EPIDEMIOLOGICAL FEATURES OF DENGUE AND CHIKUNGUNYA INFECTIONS IN BURMA

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INTRODUCTION

Antibody to dengue has been detected in Rangoon since 1965 [Central Epidemiology Unit (CEU), 1970. Unpublished data]. Unfortunately, previous to this it was not known when dengue viruses were introduced into Burma although dengue-like illness has been reported in Rangoon since 1934 (Govt. Printing Press, Burma, 1934). Outbreaks of dengue-like illness affected several parts of the country in 1963 (Directorate of Health Services, Burma, 1963. Unpublished data) but aetiological agent was not known owing to lack of laboratory facilities. A premonsoon serological survey carried out in Rangoon in May 1968 revealed a high prevalence of dengue infection among the sampled population (CEU, 1971. Unpublished data). A large outbreak of haemorrhagic fever due to dengue and chikungunya viruses occurred for the first time in Rangoon in 1970 (CEU, 1970. Unpublished data). Following this outbreak in Rangoon dengue haemorrhagic fever (DHF) was also reported in Moulmein and Bassein cities in 1971 (CEU, 1971. Unpublished data). An outbreak of dengue-like illness was also reported in Arakan State the same year (Khai Ming, C. and Po Chit, U., 1971. Unpublished data). These outbreaks prompted us to study the epidemiological features of dengue and chikungunya infections in the country.

This communication describes the age and sex distribution of children under 10 years both in urban and rural areas in the country and also the correlation between arboviral infections and the prevalence of *Aedes aegypti.*

MATERIALS AND METHODS

Study areas: Serological survey was carried out in all the 14 divisional and state capitals and 2 border towns, Tachileik and Kawthaung, located near the Burma-Thailand border. The survey sites were again divided into urban and rural areas, except Chin, Kayah and Shan States where *Aedes aegypti* mosquito was absent (*Aedes* Control Unit, 1971. Unpublished data) and also except Rangoon and Tenasserim Divisions. The urban area was taken from the town itself while rural area was a village or villages a few to several miles away from the town.

Population sample: 150 non-random sample population of children under 10 years of age were studied from each urban and rural areas except in Mandalay, Moulmein and Rangoon Cities where sample population of 150 each were studied from high, middle and low socioeconomic strata. 450 children each from Mandalay and Moulmein while 914 children under 5 years of age were studied in Rangoon. To exclude possible infection in journeys in the hilly areas — Chin, Kayah, Shan and Arakan States—who had never been out of their birth places were studied. For age comparison, data from 1971 in Rangoon (Khai Ming *et al.*, 1974) were included in the study.

Serum sample collection: Fingertip blood specimens were collected on filter paper discs

from the children by one of the authors (C.K. M). Only a single disc was collected from each child; the disc was stappled immediately onto a survey card provided and allowed to dry at room temperature. The discs together with the cards were sealed in plastic bags and sent to the National Health Laboratory (NHL), Rangoon where serological tests were carried out.

Virological studies: Haemagglutination-inhibition (HI) test:

Elution of the discs and treatment of the elute with acid washed kaolin and goose cells to remove nonspecific inhibitors of agglutination and agglutination was carried out as described elsewhere (Soe Thein, 1975). HI test was performed according to the method of Clarke and Casals (1958) with modification to microtiter equipment (Sever, 1962). Each elute was tested against 4 to 8 haemagglutinating units of dengue-3 and chikungunya viruses at serial twofold dilutions from 1:40 to 320. HI by the elute at 1:40 dilution was accepted as evidence of prior infection.

Entomological data: The entomological data in each study area were obtained from the *Aedes* Control Unit (ACU), Rangoon.

