Pre Intervention Situation Analysis on Control of Vector-borne Diseases in an Urban Area in Kerala

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Abstract

Vector-borne diseases constitute a formidable group among the communicable diseases. In India most of the vector-borne diseases remain endemic and are major public health concerns. Mosquitoes transmit some of world's worst life threatening and debilitating parasitic and viral diseases. Some of these were effectively controlled since few decades, but such hard won gains are now threatened. The present study has been done in Cherthala Municipal area of Alappuzha district, Kerala state. Alappuzha district, until recently, known as the hot spot of Brugian filariasis. Mosquito-borne diseases such as Dengue, Chikungunya, Japanese Encephalitis, West Nile, etc. have also been reported. In spite of different methods used to control these mosquito-borne diseases, satisfactory results often could not be achieved. Therefore, a study has been planned to critically look at the present strategies of vector control. An attempt has also been made to link the socio-demographic factors, environmental conditions, the attitude and practice of the local residents in the control of vectors and diseases.

Index Terms – Vector-borne diseases, Breeding Preference Ratio, Leptospirosis.

I.INTRODUCTION

Vector-borne diseases (VBDs) are a significant cause of morbidity and mortality and thus it remain one of the most important threats to global health. Factors such as insecticide resistance, increased human migration, environmental change, and development in global trading have contributed to the expansion of the geographic range of many disease vectors once thought to be under control. The risk for emergent or re-emergent vector-borne disease epidemics is greater now than it has been in nearly half a century. Many of the vector-borne diseases are co-endemic, and it is estimated that more than half the world's population live in areas where two or more VBDs are present.

Vector-borne diseases are major contributors to the global disease burden. They are responsible for more than 17% of all infectious diseases and 1 million deaths annually. Vector control is the principal method available for controlling many VBDs-both historically and today. Vector control aims to limit the transmission of pathogens by reducing or eliminating human contact with the vector (Wilson et al, 2020).

Despite great resources being poured into control of vectors, either with the development of insecticides or other strategies for vector population control, vector-borne diseases are common and often misdiagnosed, particularly in developed countries where such diseases are thought not to occur. Control of insect vectors is often the best, and sometimes the only, way to protect humans from these destructive diseases.

Vector control is a moving target with globalization and demographic changes in infection patterns; and the current unprecedented degradation of the global environment is affecting rates and patterns of vector-borne disease in ways that are still largely unknown. It is increasingly apparent that effective vector control requires multidisciplinary, community-based, and environmentally sustainable approaches that are responsive to local conditions.

Alappuzha district is known for the prevalence of many vector-borne diseases. The district was once considered as a main area of the 'largest endemic tract of Brugian filariasis in India.' Arboviral diseases such as Dengue, Chikungunya, Japanese encephalitis, West Nile, etc. were reported in the district. Many vector control measures were tried by the State health department to control these VBDs. These diseases are prevalent even today. A study has been done to analyze the Pre-Intervention situation on Control of Vector-borne Diseases in one of the urban areas, Cherthala Municipal area in Alappuzha district.

