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Environmental and Social Conditions Prevailing Dengue Fever Outbreak in Pasir Mas District, Kelantan State, Malaysia, 2010

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Abstract

A dengue outbreak occurred in Pasir Mas District, Kelantan, Malaysia during 2010. We conducted an investigation to describe the clinical and epidemiological characteristics of cases, determine risk factors for transmission and recommend appropriate control measures. A dengue case was defined as an individual with acute febrile illness and two or more of the following symptoms: rash, arthralgia, headache, myalgia, retro-orbital pain, hemorrhagic manifestation or leucopenia. Environmental surveys were done to search for *Aedes* species. A matched case-control study was done. From 5 May to 12 Aug 2010, total 465 cases were identified, with male to female ratio as 1.2:1. Most cases (34%) belonged to 11-20 years old group, followed by those aged 21-30 years (14%). Cases were mostly students (40%) or rubber tappers (15%). *Aedes aegypti* and *Aedes albopictus* species were identified in the district while many cases resided in areas with *Aedes* index of more than 1% and breteau index of more than 5%. Risk factors for getting dengue infection were presence of discarded containers within household premises (adjusted OR = 15.1, 95% CI = 5.41-41.97) and not using protective measures (adjusted OR = 3.9, 95% CI = 1.21-12.55). Control activities focused on mass clean-up and health education campaigns in affected communities. As a conclusion, this outbreak involved active individuals, and contributed by presence of breeding containers and not using personal protective measures.

Keywords: dengue, *Aedes*, disease outbreak, case-control study

Introduction

Dengue is found in tropical and sub-tropical regions, predominantly in urban and semi-urban areas. There are four distinct serotypes of dengue virus (DEN 1, 2, 3 and 4), which are transmitted by *Aedes* mosquitoes. Although infection with one dengue serotype provides lifelong immunity to that serotype, there is no cross-protective immunity to other serotypes.[1] Symptoms usually appear after incubation period of 4-10 days and last for 2-7 days. Dengue virus infections can be asymptomatic or lead to undifferentiated fever, dengue fever (DF), dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS).[2]

In Malaysia, dengue is one of the notifiable diseases. All medical practitioners who diagnose dengue cases must report them to the nearest district health office.[3] Verification, investigation and control activities are carried out within 24 hours of notification by district health staff (Figure 1). Criteria for a dengue outbreak are occurrence of at least two cases in 14 days within an area of 400 km or at least two cases in 14 days with the epidemiological linkage.[4]

In May 2010, there were increased reported dengue cases from Pasir Mas District of Kelantan Province. Pasir Mas District has an area of 577.52 km^2, with a population of 206,400. It is bordered by Thailand to the west (Figure 2). Pasir Mas has a tropical climate, with 21-32°C temperature and intermittent rain throughout the year. There are many small rubber plantations in the area.[5] Pasir Mas was not a dengue problematic district. The incidence rate in 2009 was 56 per 100,000 population. The incidence was low compared to the incidence rate of Kelantan State (63.1 per 100,000 population) and the weekly number of cases for 5-year median was less than 10 cases. This district never experienced more than two localities of dengue outbreak at one time.

Since the number of reported dengue cases was much more than the median number reported during the past five years, we conducted an investigation to describe the clinical and epidemiological characteristics of cases, determine the risk factors for transmission and recommend appropriate control measures.

