

## Leprosy Control in Shandong Province, China, 1955–1983; Some Epidemiological Features<sup>1</sup>

Li Huan-Ying, Pan Yu-Lin, and Wang Yang<sup>2</sup>

Shandong has had a high occurrence of leprosy in the past. Its history of leprosy can be traced back to the classic "Lun Yu," 436 B.C. (5).

In 1949, when New China was founded, a preliminary investigation in six counties found that the prevalence was approximately 1 per 1000. A provincial leprosy control program was initiated in 1955. In the present article, results registered and epidemiological features observed during this program are presented.

### MATERIALS AND METHODS

This coastal province has a temperate climate with 650 mm average annual rainfall. To the north of the Yellow River it is of alluvial plain, and hilly terrain is found in the mid-southern parts of the province. One of the most densely populated provinces of China, Shandong's population increased from 51.74 million in 1955 (345 persons/square kilometer) to 75.58 million in 1983. Statistical reports on the population have been annually provided by the Demography Section, Bureau of Statistics, Jinan, Shandong.

**Administration and reporting system.** The provincial leprosy control program consists of the Provincial Skin Disease Control Institute (SDCI), a network of 72 Skin Disease Control Stations (SDCS) and 77 leprosy hospitals at the county level. At present, Shandong has more than 100 medical graduates and 400 middle-level medical graduates who have received 6–12 months' leprosy training at SDCI, working at different levels of the control program (Fig. 1).

**Case finding.** SDCI organized repeated

clue surveys for the whole province in 1955–1958, 1965–1966, 1971–1972, 1975–1976 and again in 1983–1984 (Fig. 2). In these surveys, the ten major symptoms of leprosy have been made widely known to the public, and people have been asked to report suspected cases to their local SDSCS for further investigation.

Between 1972 and 1975, mass screening surveys were conducted in 29 high prevalence (> 1/1000) counties with a population of about 18.5 million. In these surveys, the whole population was examined by health workers with one week of intensive training, and suspected cases were re-examined by doctors of the SDSCS. General surveys have been conducted by 30–40 leprosy doctors in four communes of high prevalence (2–4/1000) with a population of about 150,000. Furthermore, general skin clinics have been sensitized to detect leprosy cases when present among skin disease patients. In the past few years, a bonus of 20 Yuan has been awarded for each new case reported, provided the diagnosis is confirmed by a specialist.

**Registration.** For each case of leprosy, there is a complete history and follow-up record as well as an individual patient card which is kept at the SDSCS at the country level. The Ridley-Jopling scale was substituted for the Madrid classification in 1974. Each new case is confirmed by histopathology. Relapsed cases are not registered as new patients.

These county level registries compile the relevant statistics and submit annual summary reports to the Skin Disease Control Section of the Prefecture Bureau of Health with a copy of the SDCI. Items of data for each new case and statistics on leprosy for the calendar year were revised during the course of the control program in 1963 (ASF) and 1973 (DF). They compare favorably with the OMSLEP System (3), but duration of illness at the time of diagnosis has also been recorded in Shandong and, on this ba-

<sup>1</sup> Received for publication on 11 May 1984; accepted for publication in revised form on 9 August 1984.

<sup>2</sup> H.-Y. Li, M.D., M.P.H., Research Member, Beijing Tropical Medicine Research Institute, Beijing; Y.-L. Pan, M.D., Statistician, and Y. Wang, M.D., Director, Shandong Provincial Skin Disease Control Institute, Jinan, Shandong Province, People's Republic of China.

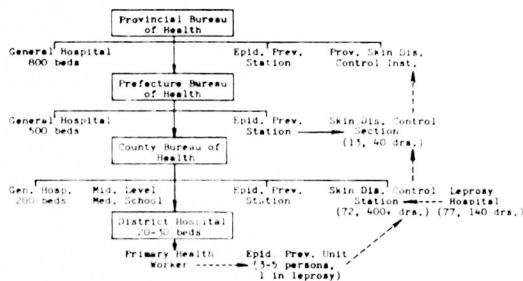


FIG. 1. Administration and reporting system of leprosy control, Shandong Province.

sis, detection and incidence rates have been calculated.

