

# LONGITUDINAL SURVEILLANCE AFTER FILARIASIS CONTROL IN GUANGDONG PROVINCE, CHINA

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**Abstract.** This paper reports the longitudinal surveillance with epidemiology, entomology and serology after filariasis has been controlled. The results showed that the microfilarial rate, natural infection rate of vectors and the positive rate of filarial antibodies decreased year by year.

## INTRODUCTION

In Guangdong Province, 67 counties (not including Hainan Island, which was established as a province in 1987) are endemic for filariasis with the total population at risk being 17,902,057. The filariasis situation in Guangdong Province has been reported by Zuoyan *et al* (1991). Since 1988, all control measures were stopped and surveillance was started because the microfilarial rate and microfilaria density had been reduced to a negligible level. We report here details of longitudinal surveillance from 1988 to 1992 after filariasis had been controlled.

## MATERIALS AND METHODS

### Observation areas

Nine observation areas were selected according to the geographical distribution of filariasis, among which were eight areas with bancroftian filariasis and other with brugian filariasis.

### Epidemiologic surveillance

One hundred and twenty microliters (120 µl) of peripheral blood were taken from residents above 1 year old for the detection of microfilaricidal and microfilaria count in the first (1988), third (1990) and fifth (1992) year of observation, respectively. The microfilaricidal were not treated and they were examined each year. The conversion to the amicrofilaricidal state was determined through peripheral blood examination 3 times within one month.

### Entomological surveillance

*Culex quinquefasciatus* (bancroftian filariasis transmission vector) and *Anopheles sinensis* (brugian filariasis transmission vector) were collected and dissected to observe the natural infection rate yearly. Examination of identification of host sources of blood meal, the parous rate of vector, the gonotrophic cycle, man biting rate and daily survival rate of *Cx. quinquefasciatus* were carried out during this period.

### Serological surveillance

In the first and fifth year, surveys for filarial antibodies as detected by ELISA were carried out in the areas with microfilaricidal.

### Investigation of human protection from mosquitoes

The situation of residents using mosquito-net to protect from mosquito bite was investigated in the first and fifth year.

## RESULTS

### The main characteristics of observation areas

The observation areas were meso-endemic or hyper-endemic for filariasis with the microfilarial rate over 5% before control (Table 1).

### Epidemiologic surveillance

36, 23 and 9 microfilaricidal were found from 18,746, 16,191 and 16,796 persons examined in 1988, 1990 and 1992 respectively; the microfilarial

Table 1  
Main characteristics of observation areas.

Country or city	Township	Microfilarial rate before control				Control measures
		Exam year	No. of exam	No. of positive	Microfilarial rate (%)	
Raoping	Haishan	1971	2,084	118	5.76	A
Huiyang	Pingtian	1972	2,014	161	7.99	A
Conghua	Taiping	1957	2,106	468	22.22	C
Taishan	Fucheng	1965	1,689	101	5.98	B
Doumen	Wushan	1970	1,924	207	10.76	C
Suixi	Lemin	1985	3,307	265	8.01	B
Yangshan	Gaofeng	1974	7,659	456	5.95	C
Ruyuan	Daqiao	1982	3,047	341	11.19	C
Pingyuan	Bachi*	1959	282	81	28.7	A

\* Brugian filariasis endemic area

A Repeated check-up and selective treatment with DEC

B Selective treatment for microfilaremias combined with mass administration with DEC for people over 3 years old.

C Selective treatment for microfilaremias combined with DEC-fortified salt for people.

rates were 0.19%, 0.14% and 0.05%, respectively. The microfilarial rate was reduced year by year (in most areas (Table 2).

#### Microfilaremic conversion to negative

About 75% of microfilaremics converted to

negative within 5 years, with the microfilaria density being down from 15.3 per 120  $\mu$ l to 7.6 per 120  $\mu$ l (Table 3). The microfilaria conversion to negative rate and the number years of observation showed a linear positive correlation, the correlation coefficient being 0.9907 ( $p < 0.01$ ), the regression equation was  $Y = 19.45 X - 17.78$ .

Table 2  
Microfilarial rate by year in areas surveillance.