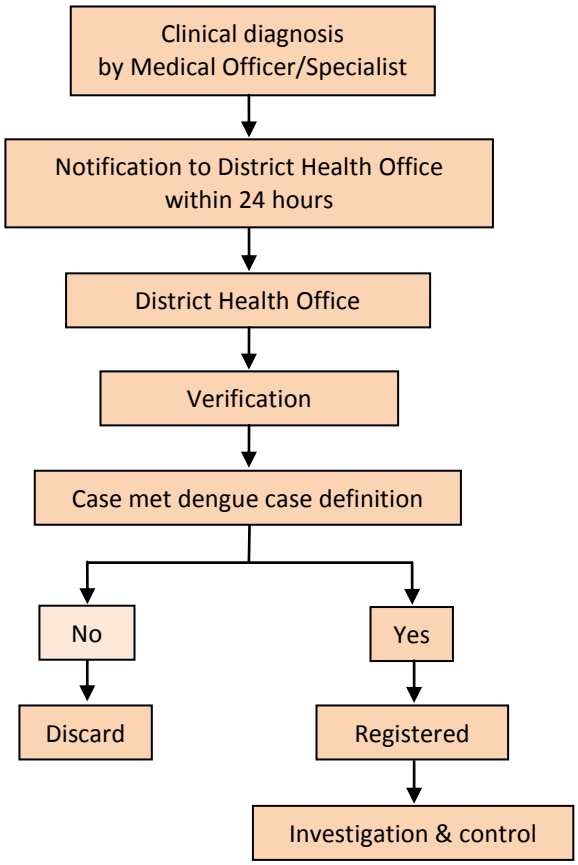

Figure 1. Dengue surveillance and response system in Malaysia, 2010

Methods

Descriptive Study

We reviewed case report forms of dengue cases that were reported from Pasir Mas District during 5 May to 12 Aug 2010. A dengue case was defined as an individual with acute febrile illness and two or more of the followings: rash, arthralgia, headache, myalgia, retro-orbital pain, hemorrhagic manifestation or leucopenia. Definitions were set up for all variables under interest as well (Table 1).

Blood samples were collected from some hospitalized cases for dengue IgM antibody detection by enzyme-linked immunosorbent assay (ELISA).[6]

Environmental Investigation

Households of the reported cases were visited and premises were searched for possible *Aedes* breeding sites within 50 meter radius from the house. Possible breeding containers were inspected for presence of *Aedes* larvae. If no larvae were detected, the search was widened up to 200 meter radius. *Aedes* index (AI) more than 1% and/or breteau index (BI) more than 5% indicated dengue sensitive areas. The following indices were computed for area around each house:[4]

$$\text{Aedes Index (AI)} = \frac{\text{Number of premises positive for } \textit{Aedes} \text{ larvae}}{\text{Number of premises inspected around the case's household}} \times 100$$

$$\text{Breteau Index (BI)} = \frac{\text{Number of containers positive for } \textit{Aedes} \text{ larvae}}{\text{Number of premises inspected}} \times 100$$

Case-control Study

We conducted a 1:1 matched case-control study with 80 subjects in each group. Cases who met the surveillance dengue case definition were selected among those reported by the surveillance system from 25 Jul to 14 Aug 2010 with systematic sampling until

