Environmental Vector Control Practices among Households of Patients with Dengue Fever during the Epidemic of 2018 in Kerala, India

Chintha Sujatha[1], Reshma Rajan Sudha[2], Sreejith Lalitha Krishnankutty[3], Prajitha Kannamkottapilly Chandrasekharan[4]

[1, 4] Department of Community Medicine, Government Medical College, Thiruvananthapuram, Kerala, India. [2]Department of Community Medicine, SUT Academy of Medical Sciences, Vattapara, Thiruvananthapuram, Kerala, India. [3]Department of Health Services, Thiruvananthapuram, Kerala, India.

ABSTRACT

BACKGROUND

Dengue fever is a major public health problem in Kerala. Vector control measures practiced at household level is the most cost-effective way of controlling dengue. This study aims to assess environmental measures of vector control practised among households of suspected or confirmed dengue patients in Thiruvananthapuram district of Kerala.

METHODS

A cross sectional study was done among households of patients diagnosed with dengue fever and reported in Integrated Disease Surveillance Programme (IDSP) in Thiruvananthapuram district from June to December 2018. Investigators interviewed the household members and made direct observations to collect data on vector control practices using a structured questionnaire.

RESULTS

A total of 108 houses were surveyed. Potential breeding habitats were found in 58 (53.7 %) houses. Aedes larva was found in containers from four (3.7 %) houses. Dry day observance was not regular with only 5 (4.6 %) houses practicing it weekly. Waste management practiced was proper in 47 (43.5 %) houses. Community level pre monsoon preparedness for epidemics was done in the vicinity of 53 (49.1 %) houses and it was found to be a protective factor against presence of breeding habitats in and around houses ($p = 0.013$). Low education ($p = 0.012$) and low occupational status ($p = 0.017$) were found to be significant risk factors.

CONCLUSIONS

Even during an epidemic, with occurrence of infections in the family, only half of the households are practising adequate vector control methods. Community level interventions and targeted information education campaign will help improve practice of environmental methods of vector control in dengue.

KEYWORDS

Dengue, Vector Control, Aedes Control, Environmental Methods, Community Interventions

Corresponding Author:
Dr. Chintha Sujatha,
Associate Professor,
Department of Community Medicine,
Government Medical College,
Thiruvananthapuram-695011,
Kerala, India.
E-mail: sujathachintha@gmail.com

DOI: 10.18410/jebmh/2021/10

How to Cite This Article:
Sujatha C, Sudha RR, Krishnankutty SL, et al. Environmental vector control practices among households of patients with dengue fever during the epidemic of 2018 in Kerala, India. J Evid Based Med Healthc 2021;8(02):48-52. DOI: 10.18410/jebmh/2021/10

Submission 08-10-2020,
Peer Review 16-10-2020,
Acceptance 21-11-2020,
Published 11-01-2021.

BACKGROUND

Dengue is a major public-health problem throughout tropical and sub-tropical regions of the world. It is the most rapidly spreading mosquito-borne viral disease, with a 30-fold increase in global incidence over the past 50 years.[1] Dengue virus is transmitted by aedes mosquitoes whose breeding is associated with environmental factors linked to human behaviour.[2] *Aedes aegypti* typically breeds in closer proximity to humans.[3] Aedes prefers dark-coloured containers with water.[4] *Ae. aegypti* lay eggs in artificial household containers such as water storing containers, plant pots and rain-filled used tyres, discarded containers and construction sites. These are termed as potential breeding habitats (PBH) for aedes. *A. aegypti* can be controlled by destroying breeding habitats by frequently emptying and cleaning the containers, by use of insecticides or by biological agents, anti-adult measures or by combinations of these methods.[5] Out of these various methods of vector control, environmental management is a preferred method. The environmental method is meant to bring changes in the environment to minimize breeding habitats for vector and preventing human contact with the vector by destroying or altering potential breeding habitats.[6] Environmental method in vector control are safe and sustainable and minimizes risk of environmental contamination and toxicity.[7]