II. MATERIALS METHODS

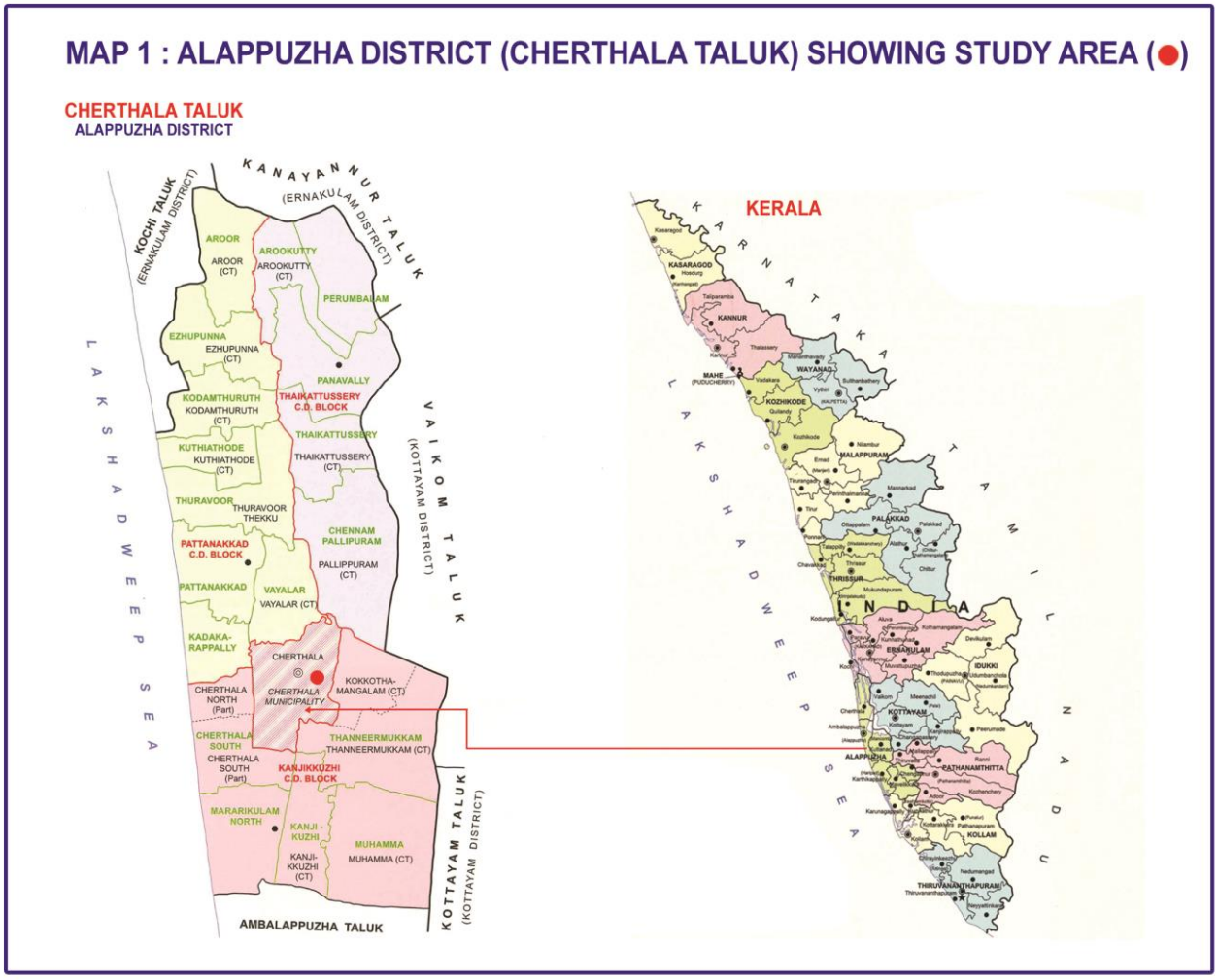
STUDY AREA

Cherthala municipality

Cherthala is a town located in the district Alappuzha. It is located 30 Km south of the city of Kochi and 22 Km north of Alappuzha town, on the Kochi- Alappuzha stretch of both National Highway 47 as well as the costal Rail-route. The coordinates of Cherthala municipality are latitude 9°41′13″North and Longitude 76°20′10″East. Cherthala municipality had a population of 45,326 over an area of 16.18 square kilometers (6.25 sq mi). The density of the population is 8858.2 per square kilometer. Males constitute 49% of the population and females 51%.

Survey Method

Random situation analysis has been conducted in Cherthala Municipality, Alappuzha district in August 2017 as a pre intervention study on control of vector-borne diseases. As part of the study, 160 houses were selected as sample, based on systematic random sampling method. Every tenth houses were selected during a transect walk through the Cherthala Municipality. i.e. 1) Cherthala-Vayalar Road and 2) Cherthala- Alappuzha NH Road. The study was conducted in Cherthala Municipal area in ward nos. 1, 2,12,13,17 & 19; face-to-face interview was conducted for data collection (Map1).



Prior to interview, an overview of the study aims, risks and benefits was given and explained to the residents. A semi structured questionnaire was used for collecting the information. The information such as age, occupation and education; health information; vector control practices; opinion about the public health services obtained from the health institutions; opinion about the public health services of the local body; suggestions about the measures to be adapted for the control of vector-borne diseases, etc were collected. The information on housing pattern, conditions of the surroundings, breeding sources of mosquitoes in and around the houses, etc. was collected through observation.

The data were collected from a total of 160 respondents. The households were interviewed through house to house visits. The collected observations and shared information were entered in the questionnaire and analyzed.

