Research Article

Anthropophilic Behavior of *Aedes albopictus*: A Predominant Vector of Dengue/Chikungunya in Thiruvananthapuram district, Kerala, South India

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Abstract

Human host seeking behavior of *Aedes albopictus* was evaluated using human landing collections conducted during both dry and wet seasons of 2010-2012 in Thiruvanathapuram district, Kerala. Collections were segregated hourly to provide a time distribution of host-seeking behavior. *Aedes albopictus'* day time landing collections comprised of 36.89% and maintained 3-4 per man hour (PMH) density during morning hours whereas 2-3 per man hour density during afternoon hours. PMH density of *Aedes albopictus* ($P < 0.001$) and *Aedes vittatus* ($P < 0.05$) varied significantly between pre and post monsoon seasons. PMH density of *Aedes albopictus* is correlated with humidity at pre monsoon season ($r = 0.64$) but slightly correlated with post monsoon season ($r = 0.35$). Night time collections showed the presence of *Ae. albopictus* and *Ae. vittatus* from both indoor and outdoor landing collections. Density of both *Ae. albopictus* and *Ae. vittatus* significantly varied in Day time and Indoor (Night time) collections ($P < 0.05$). Density of *Aedes albopictus* significantly varied in Day time and Thinnai (Night time) collections ($P < 0.05$). *Aedes albopictus* was the only species that varied both in Indoor and Thinnai night time collections ($P < 0.05$). This study revealed that the *Ae. albopictus* mosquitoes predominantly bite during day time (95.5%) compared to night time in Thinnai (3.9%). Increase in dengue cases reported during the post monsoon period in Kerala was due to the increased human host seeking behavior (71.3%) of *Ae. albopictus*.

Keywords: Dengue, Human host, *Aedes albopictus,* Kerala, India.

Introduction

Mosquitoes are vectors for many pathogens that cause human diseases like malaria, dengue fever, Japanese encephalitis and chikungunya. When significant levels of biting of these vectors occurs by their abundance in nature, transmission of the pathogens results in epidemics and high rates of human morbidity and mortality. Dengue is one of the most serious and fast-emerging mosquito-borne infections in the tropics and 50-100 millions dengue virus infections occur annually.[1-2] It is one of the most rapidly rising mosquito transmitted infections in the world and is identified as a re-emerging disease in Southeast Asia. Almost, four billion people are at risk in 128 countries worldwide.[3] In India, Dengue infection has been frequently encountered often in epidemic proportions in almost all parts of the country, claiming heavy morbidity and mortality.[4] As far as southern India is concerned, the disease has been endemic in Tamil Nadu, Karnataka and Andhra Pradesh.[5] On the other hand, Kerala is experiencing a string of focal outbreaks in different districts from 2003 onwards. Dengue is primarily spread by *Ae. aegypti* and adequately supported by *Ae. albopictus* in certain physiographical situations such as the sylvan environs of the Western Ghats region in Kerala state.[6-8] In India, chikungunya re-emerged after a lapse of three decades in a virulent epidemic form in late 2005. In 2006, there were about 1.39 million suspected cases from 213 districts in 15 states and about 565.42 million people were at the risk of infection.[9]

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There were 70,731 suspected cases in Kerala state during 2006 mainly from 3 coastal districts. In 2007, Kerala was the worst affected state in India with a recorded incidence of 24052 suspected cases, of which 909 were confirmed.[9-10] *Aedes albopictus* is an efficient vector of various arboviruses of which dengue and chikungunya are the most important diseases that could undergo outbreaks which is now well-documented.[6-7,11-12] *Aedes albopictus* currently shows a global presence and is recognized as a major threat to human health. In India, re-emergence of chikungunya was reported from several states since 2005.[13] Kerala showed the occurrence of *Ae. albopictus*, the Asian tiger mosquito, as a principal vector in hilly, rural and suburban environment in the affected areas.[14-16] There is a role played by certain species of plants especially the pineapple plants serving as an ideal habitat conducive for breeding of *Ae. albopictus.* Maximum *Ae. albopictus* breeding in plants was recorded in Thiruvananthapuram followed by Pathanamthitta, Kottayam, Eranakulam, and Palakkad districts and the peridomestic container breeding as well as rubber plantations largely supported the population build up of *Ae. albopictus* in these areas.[9] The extensive entomological studies could not detect *Ae. aegypti*, which suggests the possibility of the role of *Ae. albopictus* as the vector of dengue and chikungunya. The epidemic, which occurred during 2005-2006 in certain islands of Indian Ocean and in Kerala, indicated the probable role played by *Ae. albopictus*.[17-18] Dengue and chikungunya virus from *Ae. albopictus* in Kerala was already demonstrated.[12,19] Similar survey carried out in Lakshadweep islands, Indian Ocean during November/ December 2006, which experienced chikungunya, revealed the predominance of *Ae. albopictus* and absence of *Ae. aegypti*.[20] Kerala has now become an endemic state for dengue and chikungunya. Hundreds of cases of chikungunya and dengue reported every year since 2006 from different districts of Kerala. There is a high risk of exposure to the Asian tiger mosquito which breeds in the peridomestic areas of the households.

