ISSN 1021-366X
Department of Health
REPUBLIC OF CHINA
Vol. 11 No. 4/April 25, 1995

Epidemiology Bulletin

Investigating a Dengue Fever Outbreak in Fengshan City of Kaohsiung County

Introduction

There have been several island-wide outbreaks of dengue fever in Taiwan since the 18th Century. These outbreaks have occurred in the Penghu (1922), in Tainan (1931), Island-wide (1942), in Ryuchiu (1981) plus several in Kaohsiung, Pingtung and Fengshan areas (1987, 1988)[1]. It is noted that these outbreaks cover primarily the southern part of Taiwan: Kaohsiung City, Kaohsiung County, and Pingtung County. An outbreak which started in the Tsoying area of Kaohsiung City from mid-July to mid-September of 1994 had a cumulative total of 101 identified and confirmed indigenous cases. 99 cases of them were located in the Tsoying area and the other 2 cases were found in Fengshan City of Kaohsiung County. An investigation was therefore conducted in Fengshan area to study more about dengue fever infection; to actively identify suspected cases and to learn how much the public knows about the prevention and control of dengue fever.

Literature Review

Dengue fever has also been known as "breakbone fever", or "dandy fever", or "bouquet". It is caused by the dengue virus, transmitted by vectors such as *Aedes aegypti* and *Aedes albopictus*. In man, 3 to 15 days after the bite of an infected mosquito, the victims develop the following symptoms: high fever, chill, intense headache, muscle pain, post-orbital pain, joint pain and rash[2]. Since 1953 a mutated type of dengue fever has occurred in several Asian countries, India, Indonesia, Malaysia, Myanmar (Burma), Philippines, Singapore, Sri Lanka, Thailand and Vietnam. It primarily attacks children of 3 to 10 years old. This type of dengue fever is characterized by its fatal hemorrhagic and shock syndromes. The fatality rate ranges from 12 to 44%. Victims, symptoms and prognoses for this type of dengue fever differ significantly from the original type. It is hence referred to as "dengue hemorrhagic fever" (DHF) or "dengue shock syndrome" (DSS)[3]. This is one of the leading causes of death, particularly among children, in tropical and sub-tropical zones[4].

World-wide there were 715,238 confirmed DHF cases during the period of 1956 to 1980. Of those, 21,345 died. From 1986 to 1990, the number of cases reached as many as 1,263,321, of whom 15,940 died. Thus the number of confirmed cases had increased by about 1.8 folds in those 15 years.

Dengue fever is more prevalent in the areas between 28 degrees North Latitude and 25 degrees South Latitude. Four serotypes of dengue viruses have been identified as DEN-1,2,3 and 4. Homologous-type immunity is of long duration; heterologous immunity, though present, is very brief.

Monath[6] states that dengue viruses will induce mild fever; in severe cases, however, the antigen-antibody fixation reaction and the release of cytokines may induce blood vessel dilation and the release of hemo-agglutinogen, complement fixation and interferon; the result is dengue shock syndrome. Monath[7] reports that the chance of developing DHF by secondary infection of heterologous viruses is 100 times higher than through the primary infection. By 1980, in sub-tropical zones in a total of 61 countries which contain about 1.5 billion of the world population, there was active transmission of dengue viruses. Monath, working on world data, estimates that each year about 100 million persons are infected with dengue fever. Halstead[8] also indicates that between 1970 and 1980, about 250,000 people were infected annually with DHF.

Materials and Methods

Date of investigation: September 15-16, 1994.

Definition of case: according to the guidelines of the US Centers for Disease Control (CDC), a case is defined as a person who has had a fever as high as 38°C for more than two days, with at least one of the following symptoms: general bone and joint pains, rash and itching.

Place of investigation: Chenhsi Li and Hsiehho Li, Fengshan City of Kaohsiung County.

Samples for investigation: 92 and 67 households in each Li, where the confirmed degnue fever cases lived, were interviewed respectively. The respondents also gave blood samples for a dengue virus IgM antibody testing by Division of Epidemiology of the National Institute of Preventive Medicine. The number of respondents represented about 5% of the total area population.

Findings: (as summarized in Tables 1, 2)

a) Chenhsi Li, Fengshan City of Kaohsiung County

On September 15 1994, 92 households with 384 individuals were interviewed. Of those, 7 (1.8%) had developed clinical symptoms of dengue fever, such as, fever, muscle pains. Of those seven cases, one had dengue fever previously, and two had been

Table 1. Household Background Information in both Chenhsi and Hsiehho Lis, Fengshan Area.