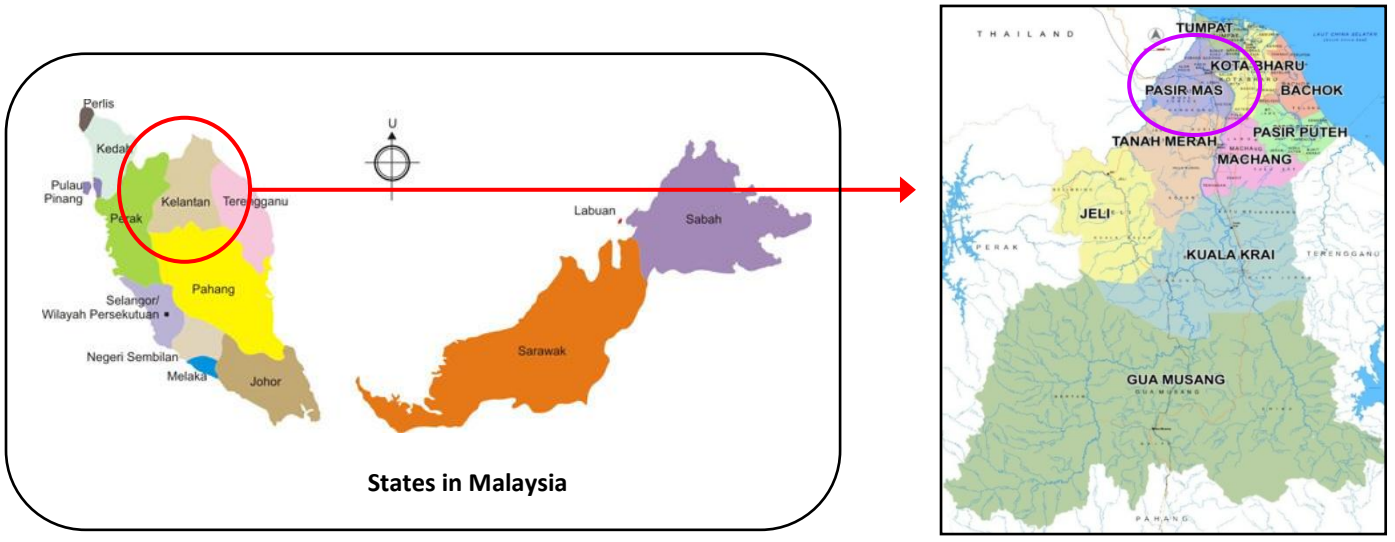

Figure 2. Location of Pasir Mas District, Kelantan, Malaysia

Table 1. Definitions of the variables under interest

No.	Variable	Definition
1	House in the estate	The house was located inside the estate, regardless the type of estate.
2	Often outside house in the morning and evening	Spent at least 30 minutes outside the house in the morning or evening
3	Protective measures	long-sleeved shirt and pant, using of mosquito net, spray, coil or repellent
4	Water container inside the house	Presence of any container to collect the water inside the house
5	Ant trap	Presence water container to trap the ant, usually put under the legs of table
6	Open well	Presence of open well inside or outside the house
7	Flower pot plate	Presence of water collector under the flower pot
8	Water container for bird drinking	Presence of water container which used as drinking water for birds
9	Bamboo stump	Presence of bamboo stump which can collect the rain water in the house compound
10	Water container outside the house	Presence of any container to collect the water outside the house, including rain water or tap water
11	Latex collector cup	Presence of any container used for latex collector, including bowl or coconut shell
12	Disposable container	Present of disposable container in the compound such as unused bottles, cans, plastic containers, polystyrene as there was no proper solid waste disposal
13	Tyre	Presence of unused tyre outside the house
14	Water container for animals	Presence of water container for drinking by cow, goat or other animals

the required sample size was reached. The cases were randomly and independently selected, and had equal variance. Controls were asymptomatic individuals from the nearest house without any ill family member and were matched for age. Face-to-face interviews of both cases and controls were conducted by five staff who were trained to use a standard questionnaire, and obtain information on demographic characteristics and possible behavioral risk factors such as using of protective measures against mosquitoes. In addition, inspection of the subjects' premises was done to identify the environmental variables such as location of houses, and presence of water containers and disposable containers. Data were analyzed using SPSS version 13.0 (SPSS Inc., Chicago III) to calculate odds ratio (OR) and 95% confidence interval (CI). Logistic regression was also performed for all variables and those with p-value less than 0.05 were included in the multivariate model.

Results

Dengue Surveillance

From 5 May to 12 Aug 2010, there were total 465 dengue cases reported in Pasir Mas District. Blood samples were collected from 210 cases, and of these, 162 (77%) were positive for dengue IgM antibody.

All the cases presented with fever, and other associated common symptoms were myalgia (95%), headache (95%), vomiting (73%) and arthralgia (65%) (Figure 3). About 64% (298/465) of the cases were hospitalized while there were four fatalities, with case fatality rate of 0.9%. During 2010, the number of cases began to increase in May (the epi week 20), reached the peak in August and then, declined to normal level by the end of October (Figure 4). The cases were distributed throughout the district.

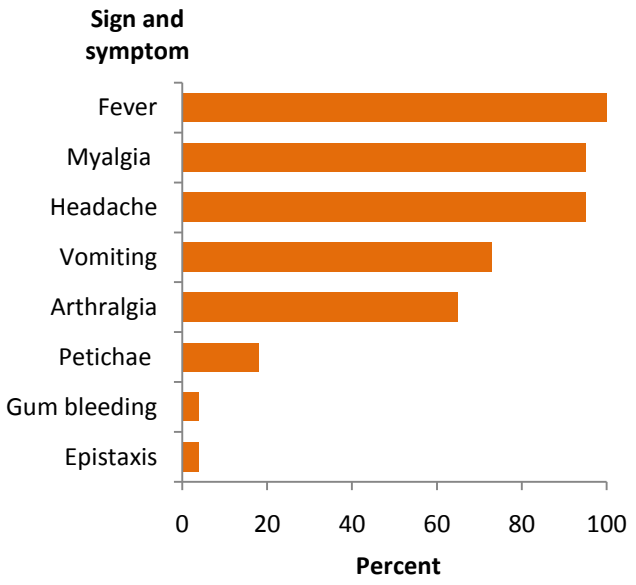

Figure 3. Signs and symptoms of dengue cases in Pasir Mas District, Kelantan, Malaysia, 5 May to 12 Aug 2010 (n=465)