Our earlier studies conducted in Kerala showed that *Ae. aegypti* was mainly found indoors and the *Ae. albopictus* was found only outdoors. Therefore, this study of direct landing catches of mosquitoes from bait was undertaken to determine human biting of *Ae. albopictus* mosquito species, to determine the day biting time, peak biting period and the seasonal variations of vector mosquito biting to explore the distribution pattern of *Ae. albopictus* adult female mosquitoes which is used to estimate abundance of available mosquito populations and to study the possible relationship to epidemics of dengue fever. Any seasonal change in the biting rate is also extremely important to understand the seasonal occurrence of this disease. This study will help to educate the public about the seriousness of the day time outdoors biting behavior of *Aedes albopictus* mosquitoes which will help to apply the vector control measures accordingly to reduce the man vector contact to bring down the incidence of dengue/ chikungunya in this area.

Materials and Methods

Study Area

Kerala is an Indian state with a total area of 38,863 km^2 and population of 31,838,619. The latitude and longitude are $8^o18'N$ and $74^o52'E$ to $77^o25'E$, respectively. Frequent outbreaks of DF have recently been documented in Kerala, southern India.[21] Thiruvananthapuram region is fairly humid and warm throughout the year with the relative humidity and temperature varying little between 70-90% and 22-34.5°C, respectively. The annual precipitation is high reaching up to 3000 mm, with the maximum number of rainy days (18-21 rainy days/month) in May to August. The study area is typically dry for one to two months from January to March. From 2003 onwards, more number of dengue cases was reported from Thiruvananthapuram district and hence Parassala and Peyad were chosen for our studies based on the history of dengue epidemics in Kerala state (Fig. 1). Four distinct seasons are observed in this region and the field survey was made during these seasons only. These are (i) Post monsoon season (January-March), (ii) Summer season (April-June), (iii) Southwest monsoon season (July-September) and (iv) Northeast monsoon season (October-December).

In Thiruvananthapuram district, dengue incidence per one lakh population was more than two and about 65% of dengue cases in Kerala were reported from Thiruvananthapuram district during the year 2006. Thus the study sites were selected purely based on the dengue case incidence. The criterion for selection of the area was based on the high incidence of confirmed cases recorded by the health department of Kerala.

