Dengue Vectors Surveillance in Endemic Areas in Kuala Lumpur City Centre and Selangor State, Malaysia

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Abstract

An ovitrap-based study was initiated to determine the distribution and abundance of dengue vectors, \textit{Aedes aegypti} and \textit{Aedes albopictus}, in four residential areas, Taman Samudera (Gombak, Selangor), Kampung (Kg.) Banjar (Gombak, Selangor), Taman Lembah Maju (Cheras, Kuala Lumpur) and Kampung (Kg.) Baru (City Centre, Kuala Lumpur). Kg. Baru gave the highest ovitrap index in both indoors and outdoors, 89.29\% and 82.35\%, respectively. Kg. Baru also gave the highest mean number of \textit{Ae. aegypti} and \textit{Ae. albopictus} per ovitrap in both indoors and outdoors, compared to Taman Samudera, Kg. Banjar and Taman Lembah Maju. However, the statistical analysis showed that outdoor population of \textit{Ae. aegypti} in 4 study sites was not significantly different from each other ($P>0.05$). The indoor population of \textit{Ae. aegypti}, and indoor and outdoor population of \textit{Ae. albopictus} from Kg. Baru were significantly more than other sites by 1.41- to 488.50-folds ($P<0.05$). This study implicates that \textit{Ae. albopictus} is the dominant outdoor breeder, and it prefers outdoor conditions with more vegetation as observed in Taman Lembah Maju and Kg. Baru. However, Taman Samudera and Kg. Banjar, which are located in rapidly developing areas and have less vegetation, showed less population of \textit{Ae. albopictus} than \textit{Ae. aegypti} even outdoors.

Keywords: Dengue, \textit{Aedes aegypti}, \textit{Aedes albopictus}, surveillance, ovitrap index, mean number larvae, Malaysia.

Introduction

Dengue is endemic in Malaysia. The disease is found mainly in the urban and suburban areas. \textit{Aedes aegypti} and \textit{Ae. albopictus} have been incriminated in the transmission of dengue virus in many urban areas of South-East Asia, including Malaysia.\textsuperscript{1-10} The distribution of \textit{Ae. aegypti} and \textit{Ae. albopictus} in Malaysia overlaps.\textsuperscript{11} Both species are adapting to urban and suburban areas.

Dengue is reported in all the states in Malaysia, with the incidence rate of 135.58 and 158.62 per 100 000 population for the years 2004 and 2005, respectively.\textsuperscript{12} This indicated that there was a 16.99\% increase of the dengue cases in 2005. This deadly disease had claimed the lives of 107 people in 2005, compared to 102 people in 2004.\textsuperscript{13}

The objective of this study was to determine the distribution and abundance of
both *Ae. aegypti* and *Ae. albopictus* in a dengue-endemic site in Selangor state and in Kuala Lumpur city.

**Materials and methods**

**Study areas**

Ovitrap surveillance was conducted in four residential areas: Taman Samudera (Gombak, Selangor), Kampung (Kg.) Banjar (Gombak, Selangor), Taman Lembah Maju (Cheras, Kuala Lumpur) and Kampung (Kg.) Baru (City centre, Kuala Lumpur). The ecological description of the study sites is given in Table 1. The selection criteria of the study sites were based on the frequent reports of dengue cases from these four localities.

The socioeconomic status of the population in the four sites is similar; the residents in the housing area have secondary to diploma education and an average household income of Ringgit Malaysia (RM) 2000 to RM 4000 per month. All four sites are

<table>
<thead>
<tr>
<th>Study site</th>
<th>Ecological description</th>
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<tbody>
<tr>
<td>Taman Samudera</td>
<td>• Urban residential area&lt;br&gt;• 200 double-storey terrace houses covering 30 ha of land&lt;br&gt;• Sparse vegetation&lt;br&gt;• Concrete storm-water drain with clear stagnant water, running through the entire residential site</td>
</tr>
<tr>
<td>Kg. Banjar</td>
<td>• Temporary settlement area with more than 200 houses, built with wood and cement covering 4 ha of land&lt;br&gt;• Discarded rubbish in the entire site&lt;br&gt;• Poor drainage system in the entire site&lt;br&gt;• Scattered vegetation</td>
</tr>
<tr>
<td>Taman Lembah Maju</td>
<td>• Urban residential area&lt;br&gt;• 300 three-storey terrace houses covering 25 ha of land&lt;br&gt;• Concrete storm-water drainage system running through the site, no stagnant water&lt;br&gt;• Vegetation found in this site</td>
</tr>
<tr>
<td>Kg. Baru</td>
<td>• Village&lt;br&gt;• Detached and semi-detached, single and double-storey terrace houses, built with wood and cement covering 15 ha of land&lt;br&gt;• Proper drainage system&lt;br&gt;• Vacant lands and dense vegetation among the houses</td>
</tr>
</tbody>
</table>
within two to 16 km from the city centre and have good infrastructure and good access to all means of communication.

**Climate**

Malaysia has a tropical climate with an average temperature of 32 °C and a relative humidity of 80%. The annual rainfall in all sites exceeds 2000 mm.