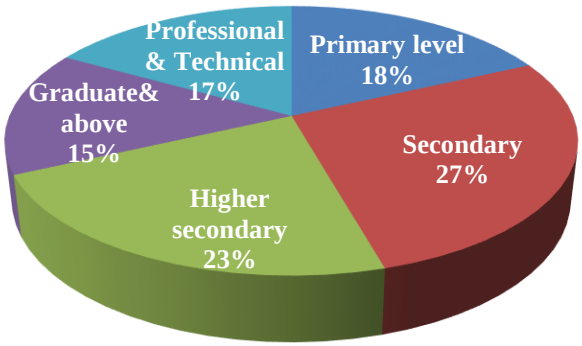
Vector surveillance

Vector surveillance was carried out in randomly selected urban wards. The houses and their surroundings were searched for mosquito larval breeding. All the water holding containers/habitats were checked for larval breeding and recorded. The immature stages of mosquitoes from each positive container were collected separately. Fifty percent of the larvae were identified microscopically and the remaining larvae/pupae were identified after adult emergence following standard guidelines (WHO, 1995).

III. RESULTS AND DISCUSSION

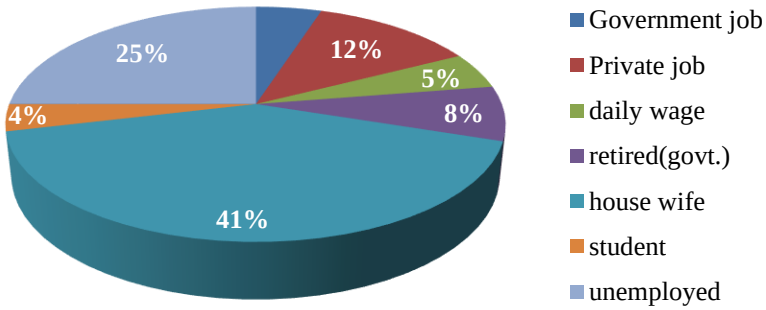
A total of 160 houses were visited in Cherthala Municipal area to collect in socio-demographic and health information, practice of the residents on preventive measures for the control of communicable diseases especially vector-borne diseases and premise observation. It has been noted that among the respondents, 89 (55.6%) were females and the remaining 71(44.4%) were males. Among the female respondents, 74.2% were housewives. The study showed that the age of the respondents (n=160) varied from 21-68 years. The educational qualification of the respondents was elicited and it has been noted that 82.0% were having secondary and above educational qualification, only 18.0% had primary level education. 39.0% were with graduation, professional or technical education (Fig: 1).

Fig1:Educational status of the Respondents(%)



The analysis of the occupational status of the respondents revealed that 41.0% were housewives and 25.0% were unemployed. 8.0% of the respondents were Government employed and 12.5% private employed. There were also retired senior citizens (7.5%). Among the respondents, 5.0% consisted of daily wage workers (fig2).

Fig2:Occupational status of the Respondent(%)



Habitat-wise observation showed that 77.5% of the households were single storied of which 32.3% were tiled houses and 19.4% were with roofs made of synthetic/metallic sheets. Terraced or partially terraced houses consisted of 60.0% of which 37.5% were double storied and 62.5% were single storied. The terraced and sunshades of concrete houses have blocked water outlets. During rainy days, the blocked parapets, window shades and roof gutters become potential sites of mosquito breeding, largely of *Aedes albopictus* that are predominantly seen in the target area.

It is also observed that the channel pipes fit on the roof edges of houses with metallic/synthetic roof are often blocked with dried leaves and filth that also collect rain water and provide ideal sources of breeding of vector mosquitoes. These pipes also provide habitation for rats and thus cause Leptospirosis threat.

The roof gutters were reported as *Aedes aegypti* breeding sites since a long time, but their mosquito production was considered negligible compared to other breeding sites. Consequently roof gutters are often neglected in the routine survey of the mosquito

breeding sites and are not included in the estimation of the *Aedes* larval indices. Moreover, the buildings were designed with unreachable rain gutters, making difficult for the local residents to check the mosquito breeding and clean the clogged gutters (Zainon et al, 2016). Roof gutters are functioning when all accessible breeding sites have been controlled and may represent a reservoir for *Ae.aegypti*. The study conducted in Guadeloupe (French West Indies) during dry season, it was observed that about two third of the roof gutters contain water and 44% were positive for *Ae.aegypti* larvae(Gustave et al, 2012). A similar observation was reported while studying the *Aedes* larval production in roof gutters in Australia (Montgomery et al, 2002). The investigators observed that the production of mosquitoes by guttering may be due to the abundance of nutrients, in the form of fallen leaves and detritus that accumulate in blocked guttering (Merritt et al, 1992) . Traditional source reduction operations often exclude guttering. Failure to treat these key containers would compromise the efficacy of dengue control operations.

