Investigation of *Aedes aegypti* breeding during dengue fever outbreak in villages of Dharmapuri district, Tamil Nadu, India

By

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**Abstract**

Consequent upon the reports of the incidence of dengue fever (DF) in some villages in Dharmapuri district, Tamil Nadu (India) in 1997, a house-to-house survey was conducted in Bikkanapalli (village 1) and Manyampadi (village 2) and a hamlet, Thandramedu (village 3). The studies revealed widespread breeding of *Ae. aegypti* in a variety of storage vessels and unprotected containers. The predominant level of breeding of *Ae. aegypti* was noticed in non-potable water. The most preferred containers were drums and cement tanks in villages 1 and 2 respectively. A sustainable approach, which should include mass education and community participation along with the provision of adequate water supply and an anticipatory weekly larvicidal application three months prior to the expected transmission period, is considered a viable proposition for the prevention of DF/DHF epidemics.

**Keyword:** *Aedes aegypti*, dengue fever, dengue haemorrhagic fever, Container Index, Dharmapuri, Tamil Nadu.
Introduction

Outbreaks of dengue (DF) in India have commonly occurred in large towns and cities where the mosquito vector, *Aedes aegypti*, is prevalent\(^1\). Recently, DF/DHF epidemics have been reported from villages in the states of Kerala\(^2\), Maharashtra\(^3\), and Gujarat\(^1\). The socioeconomic practice of storing piped water in a wide variety of unprotected containers has led to the proliferation of places suitable for *Ae. aegypti* breeding\(^4\). During 1996, a village (pop. 2429), which is located 12 km from Krishnagiri, Dist. Dharmapuri, Tamil Nadu, reported for the first time fever cases compatible to dengue fever in a rural setting\(^5\). The cases were later confirmed by serological tests as that of dengue. Entomological investigations revealed over 40% of the water storage containers as positive for *Ae. aegypti*. During July 1997, suspected cases of dengue with typical clinical symptoms were reported in Bikkanapalli (31), Maniyampadi (324) villages and a hamlet, Thandramedu (1), in the same district. The present investigations were carried out in these affected villages to elucidate entomological factors which had culminated in the transmission of the disease.

Study area

Dharmapuri district (12° 30N and 78° 10E) borders Karnataka and Andhra Pradesh states in the north, Salem district in the south, Thiruvannamalai district in the east and a part of Karnataka state in the west. The study area receives rainfall both during the south-west monsoon (June to September) and north-east monsoon (mid-October to mid-December). Bikkanapalli (study village 1), with a population of 1176, receives intermittent supply of piped water. There are about 10 pottery units in the village and most of the inhabitants store water in mud pots. Maniyampadi, another study village (village 2) is a neighbouring village of Bikkanapalli and has a population of 568. This village receives protected water supply. Thandramedu, a hamlet (village 3) which is close to Bikkanapalli village, is an isolated pocket of houses with a small population of 25. The inhabitants get their water from a hand pump.
Materials and methods

Larval and adult mosquito collections were made in the study villages according to the methods described in earlier studies\(^1\). The larval prevalence of *Ae. aegypti* was estimated by Breteau Index \((BI = \text{Number of containers with } Ae. aegypti \text{ breeding per 100 houses searched})\), House Index \((HI = \text{Percentage of houses positive for } Ae. aegypti \text{ larvae})\) and Container Index \((CI = \text{Percentage of water-holding containers infested with } Ae. aegypti \text{ larvae})\). Chi-square \((X^2)\) test was performed to find out any significant difference in the water storage practices and *Ae. aegypti* breeding in the study villages.

Results

Breeding and distribution of *Ae. aegypti*

Of the total 368 premises in the three study villages, 142 premises were surveyed randomly for *Aedes* breeding. The number of premises surveyed varied from 7 in village 3 to 103 in village 1. Villages 1 and 2 only showed the breeding of *Ae. aegypti* (Table 1).

No water storage containers breeding *Ae. aegypti* were detected in village 3. Larval indices, i.e. HI, CI and BI, for village 1 were 37.5, 26.8 and 69.9 while for village 2 these were 18.8, 10.6 and 31.3 respectively.

