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ORIGINAL ARTICLE

A CASE-CONTROL STUDY ON FACTORS AFFECTING THE INCIDENCE OF DENGUE FEVER IN JOHOR BAHRU

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ABSTRACT

Introduction : Johor Bahru has one of the highest rates of dengue disease in this country in spite of the implementation of COMBI (Communication for Behavioural Impact) in 2001.

Methods : To identify factors contributing to this problem, a case control study was conducted, focusing on risk factors such as the weather (rainfall and temperature), environment and sociodemography. Cases were selected from confirmed dengue cases from January to June, 2006. Controls were selected from patients who had no past history of having dengue illness from Health Clinics in Johore Bahru. Both case group and control group were matched by age and sex. All risk factors were analysed using SPSS version 11.5.

Results : Results from time-series analysis indicated that the cases of dengue illness were related to changes in the minimum temperature ($r = -0.149$; $p<0.05$). It was also shown that the number of dengue illness on a particular week were affected by changes of the minimum temperature at two weeks prior, during that particular week and the week after. As for other risk factors, multivariate analysis indicated that those who were unmarried (Odd ratio (OR): 2.7; 95% Confidence Interval (CI): 1.34 – 5.65), not wearing long sleeve clothes (OR: 5.4; 95% CI: 1.72 – 10.44) and whose homes were not protected with screen windows (OR: 4.2; 95% CI: 1.02 – 29.03) were at higher risk of contracting dengue. Other analysis indicated that the implementation of COMBI improved the knowledge and attitude about combating dengue but did not protect them from the illness.

Conclusion : The high rate of dengue illness in Johor Bahru is due to presence of risk behaviour such as lack of personal and home protection which exposed them to the dengue vector, *Aedes spp*. There is also a need to enhance the COMBI activities, to better protect the population from dengue illness.

Keywords : Dengue illness, Johore Bahru, weather factors, environment and sociodemography factors

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INTRODUCTION

Currently the number of dengue cases reached 100 million while cases of dengue haemorrhagic fever disease have reached 500,000 every year all over the world. Asia recorded fatal cases of 0.5% - 3.5%[1]. The problem with dengue illness is not limited to Malaysia only, since it also affected many other countries in the world[2]. Therefore, in 1999, WHO came up with a strategic plan to prevent dengue illness which emphasized on five elements: Integration of society and intersectorial with vector control in a risk area, active dengue surveillance based on health information, initial plan for epidemic, training to all level of staff and conduct a vector control. For integration of society and intersectorial with vector control in a risk area, WHO has introduced COMBI (Communication for Behavioural Impact) with its concept: M-RIP ('massive, repetitive, intense, and persistent). In Johor Bahru, COMBI was implemented with the hope that it would change the attitude and behaviour of the population for the better. COMBI emphasized on inspecting, finding and destroying any potential breeding area within and outside of the house for 30 minutes every week. Another message from COMBI is to get early medical treatment if there is any fever. Such messages were spread using pamphlets and buntings. If properly implemented, the potential breeding area for *Aedes spp* would be reduced therefore hopefully reducing the incidence of dengue case[3]. The number of dengue cases in Johore Bahru have dropped since COMBI was implemented in 2001 but in 2005, the numbers went up again till it was twice as much as before[4]. It is not surprising since Malaysia with the optimum temperature of 26^{o} C and incremental of 1.5^{o}C and rainfall of more than 300 millimetres has made it an ideal condition for the vector dengue, *Aedes spp* survival[4, 5].

Besides weather, sociodemography also play a role as one of the risk factors for dengue. A study[6] at Rio de Janeiro showed that the migration of population from lower socioeconomic group to the cities had created slums which had poor sanitation and degrading environment. Risky behaviours among them created and enhanced more potential breeding grounds for Aedes spp. The improper dumping of garbage like used tires, empty tin cans or food containers under shades like the trees would provide a main food source (detritus) for larvae of *Aedes spp***.** This would encourage them to complete their lifecycle much earlier than usual[7]. Norris[8] in 2004 also found that land use within 0.16 km of the house would increase the risk exposure to *Aedes spp***.** 2.5 times higher.

