EFFECT OF HEALTH EDUCATION ON COMMUNITY PARTICIPATION IN CONTROL OF DENGUE HEMORRHAGIC FEVER IN AN URBAN AREA OF THAILAND

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Abstract. Dengue hemorrhagic fever (DHF), a disease transmitted by *Aedes* mosquitos, remains a serious public health problem in Thailand. This paper describes the effect of health education efforts on a community-based DHF vector control program in the municipality of Mae Sot District, Tak Province, northern Thailand, from 1988 through 1990. In 1988, public health education on DHF and larval control through mass media, lectures and discussions reduced the *Aedes* Breteau index from 241 in March to 126 in June 1988. In 1989 and 1990, twice a year house-to-house visits by trained health workers were added to the health education campaigns. *Aedes* larval indices were decreased far more in the epidemic year of 1990 than in 1989. During this 3-year period, water-storage containers for drinking, washing, bathing and ant-traps were the primary sources of larval habitats, accounting for about 90% of the total breeding places. Reduction of *Aedes* larvae in these sources was due to various larval control measures. By August 1990 water containers for non-drinking purposes were the remaining important breeding places. The introduction of larvivorous fish may be an effective method of larval control for these containers. Most houses were supplied by public piped water system; however, a shortage of piped water for a period of time resulted in a significant increase in the number of water containers. An adequate water supply to the community should be provided continuously to prevent creation of new breeding places. Modifying behavioral practices to reduce domestic man-made water containers should be encouraged.

INTRODUCTION

Dengue hemorrhagic fever (DHF) continues to be a serious public health problem in Thailand, where it causes significant childhood morbidity and mortality throughout the country (Thongcharoen, 1977; Nimmannitya, 1987; Ungchusak and Kunasol, 1988; Division of Epidemiology, 1990). The average incidence rate of DHF has increased from 23 per 100,000 population during the period 1968-1977 to 54 per 100,000 for 1978-1987 (Ungchusak and Kunasol, 1988). In each year, the number of DHF cases clusters during the rainy season from May through October. The disease outbreaks usually occur every 2 or 3 years and most recently took place in 1987 with 174,285 cases (325 per 100,000) and 1,008 deaths, giving a case-fatality rate of 0.6% (Division of Epidemiology, 1989). The most important vector of dengue transmission in Thailand is *Aedes aegypti*. The occurrence of the disease outbreaks in communities is linked to the density of *Ae. aegypti* (Thongcharoen, 1977; Halstead, 1966; Scanlon, 1966; Pant *et al*, 1973; WHO, 1986). *Ae. aegypti* mosquitos breed mostly in domestic man-made water containers. Prevention and control of DHF is therefore primarily based on long-term antimosquito control measures which require active participation of people in the community. This report presents the effect of health education and community participation on a DHF control program in an urban community in northern Thailand between 1988 and 1990.

MATERIALS AND METHODS

A study was conducted from 1988 through

1990 in the municipality of Mae Sot District, the only urban community of the district, located in Tak Province about 500 km north of Bangkok. This community, covering an area of 27.2 km^2, contained 6,341 houses with 20,283 inhabitants in 1990. Most of the houses were supplied with public piped water. Since *Aedes* mosquitos were highly prevalent in the area like other urban settings of Thailand, DHF cases have been reported annually, with outbreaks observed every 2 or 3 years. The last large outbreak in the area involving 181 cases (892 per 100,000 population) and 1 death was reported in 1987.