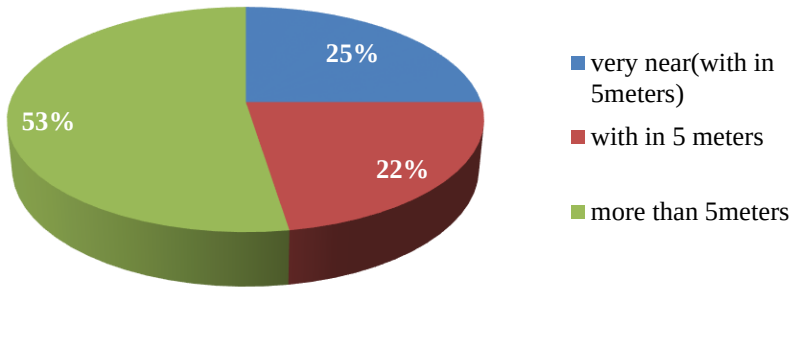
The increasing role of roof gutters as *Aedes* mosquito breeding sites, demonstrated by many investigators, has consequences on dengue transmission and prevention. In routine vector surveillance, the roof gutters should not be avoided, as they form potential breeding sites of *Aedes* mosquitoes.

An observation has also been made on the house nature-type of boundary in the survey area. It has been noted that 47.5% of the houses were protected with concrete/metallic boundary walls. 27.5% of houses were without any boundary protection, while 25.0% had temporary boundary formed of plants (biological fencing). The plants used for fencing included coral plant, agave plant, manihot plants, and *Dracaena cochinchinensis* (locally known as *Ankolam*). The agave plants have broad leaf and its bottom leaf axils collect water where *Aedes* mosquitoes find its breeding niche. Earlier reports from Kerala indicated the breeding of *Ae. albopictus* in different natural habitats such as rodent damaged cocoa pods (Hiriyan J and Tyagi B.K .2004), leaf sheaths of areca palms(Regu et al, 2008), leaf axils, tree holes, tree stumps, etc(Eapen et al, 2010., Sheela Devi, 2011., Sheela Devi et al,2012., Rajendran et al, 2020).

An observation with regard to the proximity of the house to public road/public walk way showed that almost all the houses (96%) visited for the sample study have been very close to public road or public walk way. Only 4.0% of the houses were located far away (more than 50 meters) from public passage.

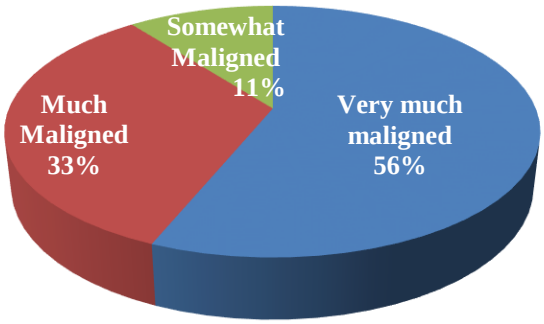
It has also been noted that nearly 48.0% of the houses were located near to open drain/canal of which 52.6% were very close i.e., within 5 meters from the houses. Only 25.0% of the houses had the drainage /canal with top ceiling. It is significant to note that 48% of the houses were in close proximity to open drain/canal (Fig:3).

Fig 3. Proximity of the house to open drainage or canal(%)



It is also found that nearly 90% of drains/canals were much maligned with organic waste and water weeds (Fig4).

Fig 4. Quality /condition of open drain/canal water (%)



The main source of pollution included thrown away wastes from houses, hotels, meat stalls; vegetable shops, etc. found both in the water and on the banks .Organic wastes help abundant growth of weeds on the banks as well as aquatic weeds in the canal. The decaying of aquatic weeds and thrown away organic wastes contribute acute water pollution. This situation is highly conducive for breeding of *Culex quinquefasciatus* and *Mansonoides* mosquitoes, the vectors of bancroftian filariasis and brugian filariasis respectively.