The aim of this study is to look at the distribution of dengue illness in Johore Bahru and factors affecting it.

MATERIALS AND METHOD

This is a case-control study. A list of dengue patients who fulfilled the inclusion criteria, was obtained from the computerised vector surveillance programme (VEKPRO), Health Office, Johore Bahru from January till June, 2006. With systematic randomised sampling technique, 77 respondents for each group of case and control were selected. Matching was done by age and sex. All of them were interviewed by using questionnaires. All data were coded, entered and analysed in SPSS 11.5. Daily rainfall and temperature data from January till June, 2006 were collected from Meteorology Department of Malaysia, Petaling Jaya[9].

RESULTS

In this study, 50.8% of 707 cases which were notified and recorded in Vekpro system had been confirmed of dengue disease through serology test. On average, the number of dengue cases in a week were 28, the highest recorded was 65 in sixth and seventh week. However, the number of cases decreased in the twelfth week which was 7 to 19 cases till the 26th week.

Rainfall and Temperature

Comparing between number of cases and rainfall, it showed that there was a positive relationship between cases and rainfall till the tenth week only (Figure 1). However, there was no relationship between both after the tenth week despite heavy rain of more than 300mm ($r = 0.211$, $p>0.05$).

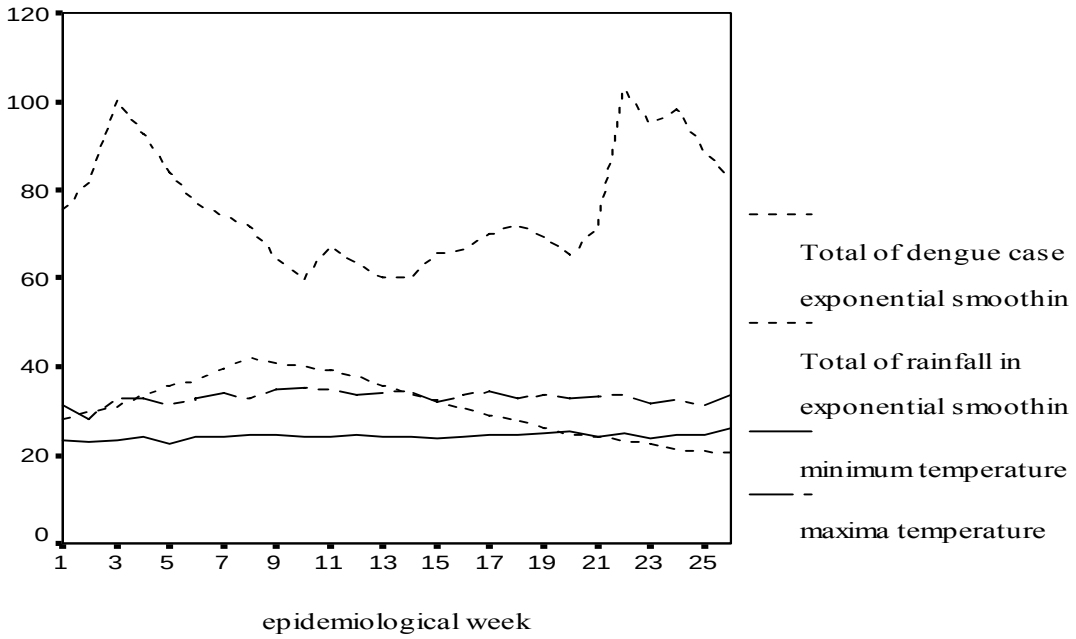

Figure 1 Dengue case, rainfall and temperature distribution according to Epidemiology week