Spot	1988			1990			1992		
	No. exam	No. pos	Mf rate (%)	No. exam	No. pos	Mf rate (%)	No. exam	No. pos	Mf rate (%)
Raoping	2,006	4	0.21	2,005	3	0.15	2,001	3	0.15
Huiyang	2,014	2	0.10	1,893	2	0.11	1,787	2	0.11
Conghua	2,081	0	0.00				2,042	0	0.00
Taishan	1,873	0	0.00	1,684	0	0.00	1,869	0	0.00
Doumen	1,601	0	0.00	1,583	0	0.00			
Suixi	2,028	13	0.64	2,024	8	0.40	2,023	2	0.09
Yangshan	2,058	0	0.00	2,020	0	0.00	2,010	0	0.00
Ruyuan	3,012	17	0.56	2,929	9	0.31	2,797	2	0.07
Pingyuan	2,055	0	0.00	2,061	0	0.00	2,087	0	0.00
Total	18,728	36	0.19	16,194	22	0.14	16,616	9	0.05

Mf = microfilaria; pos = positive; exam = examination

Table 3  
Microfilaria carriers converting to amicrofilaremic.

Year	No. of Mf pos	No. of Mf converted to negative	Mf conversion negative rate (%)	Mf density (No/120 µl)	
				Average	Highest
1988	36	0	0.00	15.3	42
1989	28	8	22.22	9.3	28
1990	22	14	38.89	9.9	22
1991	12	24	66.67	7.2	12
1992	9	27	75.00	7.6	13

### Serological surveillance

Filarial antibody examination was conducted in 4 areas with microfilarems. Anti-filarial antibodies were detected in 2,091 out of 7,226 persons in 1988 and 484 out of 3,974 persons in 1992; the antibody positive rates were 28.94% and 12.18%, respectively. The results showed that the filarial antibody positive rate dropped following the decline in microfilarial rate (Table 4).

### Filarial natural infection survey of vectors

A total of 87,965 *Culex quinquefasciatus* in 8 endemic areas of bancroftian filariasis were dissected during 1988 to 1992. Of these, 32 were detected with filarial larvae. The mean natural infection rate was 0.04% and for the period were 0.11%, 0.03%, 0.03%, 0.01% and 0.01% respectively. Infective larvae (L3) were found in 1988 to

1990, the L3 rate being 0.03%, 0.01% and 0.01% respectively. A total of 5,851 *Amopheles sinensis* were dissected in brugian filariasis endemic area during the same period; human filaria infection was not found (Table 5).

### Experimental infection of *Culex quinquefasciatus*

*Cx. quinquefasciatus* was fed on 4 volunteer donors with an average microfilaria density of 4.32 per 120 µl. Of the 977 *Cx. quinquefasciatus* dissected 12-13 days post-feeding, 58 harbored infective filarial larvae (L3). The artificial infection rate was 5.9% and average infective larvae was 1.41 per positive mosquito.

### Identification of host sources of blood meal

The identification of host source of blood meal of vector was conducted by precipitation test of

Table 4  
Results of serological surveillance.

Spot	1988				1992			
	Mf rate (%)	No. exam	No. pos	Positive rate (%)	Mf rate (%)	No. exam	No. pos	Positive rate (%)
Raoping	0.20	1,519	283	18.63	0.15	1,080	60	5.56
Huiyang	0.10	1,873	420	22.42	0.11	1,077	97	9.01
Ruyuan	0.56	2,002	320	15.98	0.09	737	64	8.68
Ruixi	0.64	1,832	1,068	58.30	0.07	1,080	263	24.35
Total	0.40	7,226	2,091	28.94	0.10	3,974	484	12.18

Table 5

Entomological survey for natural filarial infection in vectors.

Year	<i>Cx. quinquefasciatus</i>					<i>An. sinensis</i>		
	No. diss	No. pos	Positive rate (%)	L3 rate (%)	No. of L3 per pos vector	No. diss	No. pos	Positive rate (%)
1988	15,820	18	0.11	0.03	1.25	1,035	0	0.00
1989	18,410	6	0.03	0.01	2.00	1,407	0	0.00
1990	17,230	5	0.03	0.01	2.00	1,332	0	0.00
1991	19,749	1	0.01	0.00	0	1,063	0	0.00
1992	16,756	2	0.01	0.00	0	1,041	0	0.00
Total	87,956	32	0.04	0.01	1.33	5,851	0	0.00

diss = dissected

mosquito mid-gut blood in 8 bancroftian filariasis endemic areas and 1 brugian filariasis endemic area. Of the 2,335 *Cx. quinquefasciatus* examined, 1,817 showed positive reactions to human serum. The man-biting index was 0.7782. This result showed that although *Cx. quinquefasciatus* is mainly an anthropophilic species, it also fed on animal blood. Of the 318 *An. sinensis* examined, 17 showed positive reaction to human serum with the man-biting index of 0.0535, thus indicating *An. sinensis* to be a concurrently anthropophilic species.

