Short Communication

Knowledge and Practice of Household Mosquito Breeding Control Measures between a Dengue Hotspot and Non-Hotspot in Singapore

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Abstract

Introduction: The aim of this study was to compare the knowledge and practices of household mosquito-breeding control measures between a dengue hotspot (HS) and a non-hotspot (NHS). Materials and Methods: Eight hundred households were randomly sampled from HS and NHS areas, and an National Environment Agency (NEA) questionnaire was administered to heads of the households. Interviewers were blinded to the dengue status of households. We included subjects aged above 16 years, who were communicative and currently living in the household. Chi-square test was used to compare proportions and multiple logistic regression was used to adjust for socio-demographic differences between both areas. Results: The overall response rate was 59.0% (n = 472). There were significant differences in gender, educational level, employment status and housing type between HS and NHS (all *P* <0.05). NHS residents were less knowledgeable in 6 out of 8 NEA-recommended anti-mosquito breeding actions: changing water in vase/bowls [AOR (adjusted OR), 0.20; CI, 0.08-0.47; *P* <0.01], adding sand granular insecticide to water [AOR, 0.49; CI, 0.31-0.71; *P* <0.01], turning over pails when not in use [AOR, 0.39; CI, 0.17-0.89; *P* = 0.02], removing flower pot/plates [AOR, 0.35; CI, 0.18-0.67; *P* <0.01], removing water in flower pot/plates [AOR, 0.36; CI, 0.17-0.75; *P* <0.01] and putting insecticide in roof gutters [AOR 0.36; CI, 0.13-0.98; *P* = 0.04]. Hotspot residents reported better practice of only 2 out of 8 NEA-recommended mosquito-breeding control measures: changing water in vases or bowls on alternate days [AOR, 2.74; CI, 1.51-4.96; *P* <0.01] and removing water from flower pot plates on alternate days [AOR, 1.95; CI, 1.01-3.77; *P* = 0.05]. Conclusion: More HS residents were knowledgeable and reported practicing mosquito-breeding control measures compared to NHS residents. However, a knowledge-practice gap still existed.

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Key words: Cross-sectional, People, Public, Source reduction

Introduction

Dengue is the most common mosquito-borne viral disease in the world and its severity is reflected by a 30-fold increase over the last 50 years. Today, 2.5 billion people over 100 endemic countries remain susceptible to this disease with an estimated annual incidence of 50 million leading to 22,000 deaths mainly among children.[1] According to the World Health Organization, there are currently no specific treatments for dengue, and the development of a vaccine is difficult due to the need of incorporating all 4 viral serotypes.[2] Hence, source reduction remains the most effective way and key strategy in dengue control programmes.[3]

Singapore, where dengue is endemic, is known for its successful nationwide programme of vector (larval) control introduced in 1968. There was a drop in the *Aedes aegypti* population from 16% to 2% as measured by the premises index (defined as the percentage of inspected premises found to have containers with *A. aegypti* larvae or pupae), in a pilot project carried out to control the *Aedes* mosquito population. Our local premises index has remained at 2% despite 4 recent outbreaks in 1992, 1998, 2004 and 2005.[4]

The National Environment Agency (NEA) in Singapore adopts a 2-prong approach (i.e., broadcast/multi-medium advertising strategy and target-group specific outreach programmes) in reaching out to the community to check and remove stagnant water, which can breed mosquitoes in their homes. Public-People-Private sectors (3P) partners are engaged in the planning and implementation of the

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communication plan as these partners have in place an established network for the various target groups. This effort is on-going with higher intensity during the hotter months when cases are expected to increase.

In Singapore, dengue clusters are defined as when 2 or more dengue cases occur within 14 days and the homes of the dengue victims are within 150 m of each other.[5] In times of clusters, NEA would work with 3P partners such as grassroots organisations and other agencies to intensify the outreach so as to alert residents in an affected area to take preventive measures to break the dengue transmission cycle. The objective of this study was to compare the differences in the knowledge and practices between residents in dengue hotspots (HS) and dengue non-hotspots (NHS).