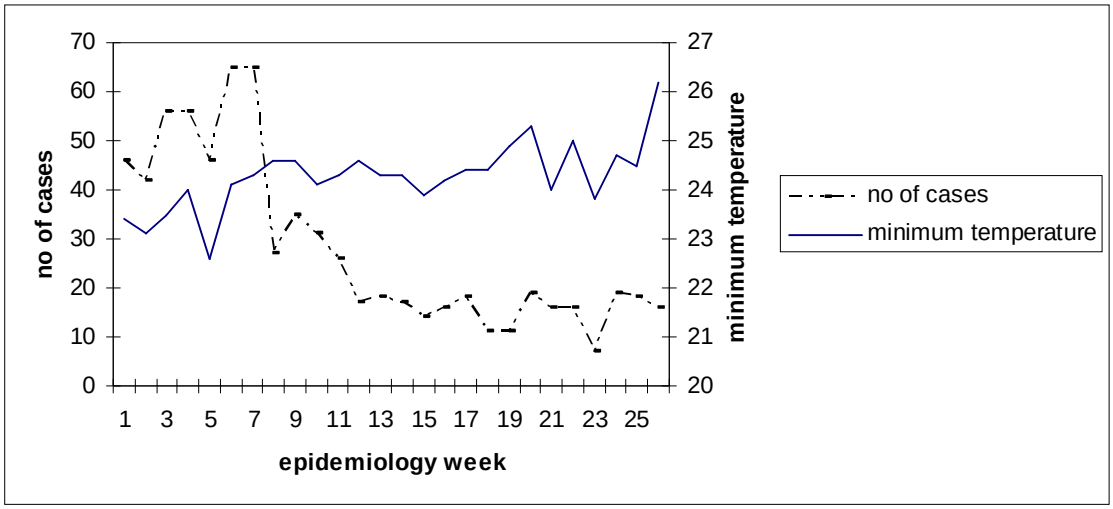

Figure 2 Number of cases and minimum temperature according to epidemiology week.

The changes of minimum temperature showed a significant correlation to the number of dengue diseases (r = -0.459; p<0.05). Time lag for changes of minimum temperature was 0, 1 and -2; meaning that we can predict the increase the case on two week prior, on that week and a week later using the changes of the minimum temperature (Figure 3). There was no correlation between the maximum temperature and the number of dengue cases.

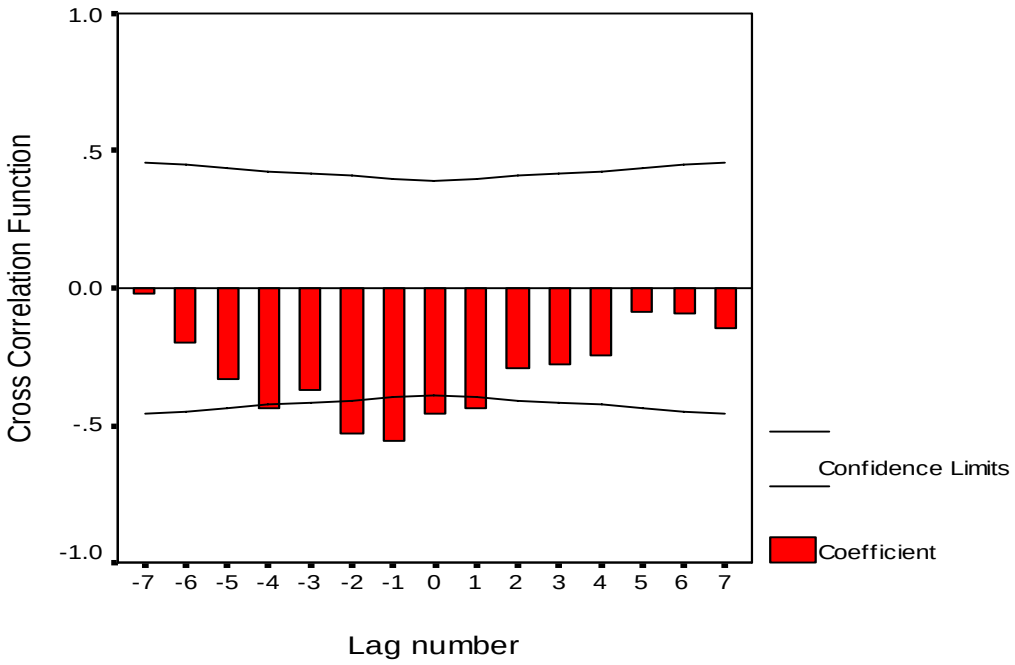

Figure 3 Cross-correlation function between case and minimum temperature

Sociodemography

Out of 154 respondents, 73 respondents (47.4%) were males and 82 respondents (53.2%) were females. Mean age for the case group was 31.62 ± 1.80 and mean age for the control group was 31.92 ± 10.939. Majority of the respondents were Malays (68.2%), followed by Chinese (20.1%) and Indians (7.1%).