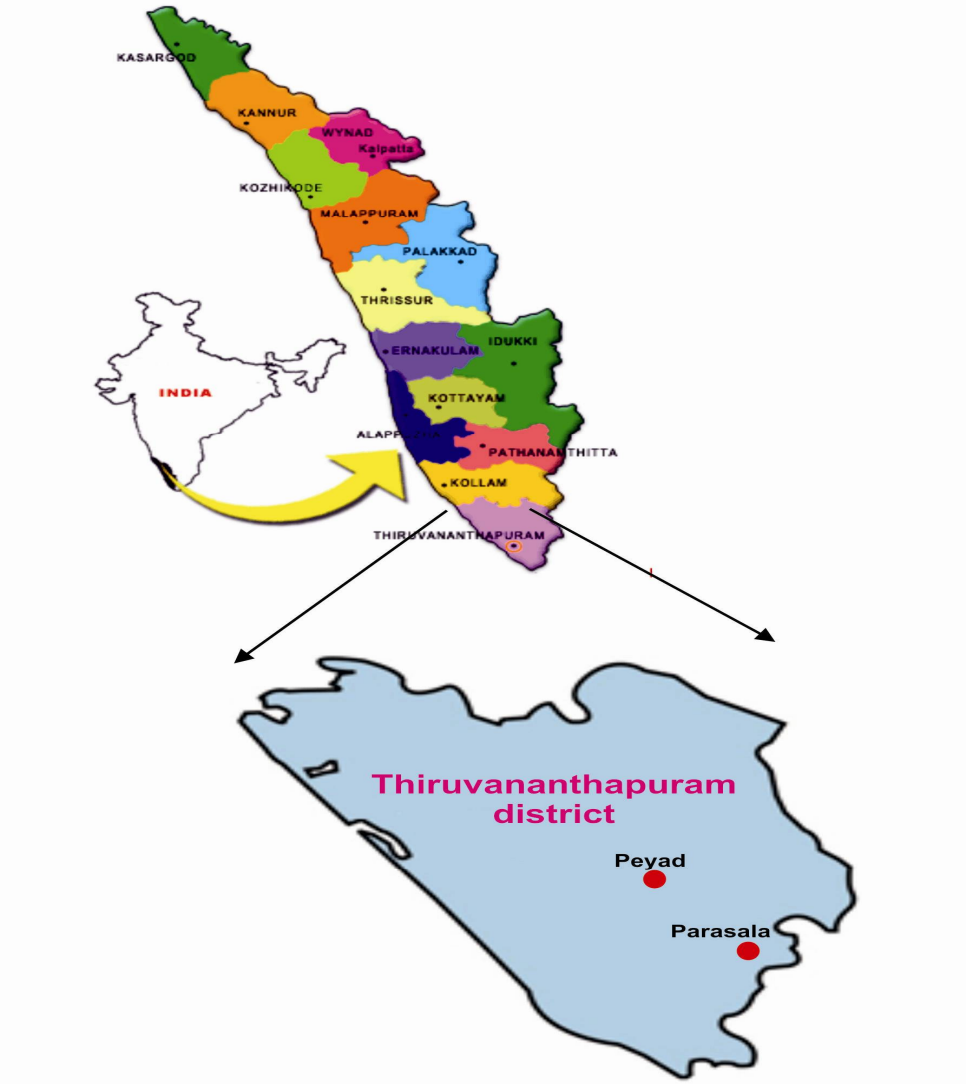

Figure 1.Study Areas in Thiruvananthapuram district, Kerala

Entomological Surveillance

All night/ day mosquito host seeking collections from dusk to dawn and vice versa are made in this method. Mosquitoes are collected while they land on the human host to bite or while in the process of biting the host (from whom informed consent was obtained). The mosquitoes were collected as soon as they landed on the host to avoid the actual biting. Hourly collections were made and recorded separately during outdoor day time landing (0600-1800 hrs) collections and night time landing collections (1800 to 0600 hrs) both indoor and in Thinnai (Porch). Generally two hosts are used for landing collections, which are conducted during pre and post monsoon periods. These collections indicate man-mosquito contact, rate of biting per day/ night, biting rhythm and peak biting time of mosquito species. All the mosquitoes collected by the above methods are examined for species identification using standard keys[22-23] and for abdominal condition, and are classified as unfed, full fed, semi or half gravid and gravid.

Data Analysis

Using modified geometric mean that compensates for the zero values, and is calculated using the formula G = anti log [sum (x+1)/N]-1, t-test was applied to study differences of vectors collection in different seasons and day and night time collections. Correlation was applied to study relation between vector density and climate variables (Humidity, maximum temperature and Lux (2000, (2000-20000)*10 and (2000-20000)*100). T-test and correlation was carried out using the SPSS version 15.0 software package.

Results

Day time landing collections were conducted from 0600-1800 hrs. In Thiruvananthapuram, they showed a total of 1320 mosquitoes and the predominant vector mosquito species collected was *Aedes albopictus* that constituted 36.89%, and the other species that dominated was *Armigeres subalbatus* (60%). During morning hours, *Ae. albopictus* maintained 3-4 per man hour density whereas during afternoon hours it maintained 2-3 per man hour density. Thus the biting recorded throughout the day showed a bigger peak in the morning hours and a smaller peak in the afternoon collection (Table 1-given at the end of the article). Only few mosquitoes of *Ae. albopictus* and *Ae. vittatus* were collected from both indoor and Thinnai night landing collections (Table 2-given at the end of the article). After *Ar. subalbatus* mosquitoes, *Ae. albopictus* predominated in this catch both in pre and post monsoon period (Tables 3 and 4). Table 3 indicates that *Ae. albopictus* ($P < 0.001$), *Ae. vittatus* ($P < 0.05$), *Ar. subalbatus* ($P < 0.05$) and *Culex quinquefasciatus* ($P < 0.05$) density varied pre and post monsoon seasons. Abundance during the pre and post monsoon periods showed significant variation for *Ae. albopictus* (1.6 & 3.9 PMH) and *Ae. vittatus* (only during post monsoon period 0.3 PMH). *Aedes vittatus* was collected during post monsoon period only. Day landing collections showed 18.8 (28.7%) during pre monsoon season and 46.8 (71.3%) during the post monsoon season.