It has been noted that more than 50% of the house surroundings were not clean and tidy, being weed grown, occupied with thrown away waste such as coconut shells, coconut husks, egg shells, fallen leaves, broken pieces of household utensils, plastic containers, bottles, etc (Table1).

Table 1 : Condition of House surroundings

Sl.No.	Condition of surroundings	Frequency	Percentage
1	Almost neat and tidy	77	48.1
2	Weed grown	17	10.6
3	Water logged	42	26.3
4	Strewn with waste materials	24	15.0
	Total	160	100.0

It is significant to note that the inhabitants of 28% of the households were affected with viral fever within the previous one month of the survey time. This denotes the highly morbid health status of the inhabitants i.e. people living in the Cherthala Municipal area.

A total of 160 house premises were searched for *Aedes* breeding in Cherthala Municipal area (urban) of Alappuzha district. Of the total 316 water holding containers/ sources searched, 41 (CI- 12.97%) were positive for *Aedes* larvae. In order to find out a relation between positive containers and number of houses examined for larval presents, the Breteau Index (BI) was calculated and was found to be 25.63 (Table 2).

Table 2. *Aedes* Larval indices in Cherthala Municipal area

Number of Houses checked	No. of Houses positive for *Aedes* larvae	HI (%)	Number of containers checked	No. of containers positive for *Aedes* larvae	CI (%)	BI
160	35	21.88	316	41	12.97	25.63

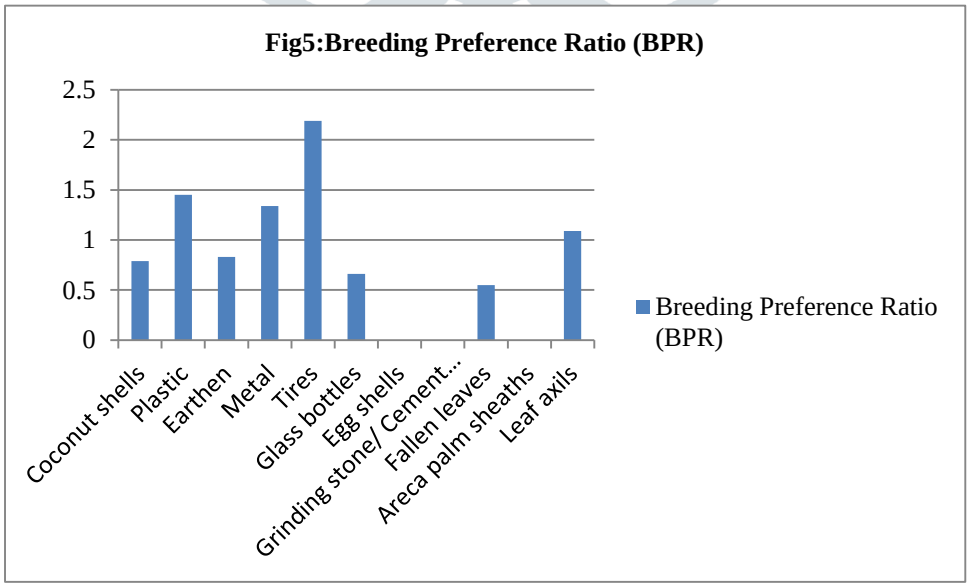
It is also observed from the present study that *Aedes albopictus* was the predominant species seen in different habitats of the target area. The availability of the sources/containers seen scattered in the peri-domestic environment may influence the site selection of *Aedes* mosquitoes for oviposition. The Breeding preference Ratio (BPR) was calculated in order to find out the most preferred habitat selection of *Aedes* mosquitoes (Table 3& Fig5)

Table 3. Breeding habitats of *Aedes albopictus* in Cherthala Municipal area

Sl.No.	Type of Breeding Habitats	Examined	Positive for *Aedes* larvae	Breeding Preference Ratio (BPR)
1	Coconut shells	39 (12.34)	04 (09.76)	0.79
2	Plastic	85 (26.90)	16 (39.02)	1.45
3	Earthen	84 (26.60)	09 (21.95)	0.83
4	Metal	23 (7.28)	04 (9.76)	1.34
5	Tires	07 (2.22)	02 (4.87)	2.19
6	Glass bottles	47 (14.87)	04 (9.76)	0.66
7	Egg shells	05 (1.58)	0	0
8	Grinding stone/ Cement tanks	04 (1.26)	0	0
9	Fallen leaves	14 (4.43)	01 (2.44)	0.55
10	Areca palm sheaths	01 (0.32)	0	0
11	Leaf axils	07 (2.22)	01 (2.44)	1.09