An intensive DHF control program began in 1988. The health education program, including lectures and discussions, instituted in March 1988 was provided to health care personnel, government officers, school children and teachers, and people in the community who were reached through community organizations such as temple membership and Rotary Clubs. The main issues of the health education program included the high incidence of DHF in the area, the severity of the disease, its transmission and the importance of eliminating *Aedes* breeding sources in and around house by residents' own efforts. Meanwhile, health information on DHF was disseminated publically through mass media, including television, radio, leaflets and local newpapers. Temephos in 1% sand granule formulation was introduced as a larvicidal control measure and made available for the community at the low cost of 10 baht (0.4 US$) per 100 g package, but was provided free of charge for use in the schools. In addition, ultra-low-volume (ULV) spraying with insecticide (using truck-mounted ULV sprayers) to kill adult mosquitos, supported by the Department of Communicable Desease Control, Ministry of Public Health, was implemented throughout the area twice a year, in March and June 1988. *Aedes* larval surveillance for evaluation of the control program was carried out first before the initiation of the program in March and then in June 1988. Each survey sample included every other house in one electoral area randomly selected from the 6 electoral areas in this community, giving a study sample of about 8% of the total houses.

In 1989 and 1990, health education campaigns through house-to-house visits by trained health workers from Mae Sot General Hospital and the Department of Health of the Municipal Office were carried out twice a year, first in March and then in June. Each health worker, accompanied by two school children, educated people about the health problems of the disease and the control measures for reduction of larval breeding sources in their premises. Temephos larvicide was sold at the same price mentioned earlier during home visits. ULV spraying was carried out about 1-2 weeks after each home visit in 1989. In 1990 ULV spraying was not carried out due to limitations in funds and manpower, despite the expectation of a DHF outbreak. *Aedes* larval surveys of a sample of about 8% of all the houses were conducted during home visits and one and a half months after each visit. Since at the first and second surveys in March and June 1988, more than 92% of larvae in the household water containers sampled for laboratory identification were those of *Ae. aegypti,* any water-holding container with larvae was considered positive for *Aedes* larvae in the study surveys. Between 1989 and 1990, larval surveys were also conducted in all of the schools located in this community, including 3 kindergartens, 7 primary schools and 1 secondary school, and results of the surveys were discussed with the school teachers. The number of DHF cases reported in this area was reviewed during this 3-year period.

RESULTS

The distributions of *Aedes* larval indices, including *Aedes* house index, Breteau index and container index, and the average number of water containers per house are shown in Table 1. In 1988, all the 3 indices surveyed in this area were reduced by 40-50% following the health education campaign through mass media, lectures and discussions. At the first home visit for health education in March 1989, the *Aedes* larval indices were as high as those determined in March 1988, and subsequently declined during the second survey. The larval indices recovered to the same high level in June 1989, 3 months after the first visit, which might be consistent with the 3-month period of larvicidal effect of temephos. They did not decrease much in the following survey. Public announcement of a suspected outbreak of DHF in 1990 had been made in February 1990 and may have resulted in the moderate reduction of *Aedes*

Table 1

Aedes larval indices and the average number of receptacles per house in the municipality of Mae Sot District, Tak, 1988-1990.

		House index*	Container index+	Breteau index++	No. receptacles per house
March	1988	79.0	39.1	240.9	6.2
June	1988	49.1	22.4	126.1	5.6
March	1989	70.4	34.4	216.7	6.3
April	1989	43.5	16.8	97.8	5.8
June	1989	58.0	27.9	220.5	7.9
August	1989	72.2	30.5	187.5	6.1
March	1990	59.1	24.7	153.0	6.2
April	1990	28.2	11.8	90.3	7.7
June	1990	42.6	21.5	131.4	6.1
August	1990	34.4	10.0	61.3	6.1

*Percentage of houses with *Aedes* larvae.
+Percentage of containers with *Aedes* larvae.
++Number of larval containers per 100 houses.

mosquito population surveyed during the first home visit in March 1990 compared to the numbers detected in the same period of time of the previous 2 years. The decreasing trend of larval indices following household health education was greater than that observed in 1989. Upon our home visits in 1989-1990, about 18-20% of the house owners could not be contacted because of their work during day-time or work in other areas, and about 2-4% of the household residents educated refused to use temephos larvicide because of its odor.