	Chenhsi	%	Hsiehho	%	Total	P value
Total No. of households	8,294		6,370		14,664	
No. households interviewed	92		67		159	
No. persons interviewed	384		340		724	
Male	201	52.3	181	53.2	382	
Female	183	47.7	159	46.8	342	
Age						
0- 9	41		49		90	
10-19	55		34		89	
20-39	147		151		298	
40-59	90		85		175	
60+	51		21		72	
Blood samples collected	147		73		220	
Male	66	44.9	26	35.6	92	
Female	81	55.1	47	64.4	128	0.242[a]
Serum IgM postive	3		0		3	
Male	0		0		0	
Female	3	100.0	0		3	
Meeting criteria of case						
Yes	7	1.8	2	0.6	9	
No	377	98.2	338	99.4	715	0.1842[b]
Past history of dengue fever						
Yes	35	9.1	5	1.5	40	
No	349	90.9	335	98.5	684	0.0000149[a]
Indoor spraying						
Yes	4	4.3	6	9.0	10	
No	80	87.0	52	77.6	132	
Don't know	8	8.7	9	13.4	17	0.3948[a]
Outdoor spraying						
Yes	40	43.5	46	68.7	86	
No	41	44.6	10	14.9	51	
Don't know	11	12.0	11	16.4	22	0.002838[a]

a: Yates corrected χ^2 test; b: Fisher exact test.

Table 2. Knowledge of Dengue Fever in both Chenhsi and Hsiehho Lis, Fengshan Area.

	Chenhsi	%	Hsiehho	%	P value
Awareness through hearsay					
Yes	84	91.3	57	85.1	
No	8	8.7	10	14.9	0.3316[a]
Knowledge of transmission route					
Mosquito bite	71	77.2	45	67.2	
Air	4	4.4	0	0.0	
Others	1	1.1	0	0.0	
Water	0	0.0	7	10.4	
Don't know	18	19.6	11	16.4	0.2216[a]
Information source					
TV	69	75.0	46	68.7	
Newspaper	10	10.9	4	6.0	
Health agency	4	4.3	1	1.5	
Radio	2	2.2	4	6.0	
Others	7	7.6	7	10.5	
Preventive measures					
Household sanitation	50	54.4	23	34.3	
Pesticide spraying	23	25.0	31	46.3	
Immunization	0	0.0	0	0.0	
Medication	0	0.0	0	0.0	0.99497[a]
Don't know	19	20.7	9	13.4	
Others	3	3.3	0	0.0	

a: Yates corrected χ^2 test.

diagnosed by general practitioners as suffering from common colds. Table 1 shows that of those interviewed, 147 (38.3%) had been tested for IgM. Serum testing had identified three positives (2% of those tested). Of those three, two met the case criteria and the other developed none of the symptoms of fever or bone/muscle pains. Of the households in the neighborhood of the confirmed case, four (4.3%) reported that health agencies had sprayed a pesticide indoors and 40 (43.5%) said that the agencies had sprayed a pesticide outdoors. Of the respondents, 91.3% heard of dengue fever; 77.2% knew that the dengue fever was transmitted by mosquitoes; 86% learned of dengue fever through TV or newspapers; 80% recognized that household sanitation and pesticide spraying were important for prevention and control of the disease (see Table 1).

b) Hsiehho Li, Fengshan City of Kaohsiung County

On September 16 1994, 67 households with 340 individuals were interviewed. As also shown in Table 1, 53.2% of them were male and 46.8% were females. Their average age was 31.3 years. Among those interviewed, 5 (1.5%) had a previous diagnosis of dengue fever.

Two individuals (0.68%) had developed fever and bone/muscle pains in the previous three months. The clinics they had consulted had diagnosed the common cold as their ailment. Of those interviewed, 73 (21.5%) were negative for the serum IgM antibody test. Of the households in the neighborhood of the single confirmed case, six (9.0%) informed that health agencies had come to spray a pesticide indoors, while 46 (68.7%) had done the pesticide spraying outdoors. Table 2 indicates that the proportion of those who had heard of dengue fever previously was 85.1%; 67.2% knew that the dengue fever was transmitted by mosquitoes; 75% learned of dengue fever through the media; and 80% mentioned awareness that household sanitation and spraying of pesticides were important prevention and control measures against dengue fever.