RESULTS

The distribution of HI antibody to dengue and chikungunya in Burma, 1973-74 is shown in Fig. 1. The figure shows the prevalence of dengue and chikungunya HI antibody in urban and rural areas combined together ex-

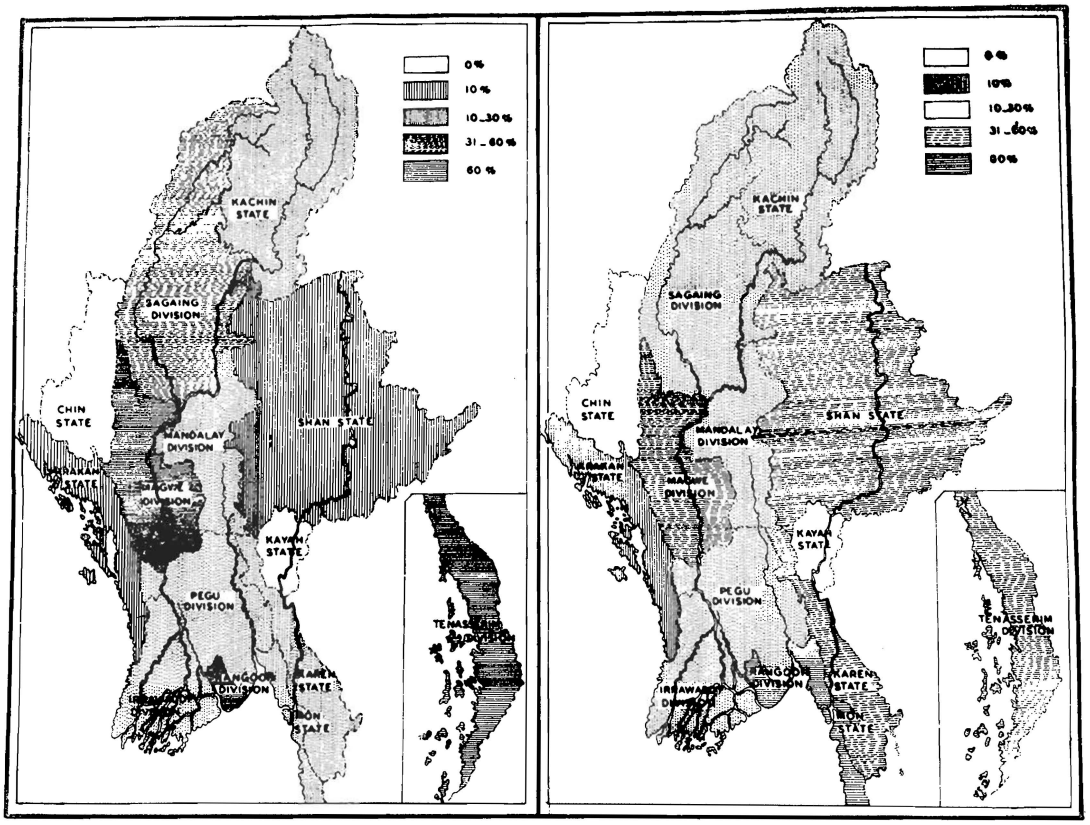

Fig. 1—Distribution of HI antibody to dengue (left) and chikungunya (right) in Burma, 1973-1974.

cept for Chin, Kayah, Shan States and Rangoon and Tenasserim Divisions where no rural areas were included in the survey.

No detectable HI antibody to dengue was observed in the Chin and Kayah States. Among the states and divisions where detectable dengue HI antibody was observed, the Arakan and Shan States had the lowest prevalence rate of less than 10% while Rangoon, Magwe and Tenasserim Divisions had the highest antibody prevalence rate of more than 60%. Sagaing Division had 31 to 60% and the remaining states and divisions had 10 to 30%.

No detectable HI antibody to chikungunya was also observed in the Chin and Kayah States. Arakan State had the lowest antibody prevalence rate of less than 10% while Rangoon Division and Mon State had the highest rate of over 60%. Surprisingly, Shan States which had very low dengue antibody rate had relatively high chikungunya antibody prevalence rate of 31 to 60%.