Methodology

A community-based, cross-sectional study was conducted in February 2007 in the Western part of Singapore. For the purpose of the project, an area with multiple recurrent dengue clusters in the preceding 2 years was identified by NEA (named as a dengue HS), and another area in the same district with no reported dengue clusters in the same period was identified (named as a dengue NHS). Researchers were blinded to the identity of the 2 areas until data analysis was completed. Information on hotspot areas in such specific detail as used in our study is not publicly available. It is only available within NEA.

A total of 800 households were randomly sampled from the 2 selected areas and a questionnaire, modified from the one used previously by NEA in their dengue prevention campaign, was administered by trained interviewers to the head of the household (or second-line decision-maker if the head of household was unavailable). We assessed their knowledge and reported practice of mosquito-breeding control measures within their household. The survey was also conducted in our native languages, namely, Chinese, Hokkien, Cantonese, Malay and Tamil, to cater to different respondents. An appendix with standardised translations of certain questions and explanation on the format of the questionnaire was also prepared.

Only respondents who were permanently residing in Singapore, aged 21 years and above and currently living in the household units were sampled. We excluded tenants temporarily residing in households for less than a year and individuals with physical or mental illness which impaired their ability to communicate or respond coherently. We visited households at least 3 or more times at different times of the day (including nights), each on 3 different days, to recruit respondents. We replaced households where occupants were not at home after 3 or more visits from a list of randomly selected reserve household units.

Entered data were checked twice and SPSS Version 16.0 was used for data entry and analysis. We used chi-square tests to compare proportions and multiple logistic regression to adjust for socio-demographic differences between both areas. Statistical significance was set at $P < 0.05$.

Results

Out of the 800 households sampled, 472 responded, giving an overall response rate of 59.0% (n = 238 for NHS, n = 234 for HS). Of the NHS respondents, 157 were from apartments (66.0%) and 81 were from landed households (34.0%), while for HS respondents, 201 were from apartments (85.9%) and 33 were from landed households (14.1%).

There were statistically significant differences in gender [males: NHS (52.5%) vs HS (42.7%); OR, 1.23; 95% CI, 1.02 to 1.49], educational level [pre-university and above: NHS (51.7%) vs HS (34.6%); OR, 1.51; 95% CI, 1.21 to 1.87], employment status [working: NHS (73.6%) vs HS (64.8%); OR, 1.33; 95% CI, 0.57 to 0.99] and housing type [landed property: NHS (34.0%) vs HS (14.1%); OR, 2.41; 95% CI, 1.68 to 3.47] between HS and NHS areas. Hence, NHS residents were more likely to be male, to have higher education, working and living in landed properties (Table 1).

There were no significant differences in the knowledge of mosquito breeding sources between NHS and HS areas (Table 2). However, compared to HS residents, NHS residents were less knowledgeable in 6 out of 8 NEA-recommended anti-mosquito breeding actions: changing water in vase/bowls (AOR, 0.20; 95% CI, 0.08 to 0.47; $P < 0.01$), adding sand granular insecticide to water (AOR, 0.49; 95% CI, 0.31 to 0.71; $P < 0.01$), turning over pails when not in use (AOR, 0.39; 95% CI, 0.17 to 0.89; $P = 0.02$), removing flower pot/plates (AOR, 0.35; 95% CI, 0.18 to 0.67; $P < 0.01$), removing water in flower pot/plates (AOR, 0.36; 95% CI, 0.17 to 0.75; $P = 0.01$) and putting insecticide in roof gutters (AOR, 0.36; 95% CI, 0.13 to 0.98; $P = 0.04$).

On the contrary, HS residents were more likely to report correct practice of only 2 out of 8 NEA-recommended mosquito-breeding control measures: changing water in vases or bowls on alternate days (AOR, 2.74; 95% CI, 1.51 to 4.96; $P < 0.01$) and removing water from flower pot plates on alternate days (AOR, 1.95; 95% CI, 1.01 to 3.77; $P = 0.04$) (Table 3). There were no significant differences in the practice of the other 6 anti-mosquito actions between both areas.