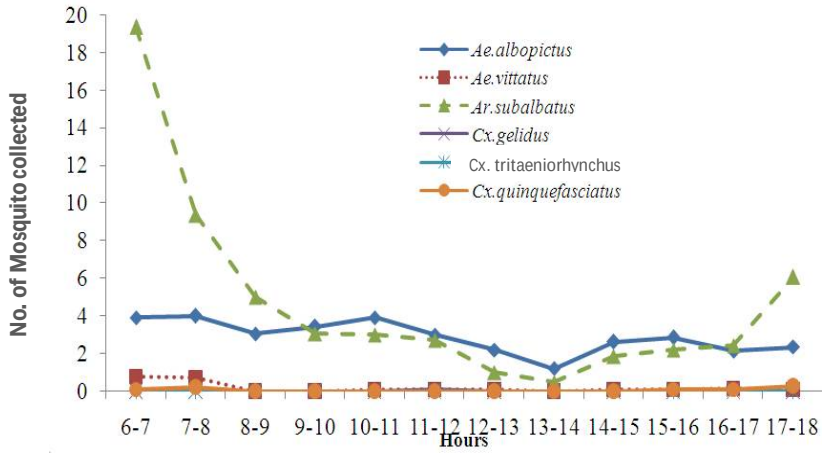

Figure 2.Man landing collections of mosquitoes during day time from (12 Hours: 0600 hrs-1800 hrs) Thiruvananthapuram, Kerala

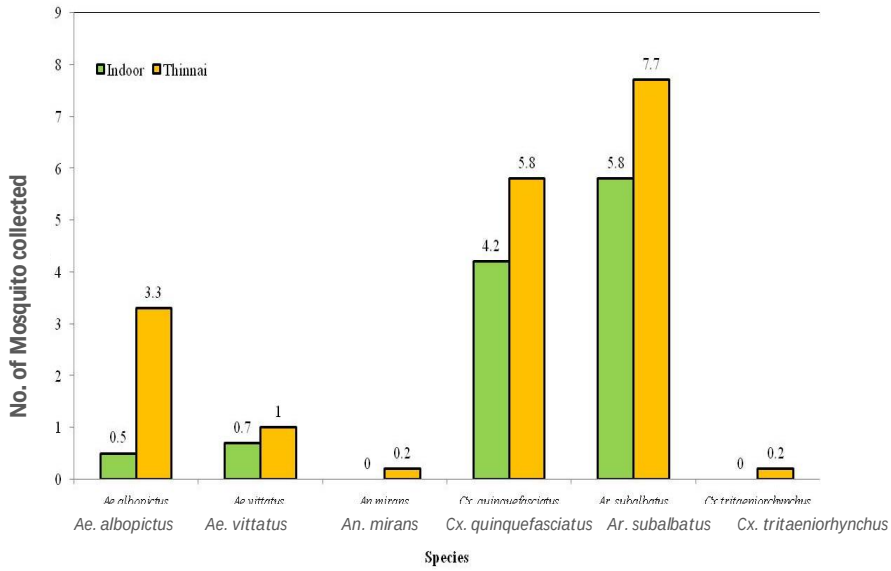

Figure 3.Man landing collections of Mosquitoes during night time (1800 to 0600 hours) Indoor and Thinnai in Thiruvananthapuram, Kerala

Table 3.Per Man hour man landing density of vectors during in Pre and Post monsoon seasons in Thiruvananthapuram, Kerala

Species	Pre Monsoon (Jan-May) (%)	PMH	Post Monsoon (Jun-Oct) (%)	PMH	Total No.
Ae. albopictus	18.8 (28.7)	1.6	46.8 (71.3)	3.9	65.6*
Ae. vittatus	0 (0.0)	0	3.6 (100.0)	0.3	3.6**
Ar. subalbatus	53.3 (47.5)	4.4	59.0 (52.5)	4.9	112.3**
Cx. gelidus	0.2 (100.0)	0.02	0 (0.0)	0	0.2
Cx. tritaeniorhynchus	0.2 (100.0)	0.02	0 (0.0)	0	0.2
Cx. quinquefasciatus	1.2 (74.5)	0.1	0.4 (25.5)	0.03	1.6**
Total Mosquitoes	73.7 (33.5)	6.1	109.8 (66.5)	9.2	183.4

* Significant ($P < 0.05$); PMH-Per Man hour Density
** Significant ($P < 0.001$); Values in the parenthesis denotes percentage

In Fig. 4, *Ae. albopictus* density is significantly affected by humidity at pre monsoon season (r = 0.64) and slightly affected by post monsoon season (r = 0.35). Maximum temperature showed negative relation between *Ae. albopictus* density in pre and post monsoon seasons respectively (r = -0.60, -0.45). Lux values showed slightly negative relation with this mosquito density in both seasons.