Kerala, a southern state of India, is endemic for dengue fever and outbreaks of increased frequency and magnitude are being reported for last two decades. In 2017 - 18, there was a major epidemic of dengue fever in Kerala with unprecedented mortality and morbidity. The worst affected district was the state capital, Thiruvananthapuram.[8] The state health department and local self-government have jointly initiated dengue prevention campaigns with community participation. Specific interventions were planned in high-risk pockets.[8] This study was planned with the objective of assessing environmental measures of vector control practiced among households of suspected or confirmed dengue patients during the epidemic of dengue fever in 2018 in Thiruvananthapuram district of Kerala.

METHODS

A cross sectional study was done among households of individuals who had a diagnosis of confirmed or suspected dengue fever and was line listed in Integrated Disease Surveillance Program (IDSP) in Thiruvananthapuram district of Kerala. Kerala had a major epidemic of dengue during 2017 - 18 and Thiruvananthapuram, the state capital was the worst affected district. Study was done from June to December 2018, which covered rainy season and had reported increased transmission of dengue fever. Selection of households was made by randomly selecting patients from the line list of dengue patients in IDSP by simple random sampling method using computer generated random numbers. Data collection was done only after discharge of the patient from hospital and recovery from illness of at least one-week duration. List of subjects obtained from IDSP line list was contacted over telephone. If the patient was a child or debilitated person, another adult member in the family was made the respondent. Investigator explained the purpose of the study and asked for their willingness to participate. Households of consenting persons were visited, and data collection done by investigators. Data collection done with a semi structured questionnaire and information obtained regarding sociodemographic variables, history of prior dengue infection in the family, knowledge of vector control methods, waste management, dry day observation, personal protective measures and other protective measures against aedes mosquito, presence of breeding sites for aedes and community level preventive measures. Presence of potential breeding habitats and waste management practices were assessed by direct observation.

Sample size was calculated for proportion of households with potential breeding habitats, for a confidence level of 95 % and absolute precision 10 %. Using the formula $N = Z\alpha^2 PQ / d^2$, with expected parameter value 68 %,[4] calculated sample size was 85. To account for 20 % non-response rate, sample size of 108 was taken.

Statistical Analysis

Privacy and confidentiality of data was maintained. Data was entered in Excel and analysed using IBM SPSS v 25. Quantitative variables were summarised as mean and standard deviation and categorical variables as proportions. Chi square test was used for testing significance of associated factors. P value less than 0.05 was considered significant.

Ethics

Ethics clearance was obtained from human ethics committee (HEC) of Government Medical College, Thiruvananthapuram. Written Informed consent from all respondents was obtained before including them in the study.

RESULTS

The mean (SD) age of patients whose households were surveyed was 35.18 (19.44). For children, their mothers were made respondents and for a patient above 80 years in the list, an adult female in the family was the respondent. Most of the respondents were females (72 %). Among the 108 houses surveyed 70 (64. 8 %) were located in rural areas. Respondents had more than secondary level education in case of 55 (50.9 %) houses and had an occupation status of skilled or more among 41 (38 %) of respondents. Previous history of dengue fever was given by 9 (8.3 %) patients and 30 (27.8 %) households had history of a family member diagnosed with suspected or confirmed dengue fever any time in the past. Sociodemographic characteristics of participants is shown in table 1.