**Treatment and follow up.** Dapsone was the main drug used throughout. The daily dosage was reduced from 200–300 mg to 100 mg in 1970. Most (80%) of the multibacillary patients were treated as inpatients until clinically cured, at which time they were treated as domiciliary patients with dapsone 50 mg/day for five years and examined annually for another five years. The rest of the multibacillary patients, who refused to be hospitalized, were treated at home. Paucibacillary patients received dapsone 100 mg/day for 3–5 years, then 50 mg/day for 3 years, and they were examined annually for another 7 years. Regularity of treatment for both multibacillary and paucibacillary patients generally exceeded 75%. Criteria for cure were laid down at the Provincial Leprosy Conference (1957) and again modified at the National Leprosy Conference (1963). Briefly, the criteria were as follows: a) complete disappearance of lesions, b) no nerve tenderness and/or leprosy reactions for at least one year, c) six consecutive negative smears within one year for multibacillary patients and negative smears before and after therapy for paucibacillary patients, and d) only nonspecific inflammation in biopsies taken from formerly active lesions. Relapsed cases were treated according to the regimen for new patients.

## RESULTS

**Case detection rate.** The peaks observed in the curves of case detection rates by sex and type correspond to the clue surveys conducted for the whole province in 1956, 1965, 1973 and in 1975, and for selected areas in 1983 (Table 1, Fig. 2).

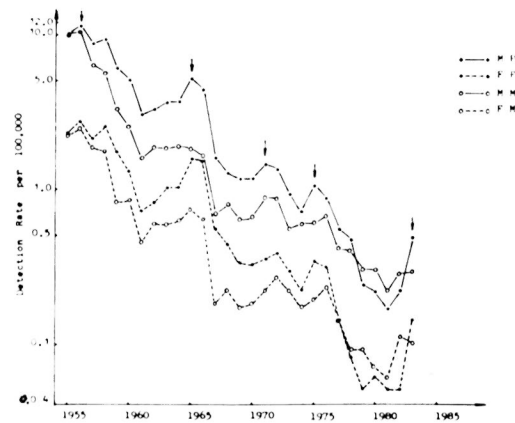


FIG. 2. Annual case detection rates by sex and type, Shandong Province, 1955–1983.

The duration of illness at the time of diagnosis has been shortened over the years—the proportion of new patients with a duration of more than five years decreased from 48.5% registered in 1955–1959 to 24.5% in 1980–1983 (Table 2). The deformity rate (WHO Grade II) in 1982–1983 was 10.9% (69 patients).

**Prevalence.** For the whole province, peak prevalence was found in 1960—4.5/10,000. By the end of 1983, the prevalence had decreased to 0.24/10,000. In 1960 there was a high prevalence (10–20/10,000) in the mid-eastern parts of Shandong and in three counties in the peninsula (Fig. 3). The highest prevalence, 20.2/10,000, was found in Wu-Lian, a very hilly, moderately populated and relatively economically poor county. In subsequent years, the prevalence has considerably decreased in all counties. In 1983, only Wu-Lian was left with a prevalence higher than 1/10,000 and 11 counties were free from leprosy.

**Incidence.** The decline in incidence rates started in the fifth year of the control program (Fig. 4). For the period 1955–1970, the exponential annual decline in incidence was 10.13%. It is estimated that by 1993 the incidence for the whole province will be reduced to 0.9/million. An effective family planning program has been in operation since 1975, and because the population increase has slowed from 2.12% to 0.97% (1975–1983), the annual decline of incidence will have to be readjusted to 9.05%. Consequently, the target of basic eradica-

TABLE 1. Annual detection rates of leprosy per 100,000 by type and sex, with five-year average L/T ratio by sex and sex ratio, Shandong Province, 1955–1983.