Table 4.Man landing collection comparison for different mosquito species in Thiruvananthapuram, Kerala

Species	Day Time (0600-1800 h) (%)	Night Time (1800-0600 h)		Total
		Indoor (%)	Thinnai (%)	
Ae. albopictus	34.8 (95.5)	0.5 (0.6) $	3.3 (3.9) #, @	38.6
Ae. vittatus	2.1 (74.4)	0.7 (10.2) $	1.0 (15.4)	3.7
An. mirans	0 (0.0)	0 (0.0)	0.2 (100.0)	0.2
Ar. subalbatus	56.6 (90.7)	5.8 (4.0) $	7.7 (5.3) #	70.1
Cx. gelidus	0.1 (100.0)	0 (0.0)	0 (0.0)	0.1
Cx. tritaeniornchus	0.07 (50.0)	0 (0.0)	0.17 (50.0)	0.2
Cx. quinquefasciatus	0.7 (14.3)	4.2 (35.7) $	5.8 (50.0) #	10.7
Total Mosquitoes	94.3	11.2	18.2	123.6

$-Significant ($P < 0.05$) (Day time Vs Indoor)
#-Significant ($P < 0.05$) (Day time Vs Thinnai)
@-Significant ($P < 0.05$) (Indoor Vs Thinnai)

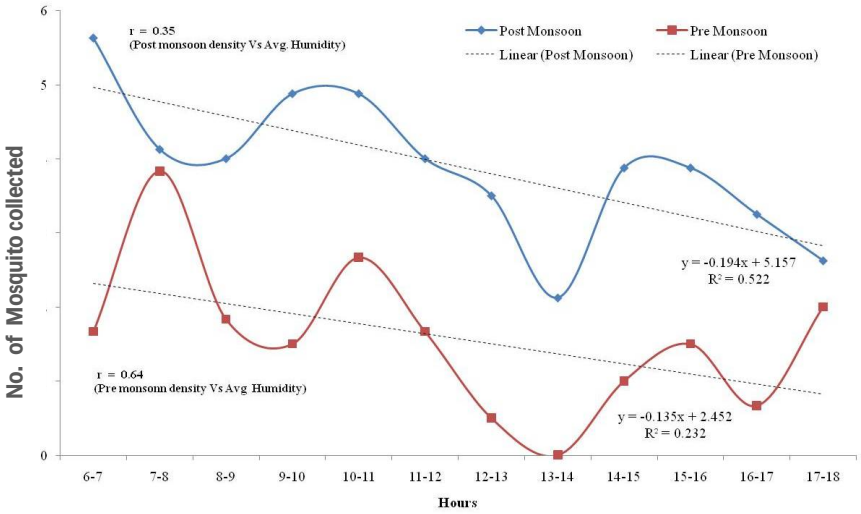

Figure 4.*Aedes albopictus* man landing collections (12 hours) during pre and post monsoon seasons in Thiruvananthapuram, Kerala

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Similarly during the night time collection, a total of 176 mosquitoes-38% from indoors and 62% from the Thinnai were collected. *Ar. subbalbatus* and *Cx. quinquefasciatus* dominated in both indoor and Thinnai night time collection. Table 4 indicated that *Ae. albopictus, Ae. vittatus, Ar. subalbatus* and *Cx. quinquefasciatus* density significantly varied in day time and night time in indoor collection ($P < 0.05$). *Aedes albopictus, Ar. subalbatus* and *Cx. quinquefasciatus* density significantly varied in day time and night time-Thinnai collection ($P < 0.05$). *Aedes albopictus* was the only species whose density varied significantly in night time indoor and Thinnai collections ($P < 0.05$). *Aedes albopictus* was collected only in the first two hours during dusk and almost zero until early morning dawn hours (Table 2 & Fig. 5).