Variable	Categories	Frequency (Percentage) (N = 108)
Age Categories (Years)	0 - 18	22 (20.4)
	18 - 45	51 (47.2)
	45 - 65	29 (26.9)
	65 - 85	6 (5.6)
Gender	Male	30 (27.8)
	Female	78 (72.2)
Socioeconomic Class	BPL	50 (46.3)
	APL	58 (53.7)
Place of Residence	Rural	70 (64.8)
	Urban	38 (35.2)
Educational Status	Secondary or less	53 (49.1)
	More than secondary	55 (50.9)
Occupational Status	Semiskilled or less	67 (62)
	Skilled and more	41 (38)

Table 1. Sociodemographic Characteristics of Patients Whose Households were Surveyed

Vector Control Practices	Frequency (Percentage) N = 108
Presence of potential breeding habitats	58 (53.7 %)
Proper waste disposal methods	47 (43.5 %)
Weekly dry day observance	5 (4.6 %)
Daily use of personal protection measures	22 (20.4 %)
Community level Pre monsoon preparedness activities	53 (49.1 %)
Presence of dumped garbage in neighbourhood	4 (3.7 %)
Field level health worker visit in last two months	48 (44.4 %)
Field worker gave information on preventive measures	43 (39.8 %)
Knowledge regarding role of mosquitoes in dengue infection present	89 (82.4 %)

Table 2. Practice of Vector Control Measures at Household and Interventions at Community Level

Practice of environmental measures of vector control was assessed by looking for potential breeding habitats of aedes in the houses, both indoor and outdoor and waste management. Potential breeding habitats (PBH) were found in 58 (53.7 %) of houses. PBH included both indoor and outdoor containers. Aedes larva was found from containers present in four (3.7 %) houses. In one house it was found in fridge tray as well as a discarded tyre. Aedes larva was found in an indoor plant pot in a house and for two other houses discarded containers and coconut shells had aedes larva. Proper waste management methods were adopted in 47 (43.5 %) houses. But the practice of observing dry day weekly was there only with 5 (4.6 %) houses. Half of the houses had clean surroundings and only four (3.7 %) houses had presence of dumping of garbage in the neighborhood. Pre monsoon preparedness for control of epidemics in the form of mosquito control activities, cleaning and waste management activities were done at community level in their vicinity in 53 (49.1 %) of houses. Field workers / accredited social health activist (ASHA) from health department had visited the houses in the last two months period prior to the onset of disease, in 48 (44.4 %) houses. Information on dengue prevention measures was given to 43 (39.8 %) households by field worker / ASHA. Knowledge regarding role of mosquitoes in dengue infection was present among 89 (82.4 %) of respondents. Health education messages through mass media viz television, radio and newspapers were the main source of information for almost all of the respondents. Practice of environmental measures of vector control and interventions at community level is shown in Table 2.

As presence of potential breeding habitats in and around the house indicates poor practice of mosquito control measures, factors associated with presence of breeding sites were determined. Factors associated with presence of potential breeding habitats of aedes are given in Table 3. Low educational and occupational status, improper waste management methods adopted and absence of community level pre monsoon epidemic preparedness activities are found to be significant risk factors for presence of potential breeding sites.

Variables		Potential Breeding Sites Present N (%)	Potential Breeding Sites Absent N (%)	Chi Square Value	P Value
Location	Rural	41 (58.6)	29 (41.4)	1.89	0.16
	Urban	17 (44.7)	21 (55.3)		
Education	Secondary or less	35 (66)	18 (34)	6.36	0.01*
	More than secondary	23 (41.8)	32 (58.2)		
Occupation	Semiskilled or less	42 (62.7)	25 (37.3)	5.72	0.01*
	Skilled and more	16 (39)	25 (61)		
Socioeconomic Status	Below poverty line	29 (58)	21 (42)	0.69	0.40
	Above poverty line	29 (50)	29 (50)		
Waste Disposal	Proper	14 (29.8)	33 (70.2)	19.14	< 0.001*
	Improper	44 (72.1)	17 (27.9)		
Weekly Dry Day	Observed Not	3 (60)	2 (40)	0.08	0.77
	observed	55 (53.4)	48 (46.6)		
History of Dengue	Present in Family	12 (40)	18 (60)	3.14	0.07
	Absent	46 (59)	32 (41)		
Knowledge	Adequate	47 (52.8)	42 (47.2)	0.16	0.69
	Inadequate	11 (57.9)	8 (42.1)		
Pre-Monsoon Activity	Done	22 (41.5)	31 (58.5)	6.22	0.01*
	Not done	36 (65.5)	19 (34.5)		
Field Worker Visit	Present	29 (60.4)	19 (39.6)	1.56	0.21
	Absent	29 (48.3)	31 (51.7)		