The correlation between dengue and chikungunya HI antibody prevalence and the prevalence of *Aedes aegypti* by urban and rural areas, Burma, 1973-74 is shown in Table 1. Both dengue and chikungunya HI antibodies were detected where *Aedes aegypti* mosquitoes were prevalent but the antibody prevalence rates were not directly proportional to the premises index as shown in

Table 1

Prevalence of dengue and chikungunya HI antibody and the prevalence of *Aedes aegypti* by urban and rural areas, Burma, 1973-1974.

State or Division	Urban or Rural	Estimated population in 1973	Altitude (in feet)	Premises index in 1971	Per cent antibody prevalence to:	
					Dengue	Chikungunya
Magwe	Urban	27,985	170	70.0	64.6	38.4
	Rural	1,000	170	77.0	77.9	52.6
Arakan (Akyab)	Urban	94,000	18	7.0	6.5	0.6
	Rural	600	18	0.0	1.9	0.0
Bassein+	Urban	74,000	33	75.0	15.2	23.9
	Rural	2,500	33	36.0	46.6	29.3
Sagaing	Urban	25,000	500	69.0	25.2	20.6
	Rural	1,700	500	56.0	58.6	34.6
Pegu	Urban	107,000	31	74.0	29.3	16.0
	Rural	2,000	31	86.0	19.3	16.0
Moulmein	Urban	150,000	69	59.0	34.7	93.4
	Rural	856	69	27.0	22.4	81.6
Mandalay	Urban	350,000	257	84.0	36.4	30.4
	Rural	865	257	51.0	19.3	58.0
Karen (Paan)	Urban	29,900	32	38.0	46.0	53.3
	Rural	3,200	32	0.0	6.0	18.6
Kachin (Myitkyina)	Urban	60,000	470	16.0	20.0	7.3
	Rural	7,211	470	3.0	14.0	48.0
Shan						
- Lashio	Urban	40,000	2,809	0.0	6.0	58.6
- Taunggyi	Urban	53,000	4,712	0.0	5.3	34.6
- Tachileik	Urban	6,925	1,030	20.0	6.6	57.3
Tenasserim (Kawthaung)	Urban	6,000	150	65.0	61.3	33.3
Kayah (Loikaw)	Urban	23,000	2,938	0.0	0.0	0.0
Chin (Haka)	Urban	8,000	6,123	0.0	0.0	0.0
Rangoon++	Urban	2,056,118	107	44.0	97.8	97.7

+ Bassein East, ++Actual population.

Note : *Aedes albopictus* is also found in some urban and rural areas except in the Chin State.

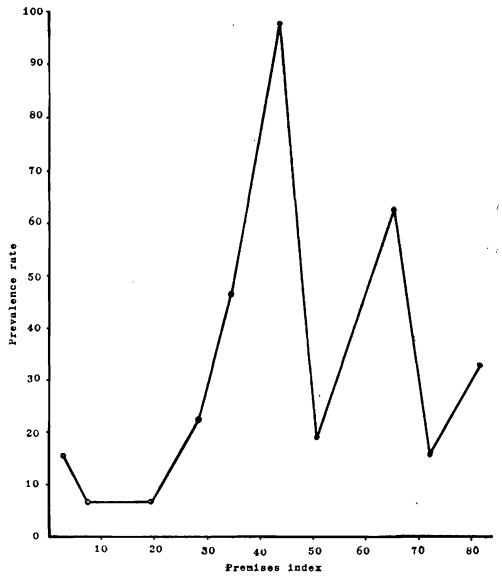

Fig. 2—Relation between dengue antibody prevalence rate and premises index, Burma, 1973-1974 (no correlation).

Fig. 2. No HI antibody to dengue and chikungunya was detected in *Aedes aegypti* free hilly areas—the Chin and Kayah States—but was detected in the Shan State. The transmission of both dengue and chikungunya infections in the latter was probably affected by *Aedes albopictus*. No *Ae. albopictus* was found in the Chin State.