In term of education, 70.8% of respondents had secondary level of schooling and 20% had tertiary level. There were 94 respondents (61%) who were married and 60 (39%) who were still single. A total of 125 of the respondents (81.1%) were currently employed while the rest were currently unemployed. Table 1 showed the sociodemographic factors of the case group and the control group. The only significant sociodemographic difference between two groups were that the case group had more singles compared to the control group (p=0.03) in term of marital status.

Table 1 Distribution of sociodemographic factors among case group and control group.

Sociodemographic factors	Case (n =77)	Control (n =77)	Test	p value
Age				
mean ± s.d	31.62± 11.80	31.92± 10.40	*t*= 0.13	0.871
Sex				
Male	37 (48.1%)	36 (46.8%)	$\chi2$=0.026	0.872
Female	40 (51.9%)	41 (53.2%)		
Race				
Malays	49 (63.6%)	56 (72.7%)	$\chi2$=1.467	0.226
Non-Malays	28 (36.4%)	21(27.3%)		
Educational level				
Primary	6 (7.8%)	8 (10.4%)		
Secondary	56 (72.7%)	53 (68.8%)	$\chi2$=0.401	0.819
Tertiary	15 (19.5%)	16 (20.8%)		
Marital Status				
Single	39 (50.6%)	21(27.3%)	$\chi2$=8.847	0.003*
Married	38 (49.4%)	56 (72.7%)		
Type of occupation				
Self	10 (13%)	7 (9.1%)		
Private	42 (54.5%)	40 (51.9%)	$\chi2$=1.997	0.573
Government	10 (13.0%)	16 (20.8%)		
Not working / housewife	15 (19.5%)	14 (18.2%)		
Time going to work				
Before 8 am	45 (72.6%)	38 (60.3%)	$\chi2$=2.106	0.147
After 8 am	17 (27.4%)	25 (39.7%)		
Time going back home				
Before 8 pm	33 (53.2%)	43 (68.3%)	$\chi2$=2.961	0.085
After 8 pm	29 (46.8%)	20 (31.7%)		

*p value is significant if p<0.05

Living Condition

The respondents lived in various types of houses. The types of houses were terrace houses (46.1%), kampong type houses (22.1%) and flats (31.8%). Out of 154, 68 (44.2%) kept their surrounding open, 42 (27.3%) had small (mini) garden, 29 (18.8%) did not have or had little space while only 15 (9.7%) had both mini garden and open space. Most of the respondents (98.7%) had land usage within 100 metres from their houses and two had land usage within 200 metres from their house. A total of 38.3% (59) of the respondents kept empty containers outside their houses. The distribution of the above factors between the case and control group can be seen in table 2. Although these factors were deemed to be important for the breeding of the dengue vectors, statistical analysis showed that none of these risk factors were found to be significant except for the presence of empty containers at outside the house between this two groups (p = 0.031). A total of 29.9% of case group and 46.8% of control group had empty containers outside the house. It was as though the presence of empty containers is a protective factor against dengue fever.

Table 2 Distribution of house type and the condition of the surrounding areas between case and control group

Type of house and its environment	Case (n=77)	Control (n=77)	Test	p value
Type of house				
kampung-type	18 (23.4%)	16 (20.8%)		
Terrace	40 (51.9%)	31 (40.3%)	$\chi 2=3.728$	0.155
Flat	19 (24.7%)	30 (39.0%)		
House to house distance				
< 100m	77 (100%)	75 (97.4%)	Yates correction = 0.51	0.48
100-200m	0 (0%)	2 (2.6%)		
Environmental condition outside of the house				
No space	17 (22.1%)	12 (15.6%)		
Open space	33 (42.9%)	35 (45.5%)	$\chi 2=7.178$	0.066
Mini garden	24 (31.1%)	18 (23.4%)		
Mini garden and open space	3 (3.9%)	12 (15.6%)		
Presence of empty container at outside house				
Present	23 (29.9%)	36 (46.8%)	$\chi 2=4.643$	0.031*
Absent	54 (70.1%)	41 (53.2%)		
Presence of land use nearby the house				
Present	24 (31.2%)	27 (35.1%)	$\chi 2=0.264$	0.607
Absent	53 (68.8%)	50 (64.9%)		

* p value is significant if $p<0.05$

COMBI (Communication for Behavioural Impact)

If we look at the respondents' location according to COMBI areas, there were more cases (58%) living in COMBI areas compared to controls (38%) (Table 3).

