

Epidemiology & Health Bulletin

— Contents —

Mosquito-borne Diseases
in Mainland China

Mosquito-borne Diseases in Mainland China

Malaria, dengue, filariasis and Japanese encephalitis are mosquito-borne diseases in Mainland China.

1. Malaria

Malaria has long been an important health problem. In 1932, soon after the lower part of Chang Jiang (Yangtze) was flooded, an epidemic of malaria occurred, with 60% incidence and 300,000 deaths. Before 1949, an estimation showed that half of the total population was at risk of infection, 70% of the counties were endemic of malaria, and 30 million cases occurred yearly.

(A) Vector species: Four species of anophelines have been confirmed recently as important vectors of malaria, i.e., *Anopheles sinensis*, *An. minimus*, *An. anthropophagus* and *An. dirus*.^(1,2) An updated review of their bionomics and control is made by Chow.⁽³⁾

An. sinensis has now become the most important vector due to its wide distribution and high density, although it is an inefficient vector. Of 2,760,000 cases of malaria reported in 1980 by the government, 80% occurred in the vast plain of Hubei, Shandong, Henan, Anhwei and Jiangsu provinces, where *An. sinensis* is considered the sole vector. It breeds mainly in ricefields. The adults prefer resting in cattle stables and biting animals. However, the mosquitoes in a stable will decrease to a very small number on the day following the removal of cattle.⁽⁴⁾

An. anthropophagus is an important vector in hilly regions along the Chang Jiang valley. It prefers cool and shady breeding sites and rarely occurs in ricefields. The adults rest more in houses than in animal stables, and prefer human blood, biting indoors. This species hibernates mainly in the egg stage.

An. minimus is the main vector in the hilly regions of south China, and *An. dirus* is a vector only on Hainan Island.

(B) Malaria situation: Generally speaking, malaria occurs in different parts of China, except the cold, high altitude areas in the south-west, mountainous districts in the north-east, and dry desert in the north and north-west, with 8% of the total population.

A large-scale control program was started in 1951, and the number of cases decreased to 1,393,500 in 1958 from 6,969,700 in 1954. The program had to be suspended due to the civil revolution, and unfortunately an outbreak occurred in 1970-71 in the vast plain between the Huang (Yellow) River and Huai River in Shandong, Henan, Anhui, Hubei and Jiangsu, with 21,980,000 cases, being 91% of the total cases in the whole country.

The nation-wide control program was resumed around 1978-80. In 1987, the number of cases was 210,600, compared with 363,700 cases reported in 1986. Some 865.4 million people in 2,447 counties were living in areas with a malaria incidence below 0.1 per 1,000; 142.7 million people in 261 counties with an incidence of 0.1-1.0 per 1,000; 52.9 million people in 114 counties with an incidence of 1.1-10.0 per 1,000; and 0.6 million people in four counties with an incidence of over 10.0 per 1,000.⁽⁵⁾

Although morbidity has been noticeably decreasing in recent years in central China with *An. sinensis* as the sole vector, a number of local outbreaks have occurred in the south (such as Hainan, Guangdong and Yunnan) where the vectors are *An. dirus* and *An. minimus*.

(C) Control: Resistance of *Plasmodium falciparum* to piperazine and possibly also to amodiaquine, mefloquine, quinine, and sulfadoxine/pyrimethamine has been detected in Hainan Province. A higher resistance of *P. falciparum* to chloroquine was found in the southern part of Yunnan.

In 1972, Chinese scientists isolated artemisinin (Qinghaosu) in pure form from *Artemisia annua*. This fernlike plant of the composite family has been used in Chinese traditional medicine to treat malaria for almost 2,000 years, the first record of such use dating from 340 A.D. It has been shown to be effective in both chloroquine-sensitive and chloroquine-resistant *P. falciparum* infections. In the early 1980s, WHO/TDR began collaborating with Chinese scientists in the development of drugs based on Qinghaosu.

Environmental management and chemical and biological control of vectors have been undertaken.

An. anthropophagus and *An. minimus* can usually be controlled by indoor residual spraying. Due to the exophilic habit of *An. dirus* and *An. sinensis*, it is difficult to control them by the same method.

In 1982 when the writer visited Hainan Island, suggestions were made to impregnate mosquito nets with deltamethrin or permethrin for mosquito control. Excellent results

were obtained in laboratory and field trials in Hainan for malaria control by the local malaria authorities.⁽⁶⁾ In 1987-89 approximately 2.2 million mosquito nets were treated with deltamethrin, providing protection for 5.46 million inhabitants in Henan, Sichuan and Jiangsu provinces. The incidence of malaria was reduced by 87% in those areas where the treated nets were employed.

