

Larval Infestation of *Aedes aegypti* and *Ae. albopictus* in Six Types of Institutions in a Dengue Transmission Area in Kandy, Sri Lanka

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Abstract

Entomological investigations were carried out at six types of community-gathering institutions, i.e. schools, hospitals, religious premises, offices, factories and city transport bus depots in Kandy district, Sri Lanka, from August 2003-July 2004, to determine the prevalence and breeding habitats of *Aedes aegypti* and *Aedes albopictus*. During the investigations, 153 individual institutions were studied and all possible indoor and outdoor *Aedes* mosquito breeding sites were examined.

Of all six types of institutions, 88 (57.52%) were found positive for *Ae. aegypti* and/or *Ae. albopictus* breeding. The highest percentages of positive containers were found in hospitals (78.95%) and city transport bus depots (78.95%) while the lowest percentage (44.29%) was encountered in schools. In all types of institutions, discarded containers and water storage receptacles were important breeding sites for both *Ae. aegypti* and *Ae. albopictus*, although tyres were the major breeding places in bus depots and offices. The container indices of all institutions combined were above 2.45, 5.09 and 8.17 for *Ae. aegypti*, *Ae. albopictus* and for both *Ae. aegypti* and *Ae. albopictus* respectively.

In view of the high vulnerability (possibilities of importation of viraemia) and receptivity (high breeding potential) of hospitals, efforts should be made to reduce the vulnerability and receptivity of hospitals for effective control of DF/DHF in Kandy district.

Keywords: *Aedes aegypti*, *Aedes albopictus*, institutions, breeding potential, Kandy, Sri Lanka.

Introduction

Dengue fever (DF) and dengue haemorrhagic fever (DHF) is an arboviral disease belonging to the genus *Flavivirus* caused by four serotypes of dengue virus (DENV-1 to -4). The disease is transmitted by the bite of an infected female mosquito of the genus *Aedes*. The major vector of DF and DHF is *Aedes aegypti* while *Ae. albopictus* is an important secondary vector of dengue in the South-East Asia and Western Pacific^[1].

Except for some African strains, *Ae. aegypti* breeds mainly in artificial containers in the domestic environment in close association with man. It is highly anthropophilic and bites indoors as well as outdoors^[2,3]. *Ae. albopictus* is less domestic than *Ae. aegypti*, tends to rest and feed outdoors and uses both artificial and natural breeding sites. Both species exhibit diurnal activity with two distinct peak periods of activity, in the early morning and late afternoon^[1,3,4]. The anthropophilic feeding habits of *Aedes* mosquitoes will make the daytime

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population-gathering institutions/sites at high risk of DF and DHF transmission when epidemiological conditions are favourable. Such institutions/sites may also serve as transmission foci for spreading the disease to other areas, resulting in high morbidity and mortality and widespread distribution of the disease. Thus, knowledge on the prevalence and breeding habitats of *Ae. aegypti* and *Ae. albopictus* at community-gathering institutions/sites is of much importance in the prevention and control of DF and DHF in the island. This study was carried out to determine the prevalence and breeding habitats of *Ae. aegypti* and *Ae. albopictus* in six types of community-gathering institutions/sites in Kandy district, Sri Lanka, during August 2003–July 2004.

Methodology

Study area

The present study was carried out in Kandy district, Sri Lanka. The land area of the district is 1939.5 km² with an estimated population of 1.29 million (2003). The district reported 647, 875 and 637 clinical and serologically positive DF and DHF cases in 2001, 2002 and 2003 respectively. For the present study, five Divisional Director of Health Services (DDHS) areas, namely, Gangawatakorale, Pathahewaheta, Yatinuwara, Harispattuwa and Kundasale, and the Municipal Council area of Kandy were selected based on the high incidence of the disease since 2001. These areas have contributed to 67.54%, 71.43% and 73.31% of the total cases in the district for 2001, 2002 and 2003 respectively.

Selection of institutions under study

Six types of community-gathering institutions/sites e.g. schools, hospitals, religious premises (temples, churches and mosques), offices,

factories and city transport bus depots were chosen based on the abundance of *Aedes* mosquito larval foci during previous surveys. A total of 153 institutions/sites were selected randomly from DF/DHF transmission localities in the study area.

Entomological investigations at the institutions

Entomological investigations (larval surveys) were carried out at each institution by a trained technician attached to the Regional Office, Anti-Malaria Campaign, Kandy. During the surveys, all possible indoor and outdoor breeding habitats of *Ae. aegypti* and *Ae. albopictus* at each institution/site were examined, and 10 larvae from each positive container were collected in separate containers and identified using standard keys^[5,6]. If a particular container had less than 10 larvae, all larvae were collected and identified as previously. When the same institution/site was visited more than once, each visit was considered as an individual and separate observation.

Results

Ae. aegypti and *Ae. albopictus* breeding was found in all types of institutions/sites under study. A total of 153 institutions/sites were surveyed, of which 88 (57.52%) were found to be positive for *Ae. aegypti* and/or *Ae. albopictus* breeding. The positivity of different institutions/sites varied from 44.29% (schools) to 78.95% (hospitals and city transport bus depots) (Table 1).