Generally, only 59 out of 154 respondents were aware about COMBI and its activities. Out of these 59, only 45 (76.7%) really understood it well. It is shown that those with COMBI activities in their area might have increased their knowledge (Table 3). However, only 40 (55.5%) respondents from COMBI area were aware and understood about COMBI and its activities (Table 4).

Table 3 Distribution of COMBI activities and awareness among case group and control group.

	Case (n=77)	Control (n=77)	Test	p value
Area involved with COMBI				
Yes	45 (58%)	27 (35%)		
No	32 (42%)	50 (65%)	$\chi 2$ =8.45	0.004*
Total	77 (100%)	77 (100%)		
Have you ever heard /knew about COMBI?				
Yes	20 (26.0%)	39 (50.6%)		
No	57 (74.0%)	38 (49.4%)	$\chi 2$=9.92	0.002*
Total	77 (100%)	77 (100%)		
If yes, what do you understand of COMBI?				
1. Poor understanding	4 (20%)	10 (25.6%)		
2. To search water-filled container within and outside the house	13 (33.3%)	13 (33.3%)		
3. Dengue Prevention Program	12 (60%)	13 (33.3%)		
4. To seek treatment earlier if having fever	0 (0%)	1 (2.6%)		
5. To search, destroy water-filled container and seek earlier treatment if had fever	2 (20%)	2 (5.1%)		
Total	20	39		

* p value is significant if p<0.05

Table 4 Awareness and understanding of COMBI between respondents from COMBI area and non- COMBI area.

		Respondents from COMBI		test	p value
		Yes	No		
Awareness / understood about COMBI	Yes	40 (55.6%)	19 (23.2%)	χ^2 =17.01	0.00004*
	No	32 (44.4%)	63 (76.8%)		
	Total	72	82		

* p value is significance if p<0.05

At Risk Behaviour

Table 5 shows the score for protective behaviour, those who don't keep water in containers, those who cover the water-filled containers and the frequency of cleaning the container between case group and control group. A total of 33 (42.9%) of the cases and 47 (61%) of the controls kept water in their home. Surprisingly this was statistically significant (p = 0.024), as though keeping water-filled containers is a protective factor against dengue fever. None of the risk behaviours were found to be significantly related to the incidence of dengue except for keeping water-filled containers at home.

Table 5 The risk / protective behaviour distribution between case and control group.

Protective/risky behaviour among respondents		Case (n=77)	Control (n=77)	Test	p value
Protective behaviour score	<75%	65 (50.8%)	63 (49.2%)	$\chi2$=0.19	0.67
	>75%	12 (46.2%)	14 (53.8%)		
Kept water in a container	Do	33 (42.9%)	47 (61.0%)	$\chi2$=5.10	0.02*
	Don't	44 (57.1%)	30 (39.0%)		
If you keep water, how long do you keep the water?	≤ 1 week	31(93.9%)	39 (83.0%)	$\chi2$=2.13	0.14
	≥ 1 week	2 (6.1%)	8 (17%)		
	Total	33	47		
If you keep water, do you use container with a cover?	Do	25 (75.8%)	28 (59.6%)	$\chi2$=2.27	0.13
	Don't	8 (24.2%)	19 (40.4%)		
	Total	33	47		
If you keep water, how often do you clean your water container?	≤ 1 week	22 (100%)	40 (90.9%)	$\chi2$=2.129	0.145
	≥ 1 week	0 (0%)	4 (9.1%)		
	Total#	22	44		

* p value is significant if p <0.05

Total number excludes those who didn't keep water (74) and who didn't clean the containers.