Discussion

The NEA's intensive education efforts have been helpful in increasing knowledge in mosquito preventive measures amongst residents from a dengue HS area, who were more knowledgeable than those in a NHS area. However, a knowledge-practice gap has been identified in the dengue

Table 1. Socio-demographic Characteristics of Study Population

Demographic characteristic		Non-hotspot (238)		Hotspot (234)		Crude	95%
		No.	%	No.	%	Odds Ratio	CI
Gender	Male	125	52.5	100	42.7	1.229	1.015-1.488
	Female	113	47.5	134	57.3	1.000	
Age	Mean	44.10	–	42.55	–	t: 0.365	
Ethnicity	Chinese	172	72.8	150	64.1	1.180	0.702-1.986
	Malay	32	13.4	49	20.9	0.672	0.351-1.286
	Indians and others	34	14.2	35	15.0	1.000	–
Educational level	Up to secondary school	115	48.3	153	65.4	1.000	1.211-1.873
	Pre-university and above	123	51.7	81	34.6	1.506	
Any child?	Yes	154	64.7	171	73.1	1.000	0.998-1.721
	No	84	35.3	63	26.9	1.311	
Employment status	Working	173	73.6	151	64.8	1.333	0.569-0.988
	Not Working	62	26.4	82	35.2	1.000	
Housing type	HDB flats	157	66.0	201	85.9	1.000	1.680-3.467
	Landed	81	34.0	33	14.1	2.413	

Table 2. Comparison of Knowledge of Vector Sources and Mosquito Breeding Control Actions between Hotspot and Non-hotspot Areas

	Correctly answered [No. (%)]			Crude Odds Ratio (COR)			Adjusted Odds Ratio (AOR)*		
Variables	**Total**	**Non-hotspot**	**Hotspot**	**COR**	**95% CI**	***P***	**AOR**	**95% CI**	***P***
Vector sources									
Flower vases	262 (55.5)	134 (56.3)	128 (54.7)	1.07	0.74-1.53	0.73	1.01	0.69-1.48	0.97
Flower pot plates	299 (63.3)	154 (64.7)	145 (62.0)	1.13	0.74-1.64	0.54	1.17	0.78-1.76	0.44
Pails and water storing containers	205 (43.4)	101 (42.4)	104 (44.4)	0.92	0.64-1.33	0.66	0.89	0.61-1.31	0.56
Roof gutters	114 (24.2)	72 (30.2)	42 (17.9)	1.98	1.29-3.06	<0.01	1.16	0.69-1.96	0.57
Bamboo pole holders	107 (22.7)	48 (20.2)	59 (25.2)	0.75	0.49-1.16	0.19	0.94	0.60-1.50	0.81
Others	170 (36.0)	98 (41.2)	72 (30.8)	1.64	1.12-2.39	0.01	1.35	0.90-2.02	0.14
Mosquito breeding control actions									
Change water in vase/bowls	436 (92.4)	209 (87.8)	227 (97.0)	0.22	0.10-0.52	<0.01	0.20	0.08-0.47	<0.01
Adding sand granular insecticide to water	304 (64.4)	139 (58.4)	165 (70.5)	0.59	0.40-0.86	0.01	0.49	0.31-0.71	<0.01
Turning over pails when not in use	441 (93.4)	217 (91.2)	224 (95.7)	0.46	0.21-1.00	0.05	0.39	0.17-0.89	0.02
Removing flower pot/plates	420 (89.0)	201 (84.5)	219 (93.6)	0.37	0.20-0.70	<0.01	0.35	0.18-0.67	<0.01
Removing water in flower pot/plates	432 (91.5)	210 (88.2)	222 (94.9)	0.41	0.20-0.82	0.01	0.36	0.17-0.75	0.01
Covering bamboo pole holders when not in use‡	332 (92.7)	146 (93.0)	186 (92.5)	1.07	0.48-2.40	0.87	1.24	0.54-2.84	0.61
Clearing blockages in roof gutters§	106 (93.0)	73 (90.1)	33 (100.0)		– †			– †	
Putting insecticide in roof gutters§	77 (67.5)	50 (61.7)	27 (81.8)	0.36	0.13-0.97	0.04	0.36	0.13-0.98	0.04