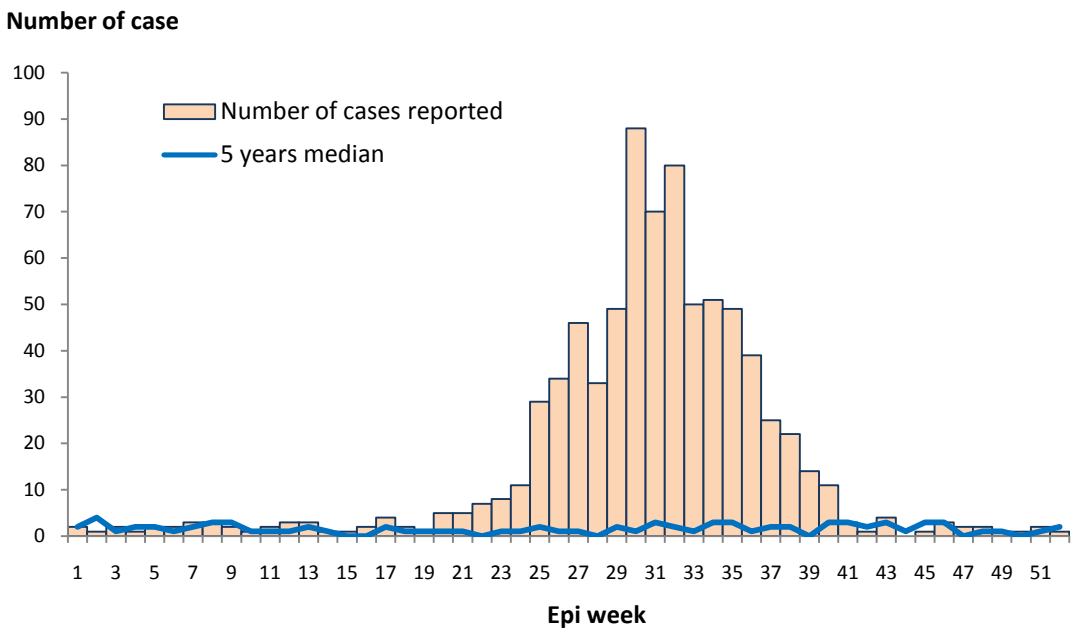

Figure 4. Number of reported dengue cases by week in Pasir Mas District, Kelantan, Malaysia, January to December 2010 (n=465)

The male to female ratio was 1.2:1. Most cases (34%) were 11-20 years of age, followed by those aged 21-30 years (14%). Cases were mostly students (40%) or rubber tappers (15%) (Table 2).

Table 2. Demographic characteristics of dengue cases in Pasir Mas District, Kelantan, Malaysia, 5 May to 12 Aug 2010 (n=465)

Characteristic	Number	Percent
Gender		
Male	251	54.0
Female	214	46.0
Age group (year)		
1-10	53	11.4
11-20	160	34.4
21-30	65	14.0
31-40	62	13.3
41-50	57	12.3
51-60	41	8.8
61-70	21	4.5
>70	6	1.3
Occupation (n=453)		
Student	182	40.2
Rubber Tapper	67	14.8
Self-employed	47	10.4
Housewife	40	8.8
Government worker	37	8.2
Private sector worker	36	7.9
Unemployed	37	8.2
Pre-school age children	7	1.5

Environmental Survey

Majority of houses in the district had no proper solid waste disposal. There were many discarded containers in the area such as plastic bottles, styrofoam food containers, broken glass containers and coconut shells (Figure 5). In rubber plantations, the rubber taps could also be breeding sites for *Aedes spp*.

Figure 5. Containers for mosquito breeding sites in Pasir Mas District, Kelantan, Malaysia, 2010

All houses where the reported cases lived, except one house, were visited by a district health team. The team inspected premises for larvae of *Aedes aegypti* and *Aedes albopictus* species. About 39% (182/464) of the reported dengue cases lived in areas with *Aedes* positive containers (within 200 meter radius from houses) while 99% (180/182) of the cases were with

more than 1% AI and 63% (115/182) with more than 5% BI.

Case-control Study

There were total 160 respondents (80 cases and 80 controls). Demographic characteristics of the cases and controls were similar (Table 3).

Table 3. Demographic characteristics of cases (n=80) and controls (n=80) in Pasir Mas District, Kelantan, Malaysia, 5 May to 12 Aug 2010

Characteristic	Number of case (%)	Number of control (%)	P-value
Gender			
Male	44 (55.0)	34 (42.5)	
Female	36 (45.0)	46 (57.5)	0.11
Ethnic			
Malay	79 (99.0)	77 (96.3)	
Non-Malay	1(1.3)	3 (4.0)	0.13
Mean age (year)	30.6	34.9	0.15
Educational status	(n=78)	(n=80)	
None	1 (1.3)	9 (11.3)	
Primary	21 (27.0)	22 (27.5)	
Secondary	46 (59.0)	42 (52.5)	
Tertiary	10 (12.8)	7 (9.0)	0.18

In univariate analysis, statically significant risk factors were presence of discarded containers and drinking water containers for animals in the premises, not using protective measures against mosquitoes, living in a rubber plantation, and staying outside the house in the mornings and evenings. These variables were included in multiple logistic regression model. Two factors that still showing statistically significant risks for contracting dengue were presence of discarded containers in the premises (adjusted OR = 15.1, 95% CI = 5.41-41.97) and not using protective measures such as mosquito repellent and long-sleeved clothing (adjusted OR = 3.9, 95% CI = 1.21-12.55) (Table 4).