Rainfall did not raise the number of water containers in this urban area, where public piped water supply was provided. But the average number of receptacles per house increased significantly from 5.8 in April 1989 to 7.9 in June 1989 when there was severe inadequacy of water supply throughout the area between late April and July 1989. The increased number of receptacles was also seen in April 1990 when people expected that a shortage of water supply might occur again.

The distribution patterns of larval sources are shown in Table 2. The primary sources were water-storage containers for drinking, washing, bathing (flushing latrines as well) and ant-traps, all together accounting for about 90% of the total number of larval habitats. Health education efforts through community participation tended to make more significant reductions of the mosquito population in the epidemic year (1990) than in the inter-epidemic years (1988—1989). Fluctuating distributions of larval containers were consistently observed, with a decreasing trend detected after each household visit. The reduced number of drinking-water containers with *Aedes* larvae was mainly attributable to the increasing proportion of covered containers which rose from 78.4% in March 1988 to 96.7% in August 1990. This control measure (covering the water containers), though massively promoted during the education program, was not much practised by people with respect to water containers for washing, of which the proportion of containers with covers varied between 32.6% and 43.1% during the study period, and to water containers for bathing, nearly all of which were uncovered. Temephos application was responsible for the decreased larval indices in these 2 types of containers. Larval control in standing water used for ant-traps was mainly controlled by the addition of chemicals, ie. temephos, salt and detergent.

The findings of *Aedes* larval surveys in the schools conducted between 1989 and 1990 are presented in Table 3. The average number of larval containers detected in these schools was reduced throughout the study period. Water con-

Table 2

Distribution patterns of larval containers per 100 houses in the municipality of Mae Sot District, Tak, 1988-1990.

		Drinking− water containers	Washing− water containers	Bathing− water containers*	Ant− traps	Others+	Total++
March	1988	14	94	46	66	21	241
June	1988	9	34	14	52	17	126
March	1989	30	59	55	63	10	217
April	1989	15	38	26	14	5	98
June	1989	21	79	43	59	17	219
August	1989	22	55	48	43	20	188
March	1990	16	70	34	27	6	153
April	1990	5	35	24	21	4	89
June	1990	16	52	35	16	13	132
August	1990	6	36	15	1	4	62

*Water-storage containers used for bathing and flushing latrines.
+Including flower vases, tyres, foot baths, tin cans, etc.
++The number was not exactly equal to Breteau index due to rounding.

Table 3

Aedes larval surveys in 3 kindergartens, 7 primary schools and 1 secondary school in the municipality of Mae Sot District, 1989-1990.

		Kindergartens		Primary schools		Secondary school	
		Average no. containers /school	Average no.larval containers /school	Average no. containers /school	Average no.larval containers /school	No. containers	No.larval containers
March	89	14.7	11.3	30.9	7.9	84.0	23.0
May	89	23.3	4.0	60.7	9.3	81.0	3.0
March	90	15.0	1.3	55.1	3.4	75.0	5.0
May	90	16.0	0.7	56.4	0.7	72.0	2.0

tainers in the toilets were the primary breeding habitats of kindergartens and secondary schools whereas both toilet containers and flower vases were significant for primary schools. The increased number of water containers observed in kindergartens from 14.7 per school in March 1989 to 23.3 in May 1989 was attributable to the increased number of water-storage containers for household use following the shortage of water supply but the number declined in 1990 surveys when there was adequacy of water supply. The increased number of containers was also observed in primary schools but it was not only due to the increase in water containers for household use but also the increased number of flower vases which rose from 12.6 per school in March 1989 to 26.6 in May 1989 and to 34.9 in May 1990.

Although the overall *Aedes* larval indices in the community had been much reduced, they remained high. The appearance of an outbreak of DHF involving 139 cases with no deaths occurred

Table 4

Annual number of cases and incidence rate of DHF in the municipality of Mae Sot District, 1987-1990.

Years	No. cases	Rate (per 100,000)
1987	181	892
1988	4	20
1989	42	207
1990	139	685

in 1990 (Table 4). However, an outbreak in school was not determined during the study period.