A total of 97 respondents (63%) claimed that they have done inspection inside and outside the house to detect any water-filled containers while the rest did not. Among those who did inspection (97), only 89 do it every week while the rest do it less frequently. However, there was no significant difference of inspection habits between the case and control group (Table 6).

Table 6 Distribution of inspection habits between the case and control group

		Case (n=77)	Control (n=77)	Test	p value
Do you inspect your house to find any water-fill container?	Yes	44 (45.4%)	53 (68.8%)	$\chi2$=2.26	0.133
	No	33 (42.9%)	24 (31.2%)		
	Total	77	77		
How frequent do you do that ?	≤ 1 week	43 (92.7%)	46 (86.8%)	Yates correction =2.49	0.11
	≥ 1 week	1 (12.5%)	7 (13.2%)		
	Total	44	53		
What will you do if you found breeding in the container ?	≤ 3 from 5 activities*	72 (93.5%)	69 (89.6%)	$\chi2$=0.76	0.39
	3 -5 activities	5 (6.5%)	8 (10.4%)		
	Total	77	77		

As for seeking early treatment, mean period of time to seek treatment for case group was 1.66 ± 1.11 days while mean period of time to seek treatment for control groups was 2.19 ± 1.16 days. Mann-Whitney test showed that there was a significance difference of duration period of seek treatment between cases group and control group ($z = 3.22$; $p= 0.001$). This was expected since those who have been exposed to COMBI and its activities would know the consequences if they seek treatment late.

Table 7 showed a list of risk factors and protective factors between the case group and control group. Almost all were significantly related to occurrence of dengue illness. For risk factors, only the presence of a refrigerator (case 67.5%, control 50.6%) was found to be related in causing dengue illness. Surprisingly, presence of empty house (case 33.8%, control 63.6%), water–filled containers (case 46.8%, control 32.5%) and improper garbage dumping (case 10.4%, control 32.5%) were found to be significantly related in protecting against dengue. As for the protective factors such as screen windows, screen doors and wearing long sleeves and pants, all were found to be significantly related in protecting against dengue except for using bed net and repellent or aerosol.

Table 7 Distribution of protective and causative risk factors distribution between case group and control group.

Risk factors		Case (n=77)	Control (n=77)	Test	p value
Empty house	Present	25 (33.8%)	49(63.6%)	χ^2= 14.98	0.0001*
	Absent	52 (67.5%)	28(36.4%)		
Water-filled container	Present	36 946.8%)	54 (70.1%)	χ^2= 8.66	0.003*
	Absent	41 (53.2%)	23 (29.9%)		
Improper garbage dumping	Present	8 (10.4%)	25 (32.5%)	χ^2= 11.15	0.001*
	Absent	69 (89.6%)	52 (67.5%)		
Refrigerator	Present	52 (67.5%)	39 (50.6%)	χ^2= 4.54	0.03*
	Absent	25 (32.5%)	38 (49.4%)		
Screen window	Present	8 (10.4%)	28 (36.4%)	χ^2= 14.50	0.00014*
	Absent	69 (89.6%)	49 (63.6%)		
Screen door	Present	6 (7.8%)	26 (33.8%)	χ^2= 15.78	0.000007*
	Absent	71 (92.2%)	51 (66.2%)		
Repellent	Present	51 (66.2%)	61 (79.2%)	χ^2= 3.27	0.07
	Absent	26 (33.8%)	16 (20.8%)		
Bed net	Present	9 (66.2%)	7 (9.1%)	χ^2= 0.28	0.58
	Absent	68 (88.3%)	70 (90.9%)		
Wearing long sleeves and pants	Present	2 (16.7%)	10 (83.3%)	χ^2= 5.78	0.01*
	Absent	75 (52.8%)	67 (47.2%)		

* p value is significant if $p<0.05$

Multiple logistic regression test was done and results indicated that those who were single had 2.7 higher risk, those whose home not protected with screen window had 4.2 higher risk and those who do not wear long clothes had 5.4 higher risk exposed to dengue (Table 8).

Table 8 Logistic regression model of risk factors of dengue illness.