#### The parous rate of female vectors

Of the 4,510 *Cx. quinquefasciatus* and 2,737 *An. sinensis* dissected. The 2,612 (57.92%) and 2,078 (75.92%) were parous, respectively.

#### Gonotrophic cycle of *Cx. quinquefasciatus*

A total of 39 *Cx. quinquefasciatus* were fed by artificial blood meal and reared in laboratory at 26-35 °C, and observed at 2-hourly intervals for 13 days. The earliest period from taking of a blood meal to oviposition was 69 hours and the latest at 304 hours, with an average of 150.13 hours (6.26 days). The development of filarial larvae in *Cx. quinquefasciatus* body required 12 to 14 days in the same environment, corresponding to 2 gonotrophic cycles.

#### Man-biting rate of *Cx. quinquefasciatus*

A double bed-net trap was used for catching mosquitos coming to feed on man from 19.00 hours

to 06.00 hours, twice per month for 12 months in the northern part (Ruyuan County) and for 3 months (May to July) in western part (Suixi County) of this province. The daily average number of man-bites were 20.2 and 31, the number of annual man-bites were 7,376 and 11,315 respectively (average 9,345). The *Cx. quinquefasciatus* man-biting season was April to October in the northern part and March to December in the western part with filarial transmission periods of 214 days and 306 days, respectively (average 260 days).

#### Daily survival rate of *Cx. quinquefasciatus*

*Cx. quinquefasciatus* was maintained in the laboratory at a temperature of 26-33 °C and relative humidity of 69-92% after a blood meal. A total of 578 out of 602 mosquitos survived 13 days post-feeding. Its daily survival rate was 99.69%. If the daily survival rate was calculated by the formula of  $p = \frac{d}{q}$  (Sasa 1976), the daily survival rate (p) was estimated as 91.65%, since the parous rate of *Cx. quinquefasciatus* (q) was 57.92% and the gonotrophic cycle (d) was 6.26 days.

#### Personal protection from mosquito bites

Personal protection from mosquito bites was investigated at the family level in 1988 and 1992. The results showed that the effective intact mosquito-nets playing a protective role were 86.04% (9,820/11,413) in 1988 and 93.77% (13,666/14,574) in 1992. Torn mosquito-net use, with non-effective

protection from mosquito bite and those without mosquito-nets were 13.96% in 1988 and 6.23% in 1992, respectively. These results indicate that the social economic condition and living standard have distinctly improved, and that the consciousness of the need for protection from mosquitos has heightened.

## DISCUSSION

Manabu Sasa (1976) pointed out that filariasis in an endemic area can be controlled, or the transmission of the parasite can be interrupted, if certain sanitary measures are applied effectively at one or more points in the life cycle of the parasites or their carriers. In Guangdong Province, considering the dearth of animal reservoirs, relative inefficiency of transmission and the availability of an effective and safe filaricide diethylcarbamazine (DEC) in treating microfilaremia cases, elimination of infection sources has been adopted as a major intervention measure in filariasis control. After control, the microfilarial rate has dropped to below 0.5% in the villages (0.12% in December 1986). Sasa (1976) considered "It follows that there can be a noninfective microfilarial level in the blood (other than zero), but when microfilariae are few, then few mosquitos will become infected". Zuoyan *et al* (1983 a, b), argued that *Cx. quinquefasciatus* can not be infected when the microfilarial rate is below 0.5% and the microfilariae density lower than 5 per 60  $\mu$ l blood after control. Zongjun *et al* (1988) deemed that the transmission role of low density microfilaria cases can be expressed by the product of man-biting rate (No./man/night), number of days of transmission season, the proportion of female mosquitos with infective larva per positive mosquito and the index of man-biting. The data of 1988 in this paper was substituted for calculating the transmission role. The result showed that the 0.63 infective larvae can be transmitted to people around

one microfilaremic ( $9,346/365 \times 260 \times 0.9165 \times 0.0003 \times 1.25 \times 0.7782 = 0.63$ ). In the late stage of filariasis control, it is difficult for filariasis transmission to continue even though a few low density microfilaremia cases exist. In the present condition of Guangdong Province, filariasis can be eradicated if surveillance is strengthened, microfilarial rate reduced, and if there is personal protection through the use of mosquito-nets.

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