Out of 9 divisions and states where the survey was carried out in rural areas as well, the frequency of dengue HI antibody was higher in Magwe rural (77.9%), Bassein rural (46.6%) and Sagaing rural (58.6%) than the respective urban areas. Similarly, the frequency of chikungunya HI antibody rate was higher in Magwe rural (52.6%), Bassein rural (29.3%), Sagaing rural (34.6%) Mandalay rural (58.0%) and Kachin State rural (48.0%).

Antibody prevalence rates of dengue and chikungunya by socioeconomic status in 3 cities of Burma, 1973-74 is presented in Table 2. No difference in the antibody prevalence rates of dengue and chikungunya by socioeconomic class in Rangoon City was observed but in Mandalay dengue affected 3 times less to high socioeconomic class than lower socioeconomic class while in Moulmein relatively low infection with dengue was observed in high and middle socioeconomic classes. Chikungunya affected all socioeconomic classes equally in Moulmein. Compared to those of Rangoon, residents of Mandalay had relatively lower frequencies of dengue antibody.

HI antibody to dengue by age and sex in other towns of Burma, 1973-74 and Rangoon City, 1971 is shown in Table 3. The overall per cent antibody prevalence in other towns was 26.9% and that for Rangoon City was 93.2%, more than 3 times higher than in the former. 8.2% in children under one year of age in other towns had detectable antibody which increased to 31.6% in the 5 - 9 year age

Table 2

Antibody prevalence rates to dengue and chikungunya by socioeconomic class in 3 cities, Burma, 1973-1974.

City	Estimated population	Upper class			Middle class			Lower class		
		No. tested	% +ve		No. tested	% +ve		No. tested	% +ve	
			D	C		D	C		D	C
Rangoon	2,056,118+	114	98.6	98.2	400	100.0	100.0	400	95.5	95.5
Mandalay	350,000	150	20.6	9.3	150	30.6	31.3	150	58.0	50.6
Moulmein	150,000	150	28.6	96.0	150	28.6	92.6	150	46.5	91.7

% +ve = per cent positive, D = Dengue, C = Chikungunya.
+ Actual population.

Table 3

HI antibody to dengue by age and sex in other towns in Burma, 1973-1974 and Rangoon City 1971.

Age group (years)	Other towns						Rangoon City					
	No. tested			Per cent positive			No. tested			Per cent positive		
	M	F	T	M	F	T	M	F	T	M	F	T
1	146	132	278	5.4	11.3	8.2	2	3	5	50.0	0.0	20.0
1 - 4	574	571	1145	24.5	26.4	25.5	67	67	134	91.0	95.5	93.3
5 - 9	754	676	1430	28.3	35.3	31.6	92	109	201	95.7	94.4	95.0
Total	1,474	1,379	2,853	24.6	29.3	26.9	161	179	340	93.1	93.2	93.2

M = male; F = female; T = total.

Table 4

HI antibody to chikungunya by age and sex in other towns in Burma, 1973-1974 and Rangoon City, 1971.

Age group (years)	Other towns						Rangoon City					
	No. tested			Per cent positive			No. tested			Per cent positive		
	M	F	T	M	F	T	M	F	T	M	F	T
1	146	132	278	33.5	33.3	33.4	2	3	5	50.0	66.7	60.0
1 - 4	574	571	1145	32.9	35.0	33.9	67	67	134	55.2	70.1	62.7
5 - 9	754	676	1130	38.7	43.3	40.9	92	109	201	71.1	67.0	69.2
Total	1,474	1,379	2,853	35.9	38.9	37.3	161	179	340	63.3	68.1	66.4

M = male; F = female; T = total.

group. In Rangoon City the rates increased suddenly from 20.0% in infants to 93.3% in 1 - 4 year age group. Both sexes were equally affected.