In the schools *Ae. aegypti* and *Ae. albopictus* breeding was found in a wide variety of containers with a majority of discarded receptacles (discarded plastic containers, glassware, tin, earthenware, metalware and



polythene), water storage containers and tyres and tubes. Water storage containers (tanks and barrels) and discarded receptacles constituted the majority of breeding habitats of *Ae. aegypti* and *Ae. albopictus* at religious premises, hospitals and factories. In the bus depots and offices, the major breeding sites of the two vectors were tyres and tubes. However, in all institutions/sites, discarded containers and water storage containers were important breeding sites of *Ae. aegypti* and *Ae. albopictus*.

In all types of institutions/sites, *Ae. aegypti* breeding was found in more than 20% of positive containers while *Ae. albopictus* breeding was found in more than 44% of positive containers. The container indices were above 2.45%, 5.09% and 8.17% for *Ae. aegypti*, *Ae. albopictus* and both *Ae. aegypti* and *Ae. albopictus* respectively (Table 2).

Table 1. Positivity of different types of institutions/sites for *Ae. aegypti* and/or *Ae. albopictus* in Kandy district (August 2003–July 2004)

Type of institution/site	Number (%) of institutions/sites	
	Examined	Positive for <i>Ae. aegypti</i> and/of <i>Ae. albopictus</i>
Schools	70	31 (44.29)
Hospitals	19	15 (78.95)
Religious premises	16	10 (62.50)
Government offices	23	14 (60.87)
Factories	6	3 (50.00)
City transport bus depots	19	15 (78.95)
Total	153	88 (57.52)

Table 2. Number (%) of positive containers and the container indices for *Ae. aegypti* and *Ae. albopictus* in six types of institutions/sites in Kandy district (August 2003–July 2004)

Type of institution	No. of containers examined	Number (%) of containers positive for			Container index for		
		<i>Ae. aegypti</i>	<i>Ae. Albopictus</i>	Total	<i>Ae. aegypti</i>	<i>Ae. albopictus</i>	Total
Schools	978	24 (27.27)	69 (78.41)	88 (100.00)	2.45	7.06	9.00
Hospitals	83	4 (28.57)	10 (71.43)	14 (100.00)	4.82	12.05	16.87
Temples	97	5 (62.50)	5 (62.50)	8 (100.00)	5.15	5.15	8.25
Offices	146	14 (56.0)	11 (44.00)	25 (100.00)	9.59	7.53	17.12
Factories	119	3 (20.0)	13 (86.67)	15 (100.00)	2.52	10.92	12.61
City transport bus depots	845	36 (52.17)	43 (62.32)	69 (100.00)	4.26	5.09	8.17
Total	2268	86 (39.27)	151(68.95)	219 (100.00)	3.79	6.66	9.66

Discussion

Natural transmission of DF and DHF depends on the presence of dengue virus (DF and DHF viraemic patients), mosquito vector(s) and a susceptible population. In a DF and DHF

endemic area the virus is always circulating within the population. Also, in community-gathering institutions, a susceptible population is always present as these institutions draw people from areas with different endemicities of DF and DHF. Thus, community-gathering



institutions located in DF and DHF endemic areas are at high risk of DF and DHF transmission if vector breeding occurs at such institutions.

In spite of the present DF and DHF control activities, 57.52% of the institutions/sites were found to be positive for *Ae. aegypti* and *Ae. albopictus* breeding. This highlights the poor response of the institutions in the elimination of *Aedes* mosquito breeding from their premises. This calls for effective intersectoral collaboration for elimination of *Ae. aegypti* and *Ae. albopictus* breeding at institutions in highly receptive areas for DF/DHF transmission.

In all institutions, discarded containers and water storage containers were important breeding sources for *Ae. aegypti* and *Ae. albopictus*. In bus depots and offices, unnecessary inventory items such as tyres, tubes and spare parts were the major breeding sites of the vectors. Investigations carried out in Kandy district also identified water storage tanks and barrels, tyres and discarded containers as important breeding sites of *Ae. aegypti* and *Ae. albopictus*^[7]. Thus, regular cleaning, proper garbage collection and disposal, regular supply of water to avert water storage and expediting inventory procedures to dispose of unnecessary inventory items from these institutions will help a great deal to eliminate *Ae.*

aegypti and *Ae. albopictus* breeding at the types of institutions under study.

The presence of *Aedes* foci, especially in hospital premises, will definitely create a major threat for the spread of DF/DHF, as hospitals in endemic areas are the first to receive viraemic individuals as DF and DHF inpatients and outpatients. Provision of bednets to all indoor patients would help in protecting them from infective mosquito bites. Although *Aedes* mosquitoes are daytime biters, protection by bednets is useful as indoor patients can use them even during the daytime.

In conclusion, the presence of *Ae. aegypti* and *Ae. albopictus* breeding at community-gathering institutions creates a major threat for spread of DF and DHF as they act as both receptive and vulnerable sites for the spread of DF/DHF in the country.

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