Year	Multibacillary				Paucibacillary				5-year average		
	No.		Rate		No.		Rate		L/T		M/F
	M	F	M	F	M	F	M	F	M	F	
1955	2637	567	10.19	2.19	2597	564	10.03	2.18			
1956	2729	642	10.38	2.44	3049	711	11.60	2.71			
1957	1700	489	6.33	1.82	2380	564	8.85	2.10	0.77	0.79	3.66
1958	1530	468	5.64	1.73	2585	689	9.53	2.54			
1959	880	220	3.28	0.82	1659	459	6.17	1.71			
1960	673	218	2.59	0.84	1323	334	5.10	1.29			
1961	410	118	1.57	0.45	810	190	3.08	0.72			
1962	501	160	1.85	0.59	880	221	3.24	0.81	0.52	0.64	3.64
1963	508	164	1.82	0.59	1008	281	3.61	1.01			
1964	552	173	1.87	0.62	1015	283	3.62	1.01			
1965	519	208	1.82	0.73	1486	442	5.20	1.55			
1966	480	180	1.64	0.62	1294	448	4.42	1.53			
1967	207	55	0.69	0.18	475	163	1.59	0.55	0.41	0.44	3.72
1968	244	67	0.80	0.22	392	131	1.29	0.43			
1969	201	53	0.64	0.17	368	103	1.17	0.33			
1970	209	59	0.65	0.18	379	102	1.18	0.32			
1971	289	72	0.88	0.22	483	116	1.47	0.35			
1972	228	90	0.83	0.27	455	127	1.36	0.38	0.62	0.67	3.64
1973	185	71	0.54	0.22	316	97	0.93	0.29			
1974	204	53	0.59	0.17	246	76	0.71	0.22			
1975	210	66	0.60	0.19	369	120	1.06	0.34			
1976	240	80	0.68	0.23	305	109	0.87	0.31			
1977	146	50	0.41	0.14	195	51	0.55	0.14	0.75	0.80	3.93
1978	143	32	0.40	0.09	170	30	0.47	0.08			
1979	107	33	0.30	0.09	85	17	0.24	0.05			
1980	108	26	0.30	0.07	79	21	0.22	0.06			
1981	80	23	0.22	0.06	64	20	0.17	0.05	1.28 <sup>a</sup>	1.17 <sup>a</sup>	3.29 <sup>a</sup>
1982	106	41	0.28	0.11	84	19	0.22	0.05			
1983	116	30	0.29	0.10	193	42	0.48	0.14			

<sup>a</sup> Four-year average for 1980–1983.

tion set at the Second National Leprosy Conference in 1981 (decrease of incidence to <2/million, county-wise) will have to be delayed until about 1997.

**Relapse.** No detailed clinical or laboratory investigations have been made on re-

lapsed cases. Of a total of 36,510 patients, 1897 (5.2%) relapsed and were re-treated with dapson, of which 1341 were proclaimed as cured again. Presumably, the remaining 556 (1.5%) patients who did not respond to dapson were dapson resistant.

TABLE 2. Delay in case detection by year of diagnosis, Shandong Province, 1955–1983.

Year of diagnosis	Duration of illness					
	<1 year		1–4 years		>5 years	
	No.	%	No.	%	No.	%
1955–1959	3,731	13.7	10,245	37.8	13,143	48.5
1960–1964	2,028	20.7	5,011	51.1	2,760	28.2
1965–1969	1,628	21.7	3,764	50.1	2,124	28.2
1970–1974	1,005	25.7	1,936	49.5	967	24.7
1975–1979	549	23.2	1,270	49.7	693	27.1
1980–1983	252	24.0	542	51.5	258	24.5