<table>
<thead>
<tr>
<th>Village/ Hamlet</th>
<th>No. of houses</th>
<th>No. of containers</th>
<th><em>Ae. aegypti</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>HI</td>
</tr>
<tr>
<td>1</td>
<td>103</td>
<td>269</td>
<td>37.5</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
<td>94</td>
<td>18.8</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Incidence in indoor and outdoor breeding

Of the containers examined, 139 containers in village 1 and 65 containers in village 2 constituted domestic (indoor) breeding sources, of which 20.1% and 9.5% respectively were found to be positive for *Ae. aegypti* breeding. Similarly, a total of 130 and 29 containers constituted the peri-domestic (outdoor) breeding sources, of which 33% and 13.7% were found to be positive for immatures of *Ae. aegypti* in village 1 and village 2.
respectively. The domestic and peri-
domestic container indices (CI) did not
differ significantly ($X^2=0.42; p >0.1$).
Although the immature stages of *Ae.
aegypti* were collected in both potable
and non-potable water containers, the
magnitude was significantly higher in
non-potable containers ($X^2 = 19.41;
p<0.001$).

### Control measures

“Search, locate and destroy
campaigns” were carried out with the
help of village youths to stop the
*Aedes* breeding in discarded
containers like tins, broken pots, split
coconut pods, etc. The unwanted pots
in the pottery units were destroyed
and the unused pots were turned
upside down. The unprotected
containers (domestic) were covered
with pieces of cloth or a lid.

During the "Search, locate and
destroy campaigns", the inhabitants
were demonstrated the *Aedes*
breeding habitats and the immature
stages of *Aedes* mosquitoes. The
community was also educated to
scrub and clean the containers once a
week before refilling them with water.
The *Ae. aegypti* populations were

evaluated after the institution of
control measures.

Two rounds of thermal fogging at
four weeks interval using pyrethrum
extract 2.0% were carried out between
1600 and 1800 hours*. All the cement
tanks (constructed) and buried mud
pots were similarly treated with
Temephos 0.025%.

### Evaluation

Of the 103 and 32 households in
villages 1 and 2, a total of 98 and 29
houses respectively were examined
after the institution of control
measures. In village 1, the CI was
found to have been reduced from
26.82 to 9.6 and in village 2 from
10.6 to 4.3. The HI was reduced from
37.5 to 7.5 in village 1 and from 18.8
to 6.9 in village 2. The BI was also
found to have gone down from 69.9 to
3.3 in village 1 and from 31.3 to 13.8
in village 2 (Table 2). During the
second visit, omissions in the
larvicidal (Temephos) application were
noticed and unprotected containers
were also found.

* control intervention at 4 weeks interval and
dosages used for temephos are not up to the
standard – Editor
Table 2. *Ae. aegypti* larval and adult indices in study villages in Dharmapuri before and after institution of control measures

<table>
<thead>
<tr>
<th>Name of village</th>
<th>HI</th>
<th>CI</th>
<th>BI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bikkanapalli</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Before)</td>
<td>37.5</td>
<td>26.8</td>
<td>69.9</td>
</tr>
<tr>
<td>(After)</td>
<td>7.1</td>
<td>9.6</td>
<td>13.3</td>
</tr>
<tr>
<td>Maniyampadi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Before)</td>
<td>18.8</td>
<td>10.6</td>
<td>31.3</td>
</tr>
<tr>
<td>(After)</td>
<td>6.9</td>
<td>4.3</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Discussion

*Ae. aegypti* mosquito has successfully adapted itself to human dwellings where water is stored both inside and outside the premises. The abundance of breeding sites found in both the surveyed villages contributed to the high density of *Ae. aegypti* infestation and the dengue fever cases. On the other hand, the hamlet, Thandramedu, reported only one dengue fever case despite the fact that there was no *Ae. aegypti* breeding. However, it was found that the particular patient was a mason who worked in village 1 during the day.

The level of *Ae. aegypti* breeding was high in peri-domestic (outdoor) containers indicating that these were more conducive for breeding than the indoor containers. This could be due to the fact that non-potable water was kept without any protective cover which favoured the deposition of eggs by *Ae. aegypti*, while the indoor containers were kept covered.

There was a delay in the notification of the disease by the primary health centres. Control measures were initiated soon after the receipt of the notification from the medical officers concerned but they did not seem to be as effective as expected. These were attributed to (i) lack of cooperation from the villagers by their refusal to allow the field workers to check their houses and apply Temephos, (ii) Community participation was lacking, and (iii) many of the houses were locked since both husband and wife had left to work in the fields.

The growing number of water containers kept in the villages contributed to the density of *Ae. aegypti* infestation. Since the need for water storage was the greatest in village 1, the highest number of
dengue fever cases was reported from there. Our experience therefore suggests that the *Ae. aegypti* infestation cannot be successfully controlled without the involvement and co-operation of the community. Therefore, a sustainable approach should include mass education and community participation, with a regular provision of adequate water supply to communities, which will help in the containment of the disease transmission.

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**References**