* Adjusted for gender, educational level, employment status and housing type.
† Odds ratio cannot be calculated because a cell in the 2 x 2 table contains a zero.
‡ For apartments only (n = 358).
§ For landed property only (n = 114)

Table 3. Comparison of Reported Practice of Mosquito Breeding Control Actions Taken Incorrectly between Hotspot and Non-hotspot Areas

	Action taken incorrectly No. (%)		Crude Odds Ratio (COR)			Adjusted Odds Ratio (AOR)*		
Mosquito breeding control actions	**Non-hotspot**	**Hotspot**	**COR**	**95% CI**	***P* value**	**AOR**	**95% CI**	***P* value**
Changing water in vases/bowls on alternate days	56 (23.5)	26 (11.1)	1.75	1.19-2.58	<0.01	2.74	1.51-4.96	<0.01
Adding sand granular insecticide to water monthly	128 (53.8)	119 (50.9)	0.91	0.82-1.01	0.07	0.53	0.28-1.01	0.05
Turning over pails when not in use	23 (9.7)	41 (17.5)	0.58	0.36-0.93	0.02	0.59	0.33-1.05	0.07
Removing flower pot plates	19 (8.0)	27 (11.5)	0.73	0.44-1.23	0.23	0.63	0.31-1.26	0.19
Removing water from flower pot plates on alternate days	46 (19.3)	24 (10.3)	1.33	0.89-1.97	0.15	1.95	1.01-3.77	0.04
Covering bamboo pole holders when not in use†	25 (15.9)	47 (23.4)	0.69	0.45-1.07	0.09	0.60	0.34-1.04	0.07
Clearing blockages in roof gutters monthly‡	33 (40.7)	17 (51.5)	0.91	0.67-1.24	0.57	0.58	0.18-1.89	0.37
Putting insecticide in roof gutters monthly‡	38 (46.9)	23 (69.7)	0.86	0.74-1.01	0.12	0.10	0.01-1.01	0.05

* Adjusted for gender, educational level, employment status and housing type
† For apartments only (n = 358)
‡ For landed property only (n = 114)

HS area. People who are well-informed may not necessarily be convinced to take up particular actions to prevent mosquito breeding.

Similar studies conducted in Northeast Thailand and Malaysia have also identified a knowledge-practice gap amongst the local population.[6,7] Barriers identified for the lack of control of sustained practice were culture-specific and prevailed over the benefits of dengue control. Hence, it is important to conduct further studies to examine the potential reasons (e.g., attitudes and behaviour) for the gap between knowledge and practice in Singapore and take steps to bridge it, so as to help improve dengue control in Singapore.

We also recommend that this study be carried out in other countries to determine the factors contributing to a knowledge-practice gap in dengue prevention. This would help enhance the country's dengue prevention outreach programmes as results would be unique to the individual country's culture and living environment.

In a Cuban study, neighbourhood level groups ensured that all in the community were included in vector control measures resulting in a drop in all entomological indices. In our local context, in addition to monitoring and assessing the efficacy of dengue control via pure statistical or disease indices such as the premises index and dengue incidence, assessment in terms of the participation process and behavioural changes in the population should also be included.[8]

Finally, it is important for NEA to continuously work with the 3P partners (Public-People-Private) with a focus on targeted measures that bridge the gap between knowledge and practice.[9] More grassroots involvement at the community level may be effective in involving households in dengue prevention and encouraging ownership of vector control efforts.

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