Discussion

High AI and BI demonstrated that conditions in Pasir Mas District were favourable for breeding of *Aedes* mosquito and transmission of dengue virus. Lack of proper sanitary waste disposal in the area resulted in many disposable containers around the houses that served as mosquito breeding sites. The case-control study showed that those living in houses with disposable containers in the premises were more likely to get dengue infection.

Most of the cases were students or young adults working in rubber plantations. Rubber taps in plantations might collect rain water and serve as *Aedes* breeding sites. Workers in these sites might get infected while working in the plantations. Students could also expose while walking to school and passing through rubber plantations or premises with mosquitoes in the mornings and late afternoons. *Aedes* mosquitoes usually bite after sunrise and before sunset.[5]

The affected age group in this outbreak was similar to that of reported in Malaysia during 1991-2000, with most cases were in young and middle age groups.[7] More children were infected probably because adults in the endemic areas might have been infected and developed immunity to the circulating serotypes.

Non-use of protective measures while living in a dengue endemic area was a risk factor as well. A study conducted by Norli and Azmi in Johor during 2006 found that those living in houses with unscreened windows (OR = 4.2, 95% CI = 1.72-10.44) and those who did not wear long-sleeved clothes (OR = 5.4, 95% CI = 1.02-29.03) were at risk of acquiring dengue infection.[8] In our study, although we did not observe specific measures like having screened windows, the risk of getting infected without using any protective measure was significant (OR = 3.9, 95% CI = 1.21-12.55).

Table 4. Multivariate analysis of risk factors for dengue in Pasir Mas District, Kelantan, Malaysia, 25 May to 12 Aug 2010

Risk factor	P-value	Adjusted odds ratio (OR)	95% CI
Presence of disposable containers (e.g. bottles, styrofoam containers, coconut shells) in premise	<0.01	15.1	5.41-41.97
Not using protective measures (insect repellent, long-sleeved clothing, mosquito coil, mosquito net)	0.02	3.9	1.21-12.55
House located in a rubber plantation	0.20	1.9	0.71- 4.90
Often stay outside the house in the mornings and evenings	0.31	1.6	0.63-4.01
Presence of water container for animal in premise	0.90	0.9	0.15-5.51

Limitations

Since all cases were not laboratory confirmed, some of them might be other illnesses. In 2009, there was an outbreak of chikungunya in Malaysia, including Kelantan.[9] Dengue and chikungunya viruses can both be transmitted by *Aedes* species and clinical manifestations are similar.[10]

The questionnaire used in the case-control study did not obtain information about specific protective measures like wearing long-sleeved clothing, using insect repellents or having screened windows at home. Furthermore, during the environmental survey, the team did not note down the type of disposable containers found positive for *Aedes* larvae. Noting specific risk behaviors and breeding sites in the area could have been helpful for providing education campaign to the residents. In addition, as the existing surveillance system was passive surveillance, mild cases did not attend health care facilities might be missed.

Conclusion

There was a dengue outbreak in Pasir Mas District in 2010 which lasted for about five months. Environmental conditions and without utilizing the protective measures contributed to the outbreak.

Public Health Action and Recommendations

Although district health teams conducted fogging operations in response to detection of *Aedes* positive containers around the premises, the effects were only temporary since the underlying conditions favoring the breeding of mosquitoes continued to provide an opportunity for dengue transmission. Intensive community education and clean-up campaign could stop further spread of the disease. Therefore, local health staff conducted health education campaigns in schools and mosques to encourage residents to clean up their premises and use protective measures.

In addition, we recommended that local authorities should improve solid waste disposal system in the area, and a recycling program was designed and implemented in the communities in order to reduce the number of discarded containers in the premises.

Regular larval surveys should be done in order to identify dengue sensitive areas and preventive measures should be instituted regularly before outbreak starts. Multi-sectoral collaboration was necessary to prevent and control dengue outbreaks as well.

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Suggested Citation

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