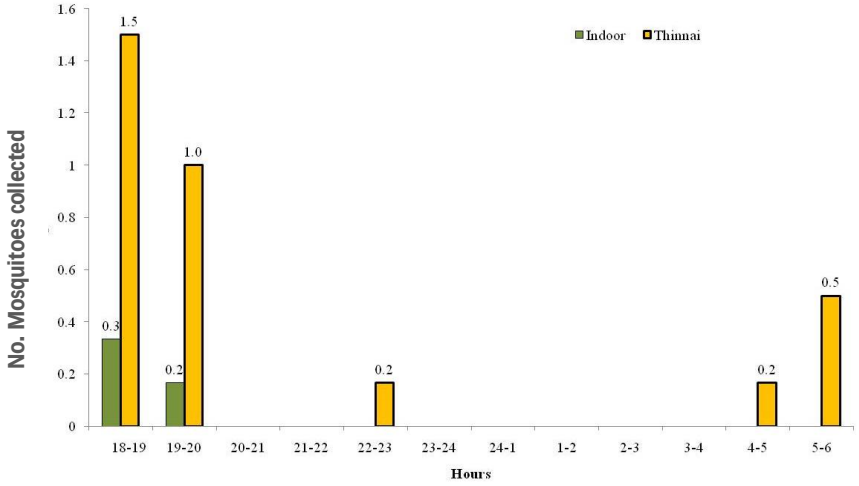

Figure 5.*Aedes albopictus* collections from Indoor and Thinnai in Thiruvananthapuram district, Kerala

Discussion

Aedes albopictus as a container breeder is well-documented worldwide. It breeds in both natural and manmade habitats. It is primarily a forest-fringe mosquito breeding in natural sites including rock pools, leaf axils, tree holes, cut bamboo stumps, etc. Widespread deforestation and increase in plantations especially of rubber, cocoa and areca nut contributed to the rapid spread of tiger mosquito in Kerala. Extensive breeding was found in containers used for collecting rubber sap in rubber plantations during the rainy season.[15] In Western Ghat regions of Malabar, profuse breeding was observed in shed leaf sheaths of areca nut palms and cocoa pods hanging from the trees as well as grounded.[14,24] Due to highly invasive nature and ecological plasticity, it spread to rural and suburban niches breeding in artificial containers like plastics and tires. Breeding of this mosquito in plastic cups around tea vendor shops in Ernakulam City, Kerala was reported.[25] Reported coconut shells and plastics dumped around the households were recorded as the major source of breeding of *Ae. albopictus* and the flower pots, glass products and tires in rural settings of Calicut, Kerala were recorded as the other breeding sites.[13] Pineapple plants support maximum breeding of *Ae. albopictus*, and Kerala has extensive pineapple plantations.[9] During the south-western monsoon (June-September) season, it is a practice to suspend tapping temporarily in some plantations leading to accumulation of rainwater in these containers, thus providing ideal breeding sites for mosquitoes.[15]

Aedes albopictus was more dependent on rainfall compared to *Ae. aegypti*, and its larval density sharply increasing after monsoon rains which filled up all the peridomestic containers strewn in that area.[26] *Ae. albopictus* females prefer to oviposit in outdoor habitats especially trash containers.[27] Before monsoon, *Ae. albopictus* was found mainly in manmade containers from the peridomestic habitats. Urban growth rate increases from 18% to 27% in the last four decades and the concomitant destruction of natural habitats forced *Ae. albopictus* to adapt to breeding in manmade containers besides natural sites, as seen in China.[28]

Aedes albopictus played a major role in dengue transmission in Kerala and the density of *Ae. albopictus* completely dominated (93.2%) in many places. Dengue and chikungunya virus were demonstrated from *Ae. albopictus* in Kerala.[6-7,12,19,29] *Ae. albopictus* populations in Penang seem largely determined by quick development in combination with low immature loss and increased oviposition.[30] Dengue epidemic was reported due to the rapid buildup of *Ae .aegypti* population in Thailand.[31]

Aedes albopictus feed readily on humans and animals, and are more likely to feed outdoors compared to *Ae. aegypti*.[26,32] Landing collection conducted from 0600-1800 hrs. in Thiruvananthapuram showed the predominance of the dengue chikungunya vector mosquito species *Ae. albopictus* (36.89%) which is a mosquito native to Asia, and one of the fastest spreading animal species over the past two decades. *Ae. albopictus* has spread from its native range to at least 28 other countries around the globe, largely through the international trade in used tires. This has aggressive daytime human-biting behavior [33] and has the ability to transmit a variety of viruses.[34]

Dengue vectors *Ae. aegypti* and *Ae. albopictus* occurred during both pre-and post-monsoon seasons at higher altitudes of Western Ghats.[35]

Aedes albopictus mosquitoes bite mainly in the morning or evening when human hosts are often outdoors. In this study, the biting was recorded throughout the day showing a bigger peak in the morning hours and a smaller peak in the afternoon collection.