2. Dengue

The earliest record of dengue in China seems to be an outbreak occurring in Shanghai in 1939-40.⁽⁷⁾ In 1945, 80% of the population in Hankow infected with dengue.⁽⁸⁾ After more than 30 years, dengue appeared again in 1978 in Foshan near Guangzhou (Canton) with 15,000 cases.

(A) Vector species: *Aedes aegypti* is the main vector, and *Ae. albopictus* is a secondary vector. However, in areas where the former species is absent, the latter becomes the sole vector, such as in the case of Foshan.

The occurrence of *Ae. aegypti* is limited to the south of 22° north latitude, in Guangdong, Guangxi and Hainan.⁽⁹⁾ *Ae. albopictus* is widely distributed in China, being more prevalent in the south of 32° north latitude.

(B) Dengue situation: There were 22,122 cases and 14 deaths in 1978 in Guangdong,⁽¹⁰⁾ and 437,469 cases and 64 deaths in 1980 in Hainan.⁽¹¹⁾ In 1988, there were 15,510 cases and 1,259 deaths in south China.⁽¹²⁾

During the large epidemic of dengue in Hainan in 1980, it involved more than 13 counties, with a morbidity of 2,146 per 10,000 population. Of 1,569 houses surveyed, 14.5% showed one case per house and 85.5% multiple cases per house. In one family with 30 inhabitants, 29 had dengue.⁽¹³⁾ It seems that there is an aggregation of cases in family.

(C) Control: Source reduction of larval habitats is launched by community participation. Cleaning and emptying artificial water containers are undertaken every five days. Temephos (Abate) 1% sand granules are applied to the water containers which cannot be emptied. For epidemic control to kill adult mosquitoes, space spraying with malathion, fenitrothion or deltamethrin is undertaken.

In Guangxi, the Chinese cat fish (*Clarias fuscus*) is placed in water containers for *Aedes* larval control.⁽¹⁴⁾ Fifteen days after placing the fish the Breteau index dropped from 50 to 0. While in another area by space spraying with insecticides, it dropped from 64 to 48 only. Furthermore, the cost for insecticide spraying is 15 times higher than that by biological control with fish.

In Hainan, *Bacillus thuringiensis* is applied to water containers, even with potable water.

3. Filariasis

Although *Wuchereria bancrofti* has been known to occur in China for several hundred years, the occurrence of *Brugia malayi* was reported only 60 years ago by Feng⁽¹⁵⁾ who also described its development in the mosquitoes.⁽¹⁶⁾ Both species are of nocturnal periodicity.

(A) Vector species: The main vectors of *W. bancrofti* are *Culex pipiens pallens* and *C. quinquefasciatus*, occurring in the north and south of 32° north latitude respectively. Both species rest mainly in houses and prefer human blood.

The important vectors of *B. malayi* are *An. sinensis* and *An. anthropophagus*.

Ae. togoi is the vector of limited importance of *W. bancrofti* and *B. malayi* along coastal areas of south-east China. It breeds in sea water in rock holes. The adults rest in houses and feed on man.

(B) Filariasis situation: Both *W. bancrofti* and *B. malayi* occur in many provinces, except Shandong and Guangdong where there is only *W. bancrofti*.⁽¹⁷⁾

Information obtained through the replies of the questionnaire sent by WHO shows that before a large-scale control program was undertaken in 1980, there were 17,398,000 persons positive with *W. bancrofti* microfilariae and 8,196,000 persons with *B. malayi* microfilariae.

During 1981-85, of 93,789,000 persons examined, 1,624,000 were positive with microfilariae. At the end of 1985, filariasis was eradicated in 600 out of 864 counties of endemic areas, and no more filariasis was found in Shandong, Guangxi, Guizhou and Shanghai. While in other areas there were 4,868,000 cases (4,013,000 of *W. bancrofti* and 855,000 of *B. malayi*), and this is only 1/6 as compared with the number of cases found before the control program was implemented.⁽¹⁸⁾

(C) Control: It is difficult and not practical to control the vector mosquitoes with insecticides, except for *An. anthropophagus*. Therefore drug treatment is the main method for filariasis control.