**Access to information**

Information is accessible via all major ways, such as mass media, newspapers, radio, television, brochures, Internet and books.

**Local dengue control strategy**

Since these four sites experience high dengue incidence, in every notified case, fogging is being carried out by the Selangor State Vector Control Unit or Kuala Lumpur City Hall within their authority sites. A second round of fogging is also undertaken 7–10 days after the first fogging.

**Ovitrap surveillance**

Ovitraps provided by Lee[14] were used in this surveillance. The ovitrap consists of 300 ml plastic container with straight, slightly tapered sides. The opening measures 7.8 cm in diameter, the base diameter is 6.5 cm, and the container is 9.0 cm in height. The outer wall of the container is coated with a layer of black oil paint. An oviposition paddle made from hardboard (10 cm × 2.5 cm × 0.3 cm) was placed diagonally into each ovitrap. Each ovitrap was filled with tap water to a level of 5.5 cm.

Ovitraps were placed indoors and outdoors in randomly selected houses and each ovitrap was placed around 25 metres apart from other ovitrap. In this study, “indoors” refers to the interior of the house, while “outdoors” refers to outside of the house but confined to the immediate vicinity of the house.[15] As it was not possible to differentiate indoors from outdoors in Kg. Banjar, the 30 ovitraps were placed randomly without any differentiation of indoors and outdoors. Ovitraps in all sites were collected after five days.

Ovitrap surveillance in Taman Samudera and Kg. Banjar was conducted simultaneously (August 2004), while ovitrap surveillance in Taman Lembah Maju and Kg. Baru was conducted sequentially in July 2004 and November 2004, respectively.

**Identification of larvae**

The collected ovitraps were brought back to the laboratory and the contents were poured into a plastic container, together with the paddle. Fresh water was added into the container and the larvae were allowed to hatch and colonize in the laboratory for another nine days. The container was kept covered. A small piece (10 mm) of fresh beef liver was added into each container as larval food. The hatched larvae were subsequently counted and identified at 3rd instar. The larval numbers were recorded individually for each positive ovitrap.

**Data analysis**

Data was analysed as follows:

1. Ovitrap Index (OI), the percentage of positive ovitrap against the total number of ovitraps recovered for each study site.
2. Mean number of Ae. aegypti and Ae. albopictus larvae per recovered ovitrap.
All levels of statistical significance were determined at $P<0.05$ by using the statistical programme, student t-test and one-way ANOVA (SPSS v10).

**Results**

Ovitraps were removed on the fifth day after placement, and an average of 80% of the ovitraps were recovered from each site.

Table 2 describes the ovitrap index (OI), larval numbers obtained per ovitrap in the four sites and the ratio of *Ae. aegypti* to *Ae. albopictus*. Kg. Baru gave the highest ovitrap index in both indoor and outdoor, 89.29% and 82.35%, respectively. Kg. Baru also gave the highest mean number of *Ae. aegypti* and *Ae. albopictus* per ovitrap in both indoor and outdoor compared to Taman Samudera, Kg. Banjar and Taman Lembah Maju. However, the statistical data showed that outdoor populations of *Ae. aegypti* in the four study sites were not significantly different from each other ($P>0.05$). The indoor population of *Ae. aegypti*, and indoor and outdoor populations of *Ae. albopictus* from Kg. Baru, were significantly more than other sites by 1.41- to 488.50-folds ($P<0.05$).

The Figure shows the percentage of *Ae. aegypti* and *Ae. albopictus* larvae collected from the ovitrap surveillance conducted in the four study sites. The results indicated that all sites showed that *Ae. aegypti* was the principal indoor mosquito, with Taman Samudera having the highest percentage of *Ae. aegypti* collected from indoor ovitraps, which was 99.48%. This was followed by Taman Lembah Maju (86.78%) and Kg. Baru (58.58%).

Among the ovitraps placed outdoors, Taman Lembah Maju and Kg. Baru showed that *Ae. albopictus* was the principal outdoor mosquito, with 99.85% and 75.03% of *Ae. albopictus* larvae obtained from total outdoor-collected ovitraps. However, Taman Samudera showed that the principal outdoor mosquito

### Table 2: Comparison of ovitrap index, mean number larvae per ovitrap and ratio of *Ae. aegypti* and *Ae. albopictus* indoors and outdoors in 4 study sites