Table 4 shows HI antibody to chikungunya by age and sex in other towns, 1973-74 and Rangoon City, 1971. The overall per cent antibody prevalence in other towns was 37.3% and that for Rangoon City was 66.4%, almost two times higher than in the former. Antibody to chikungunya increased from 33.4% in the less than one year age group to 40.9% in the 4-9 year age group in other towns while in Rangoon City it increased from 60.2% to 69.2% in the same age groups. Both sexes were equally affected.

Fig. 3 shows the antibody prevalence rates of dengue and chikungunya by age in other

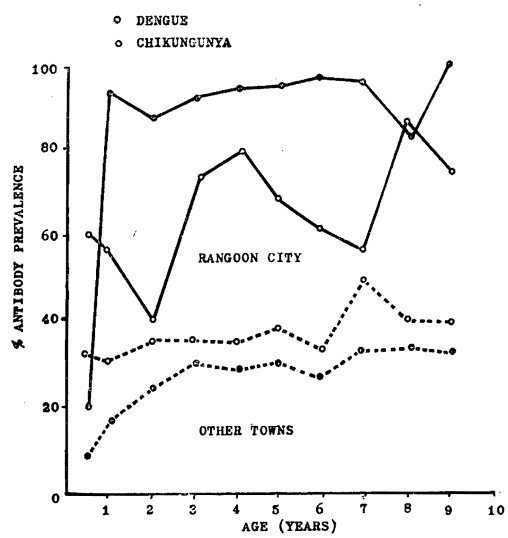

Fig. 3—The distributions of HI antibody prevalence rates of dengue and chikungunya by age in other towns, Burma, 1973-1974 and Rangoon City, 1971.

Table 5

HI antibody to dengue and chikungunya by age and sex, rural areas, Burma, 1973-1974.

Age group (years)	No. tested			Per cent positive to:					
				Dengue			Chikungunya		
	M	F	T	M	F	T	M	F	T
1	56	74	130	26.7	10.8	17.6	25.0	25.6	25.3
1 - 4	281	262	543	24.9	30.5	27.6	33.4	38.1	41.8
5 - 9	322	343	665	32.9	35.2	34.1	40.3	43.1	41.8
Total	659	679	1,338	28.9	30.7	29.8	36.1	39.3	37.7

M = male; F = female; T = total.

towns, 1973-74 and Rangoon City,1971. Antibody prevalence rates for dengue increased progressively with age in Rangoon City while it was not so in other towns, suggesting the possibility of cyclical transmission in the latter.

Table 5 shows the antibody to dengue and chikungunya in rural areas of Burma, 1973-74. The overall per cent antibody prevalence to dengue was 29.8% and that for chikungunya was 37.7%. The antibody prevalence rates of dengue ranged from 17.6% in infants to 34.1% in the 5 - 9 year age group and that for chikungunya ranged from 25.3% to 41.8% in the same age groups.

DISCUSSION

This study provides strong circumstantial evidence that dengue and chikungunya viruses are highly and widely distributed throughout Burma since undetermined period. Moreover, there is also evidence that dengue and chikungunya infections are widespread both in urban and rural population. In general, no markedly difference in distribution of dengue infection in urban and rural areas was observed but chikungunya seemed to be more prevalent in rural areas. The rate and frequency of infection decreases with increasing altitude as shown in Fig. 4. This phenomenon has been described in Thailand and elsewhere (Halstead *et al.*, 1969). In Burma *Aedes aegypti* mosquito is found in the low land but its density decreases with increasing altitude until it completely disappears above 900 meters above sea level, whereas *Ae. albopictus*, a probable vector for both dengue and chikungunya viruses, is still found to be prevalent above that altitude (ACU, 1974. Unpublished data). The prevalence of dengue and chikungunya infection in *Aedes aegypti* free hilly areas are probably transmitted by *Ae. albopictus*. At the same time the prevalence of other group B arbovirus, such as Japanese encephalitis (JE) virus in the hilly areas could not be ruled out as an outbreak of JE was reported recently in Tachileik in the Eastern Shan States (Khai Ming, 1974. Unpublished data).