Since 1972, the Institute of Parasitic Diseases of Shandong started a large-scale application of medicated salt with 0.3% diethylcarbamazine (DEC). It is estimated that a person takes 16.7 gm of the salt per day, and 9 gm of DEC in a total period of six months, i.e., 50 mg DEC per day. Taking an average of 50 kg body weight of an adult, the total dose of DEC is 180 mg/kg. Excellent results have been achieved in controlling filariasis in the whole country by medicated salt.

4. Japanese encephalitis

Japanese encephalitis (JE) occurs in different parts of China, except Qinhai,

Xinjiang and Xizan (Tibet). In 1988, there were 25,123 cases.

The main vector is *Culex tritaeniorhynchus*, which breeds mainly in ricefields. It feeds on man and animals, mostly indoors throughout the night, but rests outdoors. This species hibernates in its adult stage. However, it is difficult to discover the mosquitoes during their hibernation, and it appears that so far only in one case during 1950s a few *C. tritaeniorhynchus* adults were found in woodpiles stacked near houses on the outskirts of Shanghai.

For the control of JE, immunization of humans and pigs is the most reliable and cost-effective preventive measure.

Improvement and alternation of environmental conditions would also help in reducing the vector mosquitoes. For example, in Shandong JE cases have been reduced by the changing of rice planting to wheat planting. In Shanghai, by improving environmental conditions to reduce breeding sites and resting places for the vector mosquitoes, the number of JE cases was reduced from 50 per 100,000 population in 1965 to 2.3 in 1978.

Reported and prepared by: C.Y. Chow (formerly WHO Regional Adviser on Vector Biology and Control).

Editorial note: Mosquito-borne diseases remain important health problems in Mainland China.

When a disease is under control, man-power and resources are usually shifted to another area. As the disease has not been eradicated and the vectors are still present, it is possible that an outbreak may resume anytime, such as in the case of malaria control in Sri Lanka (Ceylon), dengue control in Singapore and schistosomiasis control in China. It is therefore necessary to have good surveillance systems and resources to cope with any outbreak.

References

1. Zhou ZJ. The malaria situation in the People's Republic of China. Bull Wld Hlth Org 1981; 59:931-6.
2. Luh PL. Vector mosquitoes in China. Working paper presented at the national workshop on the control of vector mosquitoes, held in Kwelin, China in November 1984 (in Chinese).
3. Chow CY. Malaria vectors in China. Chin J Entomol 1991; Special Issue No.6:67-79.
4. Chow CY. The bionomics of two important malaria vectors in China. Proc 4th Intern Congr Trop Med Mal Wash DC 1948; 1:861-5.
5. Advisory Committee on Parasitic Diseases. Malaria situation in China, 1987. Chin J Parasitol Parasit Dis 1988; 6:241-4 (in Chin with Eng Abs).

6. Li ZZ, Xu JJ, Li BQ, Zu TH, Li MX. Mosquito nets impregnated with deltamethrin against malaria vectors in China. WHO unpublished document 1987; WHO/VBC/87.939.
7. Ying YY. Tropical Diseases. People's Health Publisher 1954; p 60 (in Chin).
8. Capps RB. Dengue. In "Internal Medicine in World War II. Vol. II. Infectious Diseases," Coates JB ed. Wash DC 1963; p 70-1.
9. *Aedes aegypti* and *Ae. albopictus* control program. Survey of *Ae. aegypti* and *Ae. albopictus*. J Chin Epidemiol 1982; 3:354-6.
10. WHO. Viral haemorrhagic fevers. Tech Rep Ser 1985; No. 721.
11. Hainan Anti-epidemic Station. Report of dengue in Hainan 1980; p 110.
12. WHO Newsletter 1990; Vol. 16.
13. Chao JK, Chin FH. Epidemiological survey of dengue on Hainan Island. J Chin Epidemiol 1986; 7:29-32.
14. Wu N, Wang SS, Hang GE. Control of *Aedes aegypti* larvae in household water containers by Chinese cat fish. Bull Wld Hlth Org 1987; 65:503-6.
15. Feng LC. Household mosquitoes and human filariasis in Amoy, South China. Chin Med J 1933; 47:168-78.
16. Feng LC. The development of *Microfilaria malayi* in *Anopheles hyrcanus* var. *sinensis*. Chin Med J 1936; 50, Suppl I:345-67.
17. Chung SK. Human Parasitology. 1983; p 767. Beijing People's Health Publ.
18. Advisory Committee on Parasitic Diseases. Recent advances in filariasis control in China. J Parasitol Parasit Dis 1986; 4:244-5.