The figures in parentheses indicate percent values

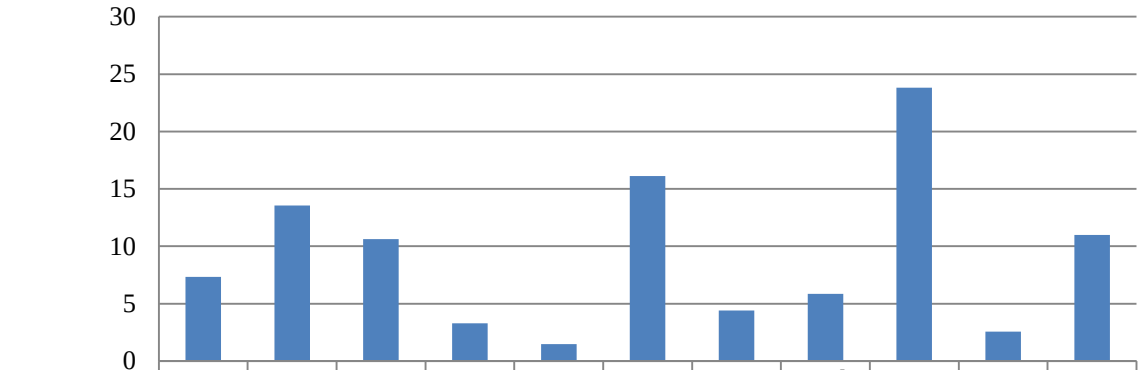
It has been noted that in the study area the BPR with respect to *Aedes* mosquitoes was more in tires (2.19) followed by plastic containers (1.45), metal containers (1.34), and leaf axils (1.09). Many researchers reported that *Aedes* mosquitoes have a predilection to lay eggs in the water collections of unused tires and form a favorable breeding site of these mosquitoes (Sheela Devi, 2011., Rajendran et al, 2020., Sharma et al, 2015).



In Alappuzha district, especially in Cherthala Taluk, the temporary boundary of the houses is formed of plants such as coral plants, agave plants, etc. This biological fencing of poor man is common in this area. In the broad leaves of agave plants, water gets accumulated during rainy season and acts as breeding sites of *Aedes* mosquitoes. Leaf axil, noted as one of the key containers in the present study substantiates that the aforesaid contention is true.

In addition to this, many different types of dry containers/sources could also be noted in the house premises (Fig 6). During summer rains/monsoon, these containers may get filled with rain water, which in turn become potential breeding sources of vector mosquitoes.

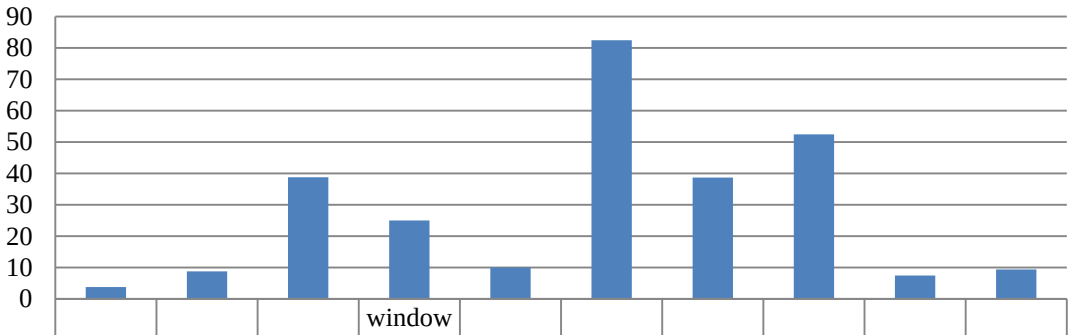
Fig6: Frequency of dry containers in the house premises



	Coconut shells	Plastic	Earthen	Metal	Tires	Glass bottles	Egg shells	Grinding stone/ Cement tanks	Fallen leaves	Areca palm sheaths	Leaf axils
Percentage	7.33	13.55	10.62	3.3	1.47	16.11	4.4	5.86	23.81	2.56	10.99

It is found that only in 28.8% of houses, the inhabitants adopted effective measures for preventing mosquito bite such as using bed nets and screening air holes and windows with mosquito nets. It is interesting to note that in almost 83% of the houses the measure to keep safe from mosquito bite has been running electric fan in high speed which is not an effective method to keep away mosquitoes; rather the mosquitoes were found in such situations continuing its feeding for long time. The other most frequently adopted measures such as burning mosquito coils, using vaporizers, electric mats, etc. are not fully effective repellent/preventive measures, and at the same time the former is quite hazardous to human health.