Table 3. Factors Associated with Presence of Potential Breeding Habitats of Aedes

*Significant p value, < 0.05

DISCUSSION

Assessment of practice of vector control measures in 108 households with family members affected by dengue during the ongoing epidemic has revealed that half of the household have adopted environmental measures like proper waste management and personal protective measures. A systematic review on vector control interventions summarises that complex and targeted interventions are needed for aedes control.[9] Key to the success of Singapore dengue control programme was consideration of dengue as an environmental disease, with a strong focus on source reduction and other environmental management methods as the dominant vector control strategy.[10] Weekly self-directed inspection by members of the household or staff at workplaces for elimination of potential breeding habitats was the strategy adopted by Cuba which helped them remain dengue free for 30 years.[11] Weekly dry day observance was found to be highly irregular in this study with adherence reported from only less than 5 % of houses. However, potential breeding habitats (PBH) were found only in half of the households and PBH included both indoor and outdoor containers. Outdoor PBHs such as flower pots, tyres and plastic bags were common as per study done in Tanzania.[4] Regarding PBHs, a household survey in Makkah city, Saudi Arabia found ten types of artificial containers and 70 % of these habitats were located indoors. In our survey, aedes larva was found only in less than 4 % of houses, consistent to findings of study from Tanzania.[4] A household survey for aedes larval breeding habitats in Ethiopia, reported presence of aedes larva in 25 % of houses.[12] A case control study from Thailand reports that the presence of dengue virus (DENV)-infected aedes in the house was associated with 4.2-fold higher odds of dengue infection.[13]

In the context of dengue vector control, "solid waste" refers mainly to non-biodegradable items of household, community and industrial waste. Proper waste management including storage, collection and disposal of waste can reduce *Ae. aegypti* larval habitats.[6] A systematic review on the effects of different dengue vector control methods provides evidence on role of community level education and waste management in reducing vector densities.[14] An intervention study from Sri Lanka reports that waste management with the elimination of potential breeding habitats led to a significant reduction of pupal indices. The coordination of local authorities along with increased household responsibility for targeted vector interventions like solid waste management is vital for effective and sustained dengue control.[15]

Communities play a major role in the success and sustainability of vector control. Half of the households have reported that community level activities for pre monsoon preparedness for epidemics were done in their vicinity. Community-based combination interventions including clean-up campaigns and mobilisation was found to be effective in reducing vector densities in Cuba.[16] Another intervention study from Burkina Faso showed that well-planned, evidence-based / community-based interventions that control exposure to dengue vectors are feasible and effective in urban settings in Africa that have limited resources.[17] Participatory community-based approaches aim to ensure that healthy behaviours become part of the social fabric and that communities take ownership of vector control at both the intra- and peri-domiciliary levels.[18] Regular street cleansing system for removing PBHs and cleaning drains were found to be effective in dengue vector control.[6]

More than 80 % of respondents had knowledge regarding role of mosquitoes in dengue infection. This finding is consistent with a study from urban Tamil Nadu which reports that 80 % of the study population was aware that dengue fever was transmitted by mosquito bite and 31.7 % of the respondents knew that aedes mosquito spread the disease.[19] Environmental interventions at household level and community level campaigns can be effective in reducing pupal and larval indices and can prevent dengue transmission.[7]

CONCLUSIONS

In spite of occurrence of dengue fever in the family, environmental measures of vector control are practised only among half of the households. Better vector control practices are found in areas where community level pre monsoon preparedness for epidemic control had been initiated. Specific interventions targeted at households with low socioeconomic status will help improve practice of vector control measures, thus reducing dengue transmission.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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