DISCUSSION

Although progress has been made in the development of a live tetravalent vaccine against dengue (Brandt, 1988), it will take some years before an acceptable vaccine for mass use will be available. Therefore, efforts to prevent and control DHF should be based on long-term antimosquito programs through health education activities aimed at raising community awareness and participation in elimination of *Aedes* breeding sources in and around their houses. Our study revealed that the household visit by a health team trained to educate people in the community had a moderate effect on vector control. Law enforcement against harboring mosquitos on premises has been demonstrated to intensify community responsive practices in nationwide vector control in some countries such as Singapore and Cuba (Chan, 1978; Goh *et al,* 1987; Armada Gessa and Gonzalez, 1986). However, this approach may not be an efficient measure in Thailand where legal sanctions are sometimes ineffective.

The majority of larval habitats determined in this urban area comprised water-holding containers for household use and ant-traps. These findings agreed with those reported in other areas of Thailand (Phanthumachinda, 1972; WHO, 1984; Phanthumachinda *et al,* 1986; Charoensook *et al,* 1989; Dunyapiree and Wongsakun, 1990). A simple and inexpensive control method, by covering water containers, was well accepted only for drinking-water containers. Temephos application was preferred for those that stored water for washing and bathing. However, temephos larvicide has residual effects persisting for about 2-3 months. As seen in this study, the vector density was reduced following the household visit, but it recovered 3 months later. This observation underscores the need for more efforts to encourage people to regularly examine mosquito larvae and apply larvicide when needed. Another sound method of mosquito control for those water-holding containers for non-drinking purposes may be the introduction of larvivorous fish (Neng *et al,* 1987). However, it requires further study on community acceptance in the area.

Vector control strategy should comprise not only eliminating the existing breeding sources but also preventing creation of new ones. Our study reveals that shortage of piped water supply for some period of time can lead to a rise in the number of water-storage containers in the community and therefore to an increase in *Aedes* breeding habitats. An adequate water supply to the community should be continuously provided so that people are assured of no need for storage of water. This requires supportive actions by water supply agencies and local government administrators.

The average number of water containers per house in this area was found to be close to those in recently published reports (Pant *et al,* 1973; Phanthumachinda *et al,* 1986; Charoensook *et al,* 1989; Dunyapiree and Wongsakun, 1990). However, it remained high and needed to be reduced. The reduction of domestic man-made water containers by modifying behavioral practices which may be possible in an urban setting should include the promotion of the use of latrines with closed flushing- waster systems and the use of water for washing and bathing directly from the water tap rather than having water-storage containers. In order to achieve these objectives, it is of course necessary to institute reliable public water supply.

It is recommended that, in case of an outbreak of DHF, immediate control of the adult mosquitos carrying the virus in the affected area should be executed. The WHO Technical Advisory Committee suggests that a moderate-sized city (about 20 km^2) have a least 1 vehicle-mounted aerosol generator, 5 mist blowers, 10 swing-fog machines, and 1,000 liters of ULV insecticide for conducting rapid adulticidal activities (WHO,

1986). This requires adequate funds and manpower support. In the 1990 outbreak in the Mae Sot area cases were scattered throughout the area. Adulticidal operation could not be done rapidly nor adequately due to the limitations of financial and manpower resources. Increased awareness with high priority on DHF control among the chief administrator is essential for better allocation of resources.

The disease outbreaks have occurred frequently in the schools when there was high density of *Aedes* mosquitos (Korprasertsri, 1987; Eamchan *et al,* 1989). High vector densities were similarly found in the schools located in the area, but it was gradually reduced by health education efforts, reinforced with regular mosquito inspections. Vector control in the school should be an essential component of the community DHF control program.

Vector surveillance should be carried out continuously for evaluation of the progress of the control program and for further planning. Monitoring of DHF cases, together with serological and virological surveillance, if resources are available, should be conducted not only for evaluation of the efficacy of control measures but also for early outbreak detection, thus permitting prompt implementation of epidemic control measures.

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