The difference in infection rates between upper and lower socioeconomic classes in

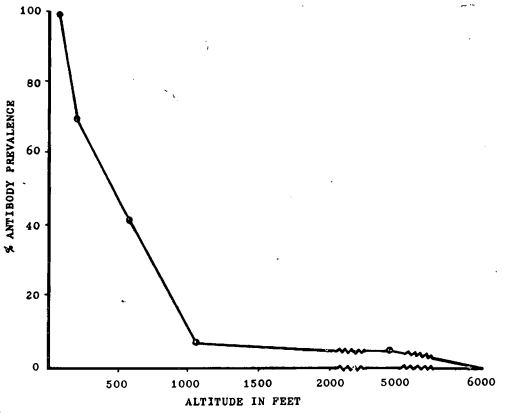

Fig. 4—Dengue antibody prevalence rates in relation to altitude, Burma, 1973-1974.

Mandalay is easy to explain by the fact that the populations of the upper socioeconomic class reside in new buildings with better water supply and environmental sanitation in a government housing project. This difference clearly explains the need for adequate water supply in the community in the control of *Aedes aegypti* mosquito.

It has been observed that dengue and chikungunya infection rates are in parallel since both viruses are transmitted by the same vestor, (Halstead *et al.*, 1969). This observation is not exactly in agreement with our finding where unparalleled rates of infection could occur even in areas with simultaneous presence of both viruses.

Virological studies are few and limited in Burma, but dengue-3 virus has been isolated from a pool of *Aedes aegypti* in Rangoon in 1970 (Mi Mi Khin, 1970, pers. comm.). A serological study on hospitalized cases of DHF showed that all 4 dengue serotypes were prevalent in Rangoon in 1971 (Khai Ming *et al.*, 1975). As dengue infection was already widespread in the country, it is thus possible in the near future that new outbreaks of DHF could occur following introduction of heterogenous dengue viruses into population previously exposed to one serotype. Since its first outbreak in Bangkok in 1958, DHF is now reported in all provinces in Thailand (WHO, 1974). Thus, our study strongly indicates the need for a long term surveillance throughout the country.

SUMMARY

A serological survey for antibody to dengue and chikungunya was carried out in all 14 divisions and states and 2 border towns in Burma during 1973-74. Dengue HI antibody prevalence rate of less than 10% was observed in Arakan and Shan States, 10 to 30% in the Irrawaddy, Pegu, Mandalay Divisions and Kachin, Mon and Karen States, 31 to 60% in Sagaing Division, and over 60% in Rangoon, Magwe and Tenasserim Divisions. Similarly, chikungunya HI antibody prevalence rate of less than 10% was observed in Arakan State, 10 to 30% in the Irrawaddy, Pegu, Mandalay and Sagaing Divisions and Kachin State, 31 to 60% in Rangoon Division and Mon State.

Both dengue and chikungunya antibodies were detected where *Aedes aegypti* mosquitoes were prevalent but the antibody prevalent rates were not directly proportional to the premises index. No HI antibody to dengue nor chikungunya was detected in *Aedes aegypti* free hilly areas, Chin and Kayah States, but was detected in the Shan State. Dengue and chikungunya infections were observed both in rural and urban populations.

Dengue and chikungunya infections affected all socioeconomic classes in Rangoon equally but in Mandalay high socioeconomic class was nearly 3 times less affected than lower socioeconomic class.

The frequencies of dengue and chikungunya infections were observed to be 2 to 3 times higher in residents of Rangoon City than those of other towns. In Rangoon the antibody prevalence rates to dengue increased progressively with age while in other towns no appreciable increase in rates with age was observed. Both sexes were equally affected.

This study provides strong circumstantial evidence that dengue and chikungunya viruses are highly and widely distributed throughout Burma, and that new outbreaks of haemorrhagic fever could occur in previously free areas following introduction of dengue viruses into populations previously exposed to one type of dengue.

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