Similarly *Ae. albopictus* was found to have bimodal daily feeding activities and was found to have exophagic (89%) and exophilic (87%) behaviors. *Ae. albopictus* significantly preferred humans than other animals and showed its high degree of anthropophily.[34] *Culex quinquefasciatus* and *Ae. aegypti* are markedly domestic species that feed almost entirely on humans and rest in and around houses. Highly anthropophilic blood feeding pattern of these mosquitoes were observed.

In this study, adult females were collected only in landing collections biting humans outdoors, around the houses and preferably near vegetation, and no specimen was captured in indoor resting collections as already observed and reported in the dengue endemic villages of Vellore district, Tamil Nadu. This species was recorded with PMH density ranging between 0.5 (February-pre-monsoon season) and 22.1 (November-post-monsoon season).[36]

The host seeking behavior of *Ae. albopictus* was recorded throughout the day showing a bigger peak in the morning hours and a smaller peak in the afternoon collection. Thus, *Ae. albopictus* was found to have bimodal daily feeding activities. *Ae. albopictus* significantly preferred humans than other animals and showed its high degree of anthropophily.

The higher seroprevalence rate reported in Kerala could be attributed to the exposure of the population dwelling and engaged in the rubber plantations to the infective bites of the day biting and exophilic vector species, *Ae. albopictus*, abundant in this region. *Aedes albopictus* was found to be the predominant species in the region (61.99%).[37]

The seasonal determination surveys in Khyber Pakhtunkhawa, Pakistan demonstrated that the dengue infection was most prominent in the post-monsoon season, in urban areas, and in patients with a history of travel to an endemic locality and no single positive case was noted in the pre-monsoon period.[38] Similarly more dengue cases were observed during post monsoon period in Maharashtra[39] and in Pakistan.[38] Virus activity is high during the monsoon and post monsoon period[40] as observed in Kerala where the dengue case details reported showed more cases during the post-monsoon period of 2007-2012 and were found to be statistically significant ($P<0.05$) as compared to the pre-monsoon period, which is due to increase in the human landing collection of *Ae. albopictus* as observed in this study.

In conclusion, *Ae. aegypti* and *Ae. albopictus* seem to be restricted to their own limited breeding territorial sites before and after the onset of monsoon so control measures focusing on prime breeding sites would be more labor intensive for routine larvicide application and source reduction or elimination. Due to the absence of effective vaccine, the source reduction is the main control strategy practiced everywhere. A recently conducted KAP study in Vellore in Tamil Nadu where an abnormal increase in the incidence of dengue was reported showed lack of awareness on the day time biting behavior of Aedes mosquitoes.[41]

The host seeking behavior studies of these hematophagous vector mosquitoes are considered to be the most important factor which facilitates the man vector contact thereby leading to the transmission of dengue and chikungunya in these areas. Education of public about the biting pattern of these vectors is a key issue to be taken up. Before initiating the same, behavioral changes in the communities should be monitored to alert both households and communities which will help us to target the actual or potential larval habitats and the needed steps like coverage of water containers with mosquito proof lids, and water tanks, containers and plant pots to be emptied or dried at least once a week. Developing nations like India with high population density are expected to face a host of health effects due to rapid change in the ecosystem by global warming, urbanization, deforestation, changing human behavior and availability of host affecting the feeding behavior of mosquitoes. They influence the transmission of vector borne diseases such as malaria, dengue and chikungunya.[42]

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This study revealed that *Ae. albopictus* mosquitoes predominantly bite during day time (95.5%) and obtained very few numbers in the Thianai during night time (3.9%). More dengue cases reported during the post monsoon period in Kerala was due to the increased human host seeking behavior (71.3%) of *Ae. albopictus*.

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Conflict of Interest: Nil

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Table 1.Man landing mosquitoes collections (%) from day time (0600 hrs-1800 hrs) in Thiruvananthapuram, Kerala