Discussion and Conclusion

a) Case Finding

Of the 147 blood specimens collected from the Chenhsi Li, 3 were identified as IgM positive. It indicates that they had recently been infected with dengue fever, but they had not been diagnosed. Of those three, two developed symptoms such as fever, chill, muscle pain, postorbital pain, and rash and one developed no symptoms. An IgM positive case, without symptoms, is called a "sub-clinical dengue fever case". While including the index case, the total number of IgM positive cases in this community was four, which has a sub-clinical infection rate of 25%.

According to the CDC definition, the present study estimated a sensitivity of 75% and a specificity of 97% (see Table 3). For those developing clinical symptoms of dengue fever in the past three months, the IgM positive rate was 42.8% (3/7). CDC findings show an IgM positive rate of 30 to 45% for suspected dengue fever cases in the Americas from 1986 to 1992. These two IgM positive rates are fairly close. In areas of less aware and poorer quality of medical care, dengue fever can be mis-diagnosed. Of the four IgM positive cases identified in the present investigation, only one was reported, the other three went unnoticed. One of these three unnoticed cases did not develop symptoms. It is therefore speculated that dengue cases in this area were under-reported at a rate of about 67%. Those interviewed were neighbors of the cases identified, and included only 5% of the area's population. Whether the under-reporting rate represents the infection rate of dengue fever for of the entire community has yet to be learned.

Table 3. Results of the Serum IgM Antibody Test for Dengue Fever Symptoms.

		Serum IgM Antibody		
		Positive	Negative	Total
Symptoms similar to dengue fever in the past 3 months	Yes	3	4	7
	No	1	140	141
	Total	4	144	148

Note: sensitivity, 75% (3/4), and specificity, 97% (140/144).

Of those interviewed, 35 (9.1%) had a history of dengue fever infection; of the serum IgM positives, 2 had previous dengue fever infection. It was therefore speculated that the reinfection rate for dengue fever in this area was at least 5.7%. This indicates that the dengue virus is still active there, and more preventive measures are required. No IgM positive case was identified in the blood specimens collected in the Hsiehho Li. Serum IgM was also negative for the two cases who reported having some fever. No new case was identified.

b) Indoor and Outdoor Pesticide Sprayings

The confirmed case resides in Tzuli Street of the Chenhsi Li. There are about five households and a temple in the neighborhood, with an open space which is rented out for dinner parties about two or three times monthly. The two rows of buildings are back-to-back facing a six-meter-wide street. The street is relatively clean, without noticeable dirty water drains. Residents think of the street as relatively clean, of the lane and between-building drainage as rather dirty, and recognize that an open space near the index case's house is overgrown with weeds which harbor many mosquitoes. This could be the vector's breeding place. The other confirmed case at the Hsiehho Li lives in an illegally-built house. There are about three houses in this dirty, ill-smelling neighborhood. Buildings are disordered, and the four-meter wide street which is piled with junk. The index case has moved to Kaohsiung, and therefore has not been met.

Pesticide spraying, either indoors nor outdoors, according to the investigation were not frequent (4.3% indoor, 43.5% outdoor in the Chenhsi Li; and 9.0% indoor and 68.7% outdoor in the Hsieh-ho Li). According to the Manual for the Control of Dengue Fever"[1], health agencies are required to spray 25 households on either side of the residence of a case; the actual spraying rate was around 40% within the range of responsibility of health agencies. Some of the reasons for the low indoor spraying rate may be that individual households did their own spraying; or householders were not at home during the daytime hours; or spraying was refused for fear pesticides

may be hazardous to the health.

As to the effect of pesticide spraying on dengue fever infection, in each individual Li, neither indoor nor outdoor spraying was found to be significantly related to the infection ($p<0.05$) , though between the Lis, spraying outdoors was significantly related to the infection ($p<0.05$). The spraying rate of 68.7% in the Hsiehho Li was obviously higher than the 43.5% of the Chenhsi Li. In addition, spraying outdoors was found to be statistically, significantly related to dengue fever infection ($p<0.05$). Since the index case in fact lived elsewhere and no source of infection was found, it is difficult to reach a valid conclusion concerning the preventive effect of the pesticide spraying on the infection.

