva Municipality area has minimum 1.8 percent while in Kothamangalam CHC area it was maximum 24.8 percent (Table 1). Moothakunnam and Kothamangalam CHC areas have high risk of transmission of dengue fever. The area under Alva Municipality has the minimum risk of transmission of dengue fever.

Larvae of mosquitoes collected during the survey were allowed to grow in laboratory under controlled condition. A total of 51 larvae developed in to adult mosquitoes and were examined to ascertain their species by entomologist. Out of total 51 mosquitoes, 33 (64.7%) were Aedes

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Albopictus, 4 (7.8%) were Aedes Pseudotaeniatus, 5 (9.8%) were Armigeres Subalbatus and 9 (17.6%) were Culex Quinquefasciatus (Figure 3).

Discussion

There was a heavy rainfall between 15.8.2018 to 22.8.2018 giving rise to flood. Secondary data analysis shows dengue is endemic in Ernakulam district of Kerala.[6] Flood had swept away most of the adult and larval stage of mosquitoes. This was evident from the secondary data analysis. It shows that there were less number of dengue cases in 2018 in comparison to number cases reported in 2016 and 2017 year.[7]

The main potential containers with chances for mosquito breeding were plastic containers (35.7%), metal containers (21.9%), Plastic drums (9.9%) and discarded containers (8%). In more than 90% places House Index was more than 5%. In six places the Index was from 10 to 18%. House Index (HI), Container Index (CI) and Breatu Index (BI) were high in Moothakunnam and Kothamangalam CHC area.

Among the above three indices, the HI has been widely used to calculate the presence and distribution of Aedes populations in a given locality. However, the HI does not take into consideration the number of positive containers per house. Similarly, the CI only provides information on the proportion of water-holding containers that are positive. On the other hand, the BI establishes a relationship between positive containers and number of houses. Hence, the BI is considered the most useful single index for estimating Aedes density in a location. The BI and HI are commonly used for the determination of priority (risk) areas for control measures. Generally, a HI greater than 5% and/or a BI greater than 20 for any locality is an indication that the locality is dengue-sensitive. For epidemiological purposes, the HI is extremely important and indicates potential spread of virus through an area once an infected case becomes established.[8]

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. These larval indices are used to predict the outbreak of mosquito borne diseases and take preventive measures.[9]

Since HI<1% or BI<5 was proposed to prevent yellow fever transmission, these values have also been applied to dengue transmission but without much evidence. The Pan American Health Organization described 3 levels of risk for dengue transmission: low (HI<0.1%), medium (HI 0.1%-5%) and high (HI>5%), but these values need to be verified. The vector density, below which dengue transmission does not occur, continues to be a topic of much debate and conflicting empiric evidence.[10]

In a study, Dengue vector prevalence and virus infection in a rural area in south India, Breteau Index was found to be ranging from 9.05 to 45.49 percent.[11] In present study results were within that limit but Breteau Index was not so high.

In Ernakulam, The average HI, CI & BI was much higher than the norm. As Dengue is endemic in this district so there is a potential risk for transmission. The most important vector of Dengue virus is the mosquito Aedes Aegypti, which should be the target of surveillance and control activities.[12]

In present study, the major mosquito species were Aedes albopictus (64.7%). None of the samples showed breeding of Aedes Aegypti.

Unplanned urbanization and the lack of a reliable piped water supply or solid waste management can render large populations in towns and cities at risk of viral diseases spread by mosquitoes.[13]

Prevention of dengue transmission must be based on community participation, public health education in schools, epidemiological surveillance and good vector control etc.[14]

To control Dengue transmission following measures has to be taken:

- Advocacy, social mobilization and regulatory control for public health and empowerment of communities are needed.
- Evidence-based decision making guided by operational research and entomological and epidemiological surveillance and evaluation.
- Development of adequate human resources, training and career structures at national and local level to promote capacity building and manage IVM programme.[9]
- It was a good experience for the state to work hand in hand with a central team consisting of specialists of different background.

Conclusion

High level of all the vector indices and plenty of empty containers is responsible for endemicity of dengue and it can give rise to outbreak at any point of time.

Limitation

The data was collected from flood affected area. So its external validity cannot be applied to other areas. Baseline data regarding vector surveillance could not be collected.

Recommendation

- Health education of the community regarding breeding

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habit of mosquitoes and how to prevent vector borne disease has to be given. At least two vector surveys i.e. Pre and Post monsoon may be done on priority basis.

- Shallow wells have to be covered by mosquito proof screens.
- Disposing of solid waste properly e.g. broken bottles, flower pots, buckets, tyres etc.
- Covering, emptying and cleaning of domestic water storage containers on a weekly basis.
- Improving community participation and mobilization for sustained vector control.

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 thereby prevent disease transmission.

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Ethical Clearance: Study was conducted after taking permission from the appropriate authorities. Informed consent was taken from the study participants.

Source of Funding: None

Conflict of Interest: None

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