Risk Factors	Wald value	Regression coefficient (β)	Odds Ratio**	Confidence interval 95%	p value
Marital status (single)	7.58	1.01	2.75	1.34-5.65	0.006*
Not use screen window at home	9.85	1.44	4.24	1.72-10.44	0.002*
Not use long sleeve clothes	3.94	1.70	5.45	1.02-29.03	0.047*

* p value is significant if p<0.05
** Odd ratio (Exp B)

DISCUSSION

In this study, the changes of the minimum temperature, not using screen windows and not wearing long clothes are at higher risk exposed to dengue illness.

Depradine C and Lovell E[10] did a study in Caribbean Island showed that the changes of minimum temperature influenced the incidence dengue cases up to 16 weeks but a cross-sectional study by Loh B & Ren J.S[11] in Singapore showed that the temperature did not influenced the incidence of dengue illness. This may due to the lack of much difference in temperature in a tropical country like Singapore. They also found that rainfall is not a factor that can influence the dengue illness. In this study, despite the presence of heavy rain at 21st week, there was no increase of dengue case during this period. This may be due to the proactive efforts of identifying the risk area earlier, destruction of all potential water-filled containers or putting antilarvae in the water-filled containers.

As for marital status, it was noted that singles had 2.75 higher risks to dengue disease (p<0.05; 95% CI: 1.34-5.65). Other sociodemographic factors had no effect on dengue disease. This is in concordance with other studies[12, 13, 14]. Those who were singles may have various factors that caused them to stay in dengue prone area and ended up being exposed to *Aedes spp* bite[15].

We couldn't find any significant relationship between type of house and house to house distance and dengue illness. Mohamad Ali[16] who found that having other homes within 50 metres was not associated with dengue disease. This is consistent with our study. However, he did find that it was significant if the houses were within 30 metres of each other. This may due to the fact that *Aedes aegypti* had a limited flying range and sucked blood more frequently than *Aedes albopictus.*

As for COMBI, generally only 45 (76.7%) of 59 respondents who were aware about COMBI, inspected their house, search and destroy water-filled containers. Meanwhile, among 72 respondents from COMBI area, only 55.5% were aware or understanding about COMBI and its activities. It is shown that the respondents, who come from COMBI area, still lack the basic knowledge about it and thus display lack of protective behaviour among them. This is opposite to Winch P.J[17] finding. He found that exposure to dengue prevention program was associated with increased dengue-related knowledge; increase of potential breeding containers (tires) being protected from the rain and decrease numbers of breeding site.

YC Ko[18] did a study in Kao-Hsiung, Taiwan and found that screen windows and screen doors would protect from *Aedes spp* bite and thus reduced the risk of dengue illness (adjusted odds ratio from 0.18 (95% CI: 0.06 – 0.56) to 0.58 (95% CI: 0.36 – 0.92). Meanwhile, wearing of more than one pair of clothes was a protective practice which can reduce up to 50% from being infected from vector[19] (Odd Ratio: 0.44; 95% CI: 0.23-0.83). This is consistent with the finding of this study where the use of screen doors and windows and wearing of long sleeve clothes are protective against dengue illness.

There were some limitations in this study. The result of serology dengue tests were not available in all cases which recorded in Vekpro system from January to Jun, 2006. Therefore, the number of confirmed dengue cases may be higher and could have been used in this study especially in time-series analysis. The case group were taken from the confirmed cases who were infected six months prior of study. After they were infected and thus were more informed about dengue, some risk factors and personal risk behaviour may have changed and thus distorted the findings such as risk factors of keeping water-filled containers and improper garbage dumping .

CONCLUSION

Of weather factors, only the changes of minimum temperature were found to be related to dengue illness. Therefore, any change of minimum temperature should be followed by intense activities to destroy breeding areas to avoid an outbreak.

We should encourage them the use screen windows and screen doors. Despite hot and humid weather of Malaysia, we should also encourage the use of long sleeves clothes especially at dusk and dawn since this is when *Aedes spp* bite.

The current COMBI activities do not seen to have the desired effect in this district. Therefore the activities need to be enhanced to ensure not only a change in the awareness, but also a change in the attitude and practice.

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