<table>
<thead>
<tr>
<th>Study site</th>
<th>Ovitrap Index (OI)</th>
<th>Mean number larvae per ovitrap</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indoor</td>
<td>Outdoor</td>
<td><em>Ae. aegypti</em></td>
<td><em>Ae. albopictus</em></td>
<td></td>
</tr>
<tr>
<td>Taman Samudera</td>
<td>38.46%</td>
<td>31.03%</td>
<td>7.69 $\pm$ 3.68 $^a$</td>
<td>0.04 $\pm$ 0.04 $^c$</td>
<td>200.00 : 1.00</td>
</tr>
<tr>
<td>Kg. Banjar</td>
<td>56.52%</td>
<td>10.13 $\pm$ 3.36 $^{a,b}$</td>
<td>8.72 $\pm$ 4.02 $^b$</td>
<td>1.66 $\pm$ 1.49 $^d$</td>
<td>5.27 : 1.00</td>
</tr>
<tr>
<td>Taman Lembah Maju</td>
<td>12.50%</td>
<td>56.67%</td>
<td>5.25 $\pm$ 2.82 $^a$</td>
<td>0.03 $\pm$ 0.03 $^b$</td>
<td>6.56 : 1.00</td>
</tr>
<tr>
<td>Kg. Baru</td>
<td>89.29%</td>
<td>82.35%</td>
<td>27.64 $\pm$ 6.76 $^a$</td>
<td>19.54 $\pm$ 4.89 $^c$</td>
<td>1.41 : 1.00</td>
</tr>
</tbody>
</table>

$^a$ ($F = 5.66$, $P<0.05$)  
$^b$ ($F = 1.84$, $P>0.05$)  
$^c$ ($F = 11.98$, $P<0.05$)  
$^d$ ($F = 18.01$, $P<0.05$)
was the same as indoor, i.e. Ae. aegypti, with 84.01% of total outdoor-collected ovitraps. This
is different from other study sites.

This study also indicated the principal mosquito in Kg. Banjar was Ae. aegypti, with 83.24% from the total collected ovitraps.

The percentage of mixed breeding in all study sites in both indoors and outdoors accounted from 10% to 32% from the total collected ovitraps.

Discussion

According to Sucharit et al.,[16] the habits of Ae. aegypti and Ae. albopictus are different, the former preferring urban areas with less vegetation, biting indoors and ovipositing and breeding in artificial containers, and the latter preferring rural areas with vegetation, biting outdoors and breeding in natural containers and tree holes.

Taman Samudera is an urban residential site, generally clean, the house compound is well-managed by the house owner, and discarded rubbish was not found in this site. This site has less vegetation, thus suitable larval habitats were not available for the breeding of Ae. albopictus, which prefer breeding proximal to vegetation. Ae. aegypti was the principal mosquito indoors and outdoors in Taman Samudera. This site had minimum artificial larval habitats such as containers and tyres. However, the major larval habitat was the clogged concrete storm-water drains with clear stagnant
water. The clear stagnant water from these drains was found to support all stages of *Ae. aegypti* lifecycle. This study conducted by Moo et al. (per comm.) showed that the clear stagnant water from these drains had 6- to 8-folds more eggs, larvae, pupae and adults than in tap water.

Kg. Banjar is a temporary settlement site with more than 200 houses randomly built in the overcrowded 4 ha land and no clear differentiation between indoors and outdoors could be defined. This site also showed high breeding of *Ae. aegypti* with 83.21% from the total collected ovitraps. Observation indicated that *Aedes* can oviposit in all sorts of discarded rubbish around the houses in Kg. Banjar. Beside that, the poor drainage system and abandoned houses also serve as larval habitats for mosquitoes. Some residents in this site also store tap water or rain water for routine use. This may also contribute as larval habitats. The inside of the houses is typically dark and damp, providing a potential resting place for *Ae. aegypti*. Chan[17] reported resting of large numbers of adult *Ae. aegypti* on the clothing, furniture and other articles in dark and damp houses.

In Taman Lembah Maju, the study indicated that *Ae. aegypti* was hardly found outdoors, which had shrubs. The ovitraps were placed near an abandoned building at the centre of Taman Lembah Maju. This abandoned building was surrounded by overgrown shrubs and vegetation, providing the natural ovipositing site for *Ae. albopictus* in this study site. Only indoors, *Ae. aegypti* was found ovipositing with 86.78% of the total positive ovitrap collected. Thus, in Taman Lembah Maju, *Ae. aegypti* were endophilic, while *Ae. albopictus* was exophilic as reported by Thavara et al.[18,19] in Thailand.

Kg. Baru is an urban housing area located at the centre of Kuala Lumpur city centre and has more vegetation than other study sites. Vacant land adjacent to the housing units is overgrown with shrubs and vegetation. Most of the houses have ornamental plants in front of the house and inside the house compound. This may contribute to the ovipositing of *Ae. albopictus*. In this site no significant difference between indoor population densities of *Ae. aegypti* and *Ae. albopictus* was observed ($P>0.05$), and *Ae. albopictus* population was significantly more than *Ae. aegypti* population outdoors ($P<0.05$). This indicated that *Ae. albopictus* do oviposit in both indoors and outdoors. Sulaiman et al.[20] reported a similar observation in Kuala Lumpur where besides *Ae. aegypti*, *Ae. albopictus* was also found to oviposit inside human dwellings. In certain human dwellings/habitats, *Ae. albopictus* were ovipositing inside the premises and was dominant in population than *Ae. aegypti*.

According to this study, *Ae. albopictus* was the dominant outdoor breeder, but it prefers outdoor conditions with more vegetation as observed in Taman Lembah Maju and Kg. Baru. However, Taman Samudera and Kg. Banjar, which located in a rapid developing area, which has less vegetation showed less population of *Ae. albopictus* than *Ae. aegypti* even outdoors.

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