Literature[10] shows that when the vector indices of *Aedes aegypti* ova in a community range from 0 to 69%, the infection rates of dengue fever can run from 0 to 90%. Ecological analysis indicates that the relative risk of infection by dengue fever in an environment with 100% larva breeding is 12.7 times higher than in one with 0% larva breeding. Individual analysis, however, gives a relative risk of 1.1 folds. In other words, the higher the vector indices are in a given area, the higher the risk of dengue fever infection.

In this outbreak, the Breteau index in September was three and the larva index was six. No survey of the vector index was done in the Hsiehho Li. It is difficult to deduce the relationship between an ecological environment and dengue fever when the number of confirmed cases is so small (only three), and when spraying only, and not an actual environmental survey, was used for assessment. If the vector index in the environment is an alarming sign for dengue fever possibility, then an index change should warn both health agencies and the public to control the vectors. The failure of the present investigation to collect complete indices of dengue fever in the area is a study shortcoming.

c) Knowledge of dengue fever

In general, people of the two Lis knew of dengue fever, and the difference between the two Lis was not significant (91.3% in the Chenghsi Li versus 85.1% in the Hsiehho Li, $p<0.05$). Most people had learned about the dengue fever from the public media and health agencies (4.4% and 1.5% in Chenshi and Hsiehho Li, respectively). No difference was noted in knowledge about the route of transmission ($p<0.05$) between two Lis. This contradicts the general belief that knowing more about a diseases assists its prevention. Cognition is composed of knowledge, attitude and behavior. The questionnaire reflected only the knowledge portion, and did not explore either attitude or behavior. Having knowledge does not necessarily change behavior. At interview, neighbors may influence the answers obtained from the respondents. The effect of health education on prevention and control of dengue fever is, therefore, doubtful.

d) Limitation of investigation

The index case of the Hsiehho Li does not live there any more, and it is doubtful whether the case was indeed infected. The serum IgM antibody test did not identify any positive case, either. In future, any report of a suspected case of infectious disease should give a current address, not the place of registration, to avoid wasting time in attempting a follow-up.

Recommendations

a) In a high prevalence of dengue fever area, an environmental monitoring of the vector index should become a routine duty to detect any trend in infection. This trend information should be announced to the public as an aid to prevention.

b) In seasons of high prevalence of the dengue fever infection, the public should be alerted to that danger through the mass media. Consolidated efforts should be used to assist prevention.

c) When cases have been identified, it is recommended that the policy applied for a pesticide spraying (now by regulation within 50 feets of confirmed cases) should be revised.

d) With an increase in the number of dengue fever infection, more should be done to assess knowledge, attitude and behavior of the general pupulation. For example, to educate those living in high risk areas of dengue fever.

e) Studies of dengue viruses have been active in Taiwan. Indigenous studies of virology and related epidemiological data are still in process. When disease outbreaks occur, the media often fail to report correctly because information provided them is insufficient. An indigenous data base concerning dengue fever is very much needed.

Prepared by: S.F. Lee[1], H.C. Chou[1], P.H. Wu[1], Y.C. Wu[2], L. Chou[2], K.T. Chen[1]

1. Field Epidemiology Training Program, National Institute of Preventive Medicine, DOH
2. Epidemiology Division, National Institute of Preventive Medicine, DOH

References

1. Department of Health/Environmental Protection Administration. Manual for the Control of Dengue Fever, November 1991.
2. CDC. Case definitions for public health surveillance. 1990; 39: 10-11.
3. Benenson AS. Control of communicable diseases in man. American Public Health

Association 1990; 15th: 117-123.
4. World Health Organization. Dengue haemorrhagic fever: diagnosis, treatment and control. Geneva 1986: 12-13.
5. Halstead SB. The 20th century dengue pandemic: need for surveillance and research. World Health Stat Quart 1992; 45: 292-298.
6. Monath TP. Dengue: the risk to developed and developing countries. Proc Natl Acad Sci 1994; 91: 2395-2400.
7. Halstead SB. Pathogenesis of Dengue: challenges to molecular biology. Science 1988; 239: 467-481.
8. Halstead SB. Global epidemiology of dengue hemorrhagic fever. Southeast Asian J Trop Med and Public Health 1990; 21(4): 636-641.
9. Rigau-Perez JG, Gubler DJ, Vorndam AV et al. Dengue surveillance -- United States, 1986-1992. MMWR 1994; 43: 7-19.
10. Koopman JS, Longini IM. The ecological effects of individual exposures and nonlinear disease dynamics in population. Am J Public Health 1994; 84(5): 836-842.