Species	6-7 (%)	7-8 (%)	8-9 (%)	9-10 (%)	10-11 (%)	11-12 (%)	12-13 (%)	13-14 (%)	14-15 (%)	15-16 (%)	16-17 (%)	17-18 (%)	Mean no (± SE)	Total
Ae. albopictus	3.9 (11.3)	4.0 (11.5)	3.1 (8.8)	3.4 (9.9)	3.9 (11.3)	3.0 (8.6)	2.2 (6.4)	1.2 (3.5)	2.6 (7.6)	2.9 (8.2)	2.1 (6.2)	2.4 (6.8)	2.8 ± 0.07	34.8
Ae. vittatus	0.8 (37.9)	0.7 (34.5)	0.0 (0.0)	0.0 (0.0)	0.1 (3.4)	0.1 (3.4)	0.1 (3.4)	0.0 (0.0)	0.1 (3.4)	0.1 (3.4)	0.1 (6.9)	0.1 (3.4)	0.2 ± 0.06	2.1
Ar. subalbatus	19.4 (34.2)	9.4 (16.5)	5.0 (8.8)	3.1 (5.4)	3.0 (5.3)	2.7 (4.8)	1.0 (1.8)	0.5 (0.9)	1.9 (3.3)	2.2 (3.9)	2.4 (4.3)	6.1 (10.7)	3.4 ± 0.23	56.6
Cx. gelidus	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (100.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.01 ±0.01	0.1
Cx. tritaeniorhynchus	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (100.0)	0.0 (0.0)	0.01 ± 0.01	0.1
Cx. quinquefasciatus	0.1 (10.0)	0.2 (30.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (10.0)	0.1 (10.0)	0.3 (40.0)	0.1 ± 0.02	0.7
Total	24.1 (25.6)	14.3 (15.2)	8.1 (8.6)	6.5 (6.9)	7.0 (7.4)	5.9 (6.2)	3.3 (3.5)	1.7 (1.8)	4.6 (4.8)	5.2 (5.5)	4.9 (5.2)	8.8 (9.3)	6.5 ± 0.18	94.3

Table 2.Man landing Mosquitoes collections (%) during Night Time (1800 to 0600 hours) in Thiruvananthapuram, Kerala

		18-19 (%)	19-20 (%)	20-21 (%)	21-22 (%)	22-23 (%)	23-24 (%)	24-1 (%)	1-2 (%)	2-3 (%)	3-4 (%)	4-5 (%)	5-6 (%)	Mean (±SE)	Total
INDOOR	*Ae. albopictus*	0.3 (66.7)	0.2 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.04±0.03	0.5
	Ae. vittatus	0.3 (50.0)	0.2 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.2 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.05±0.03	0.7
	An. mirans	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.00±0.00	0.0
	Cx. quinquefasciatus	0 (0.0)	0.2 (4.0)	0 (0.0)	0 (0.0)	0.5 (12.0)	0.7 (16.0)	0.5 (12.0)	0.7 (16.0)	0.3 (8.0)	0.5 (12.0)	0.5 (12.0)	0.3 (8.0)	0.32±0.06	4.2
	Ar. subalbatus	4.5 (77.1)	0.8 (14.3)	0.2 (2.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.2 (2.9)	0.2 (2.9)	0.26±0.15	5.8
	Cx. tritaeniorhynchus	0.0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.00±0.00	0.0
	Total	5.2	1.3	0.2	0.0	0.5	0.7	0.5	0.8	0.3	0.5	0.7	0.5	0.70 ± 0.14	11.2
THINNAI	*Ae. albopictus*	1.5 (45.0)	1.0 (30.0)	0 (0.0)	0 (0.0)	0.2 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.2 (5.0)	0.5 (15.0)	0.21±0.09	3.3
	Ae. vittatus	0.2 (16.7)	0 (0.0)	0.2 (16.7)	0 (0.0)	0.2 (16.7)	0 (0.0)	0.2 (16.7)	0 (0.0)	0 (0.0)	0.2 (16.7)	0.2 (16.7)	0 (0.0)	0.08±0.02	1.0
	An. mirans	0.2 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.01±0.01	0.2
	Cx. quinquefasciatus	0 (0.0)	0 (0.0)	0.2 (2.9)	0.7 (11.4)	0.8 (14.3)	0.8 (14.3)	0.7 (11.4)	0.8 (14.3)	0.7 (11.4)	0.3 (5.7)	0.3 (5.7)	0.5 (8.6)	0.45±0.07	5.8
	Ar. subalbatus	4.2 (54.3)	1.2 (15.2)	0 (0.0)	0.3 (4.3)	0 (0.0)	0 (0.0)	0.5 (6.5)	0 (0.0)	0 (0.0)	0 (0.0)	0.2 (2.2)	1.3 (17.4)	0.41±0.16	7.7
	Cx. tritaeniorhynchus	0 (0.0)	0 (0.0)	0 (0.0)	0.2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.01±0.01	0.2
	Total	6	2.2	0.3	1.2	1.2	0.8	1.3	0.8	0.7	0.5	0.8	2.3	1.25±0.14	18.2
Grand Total		11.2	3.5	0.5	1.2	1.7	1.5	1.8	1.7	1.0	1.0	1.5	2.8	1.89±0.17	29.3

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