Fig 7. Household measures adapted for preventing mosquito bite(%)



	All members use mosquito net	Some members use mosquito	Electric bat	windows and air holes sealed with mosquito net	fumigants burned in dusk time	fan run in high speed	vaporize repeellents	mosquito coils	skin oinments	No measures
percentage	3.8	8.8	38.8	25	10	82.5	38.7	52.5	7.5	9.4

It has been noted that in 39% of the houses, home yard/surroundings were cleaned and cleared off wastes weeds only occasionally. In 24% of the houses, the premises were cleaned, reportedly only once in a week. Regular cleaning was done in 37% of sample houses.

It has been found that, out of 160 sample houses visited 74 (46.3%) houses had wells. It is alarming to note that regarding houses having well as a source of fresh water, only 28% have been kept with mosquito proof covering. It is to be noted that Cherthala Municipality area is geographically of low plane with water logged land and consequent shallow domestic wells. The Water authority is regularly supplying water to the households of Municipal area. The supply of water is made possible with the technical support of Japanese collaboration. So generally the public used to call 'Japan drinking water'. Due to the regular supply of drinking water, the inhabitants are not using the well water and most often these shallows wells become an important breeding

source of vector mosquitoes. In the present study, the team could note the breeding of *Aedes albopictus* and *Anopheles stephensi* in shallow wells. The breeding of *Anopheles stephensi* in Cherthala municipality, Alappuzha district is the first report. The former is vectors of dengue and chikungunya where as the latter mosquito is well known vectors of malaria in Kerala and elsewhere.

There were 45 houses with drinking water storage tanks (28.1%). 31% of these were not kept mosquito proof. The *Aedes* mosquitoes, the vectors of dengue fever and chikungunya especially prefer to breed in such fresh water stores.

Regarding awareness about mosquito-borne diseases, 72 persons (45%) of the respondents were aware only about dengue fever. There was nobody aware about all the five major mosquito-borne diseases (malaria, filariasis, dengue fever, chikungunya, Japanese encephalitis). Only 3.8% were aware about four of the diseases (malaria, filariasis, dengue and chikungunya). There was only one person (0.6%) among the respondents aware about Japanese encephalitis was spread by mosquitoes. 6.3% of the respondents were aware about three mosquito-borne diseases. 16.3% were aware about two of the mosquito-borne diseases. 14 % of the respondents were not aware about any of the mosquito-borne diseases. It is quite evident from the analysis that in spite of high education status, the respondents awareness about mosquito-borne diseases has been much low. This calls for elaborate awareness/IEC programs to educate all strata of the community about mosquito-borne diseases, their vectors and control measures.

Only 32% of the sample houses were reportedly visited by public health workers from various health service providing institutions such as Taluk HQ Hospital, District Vector Control (DVC) unit, etc. This means the majority of the households were not visited by public health workers. It is also observed that public health awareness programs did not reach in 66% of houses. 28% of households were benefited by Immunization program. There were 9% of the households benefited from medical camps conducted by various government and non-government agencies. There were 11% of the households that did not receive any of the public health services mentioned above.

The observations of the respondents are clearly indicative that the public health and other services from the Municipality have been quite insufficient. Action should be taken to intensify all sorts of services considering the need of the community. There should be a proper planning for the execution of services to preserve the health and welfare of the inhabitants of Cherthala Municipal area.

CONCLUSION

Vector control has been shown to be highly effective, historically and presently. There is an urgent need for increased investment in strengthening pragmatic capacity for surveillance and control, as well as the development of new vector control tools. Integrated and effective vector control strategies depending on the terrain and local conditions are to be implemented with the active participation of the community. It is only through gaining conscientious awareness of people and ensuring participatory involvement of the society, efforts to control these dreaded diseases will bear fruit.

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