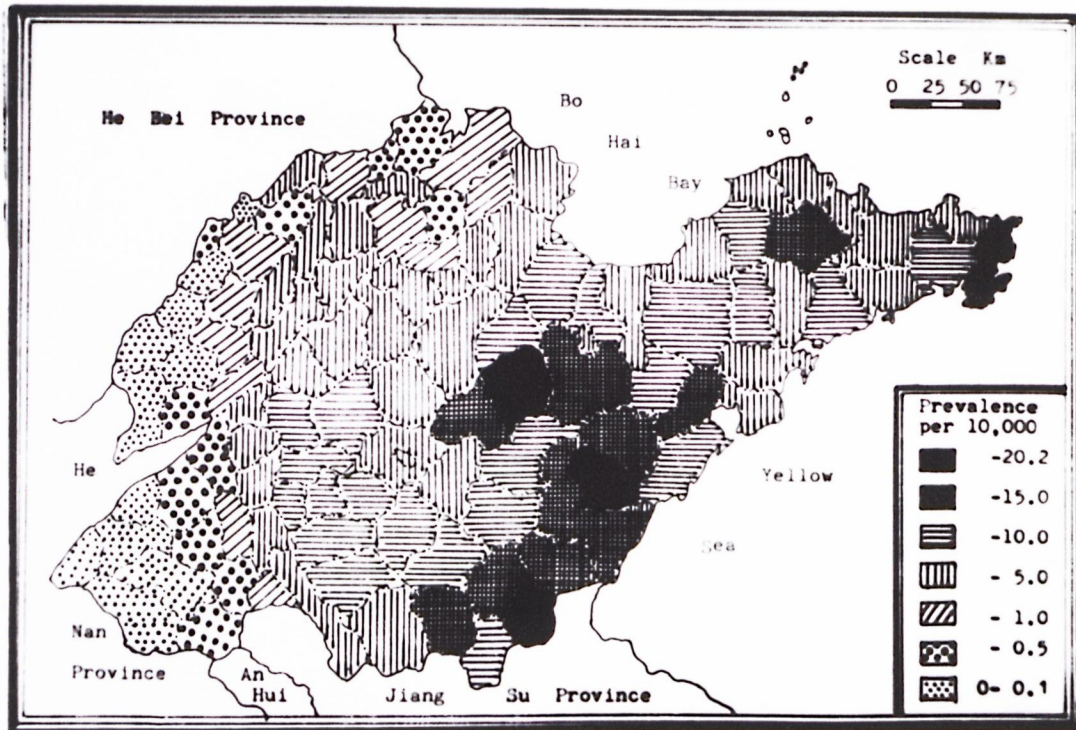


FIG. 3. Prevalence of leprosy by county, Shandong Province, 1960.

**Age- and type-specific rates.** With the decline of incidence, there was a steady rise in the mean age at onset from 30.5 (1955–1959) to 38.4 (1975–1979) years for males and from 28.1 to 38.9 years for females for the same period. Correspondingly, the proportion of new cases belonging to age groups

less than 30 years has decreased from 60.8% (1955–1959) to 40% (1975–1979) (Fig. 5).

Age- and sex-specific rates show that the peak age at onset in males for the period 1955–1969 was in the age group 20–29 years, and shifted to older age groups from 1970 onward (Fig. 6a). The peak age at onset for females was lower—in the age group 15–19 years during the period 1955–1964. It rose to 60+ years from 1965–1969 onward (Fig. 6b).

When analyzed by year of birth, there was a steady decline in the age-specific incidence for males and females in successive five-year cohorts (Fig. 7). However, within each cohort the distribution of cases by age was fairly constant with no evidence of an increasing age at onset in the later cohorts.

**Lepromatous/tuberculoid (L/T) ratio.** In the early period of the campaign, as more multibacillary patients were detected, the L/T ratio based on year of detection was high—0.77 for males and 0.79 for females. After ten years of control the ratio decreased to 0.41 and 0.44, respectively, and rose slowly thereafter (Fig. 8).

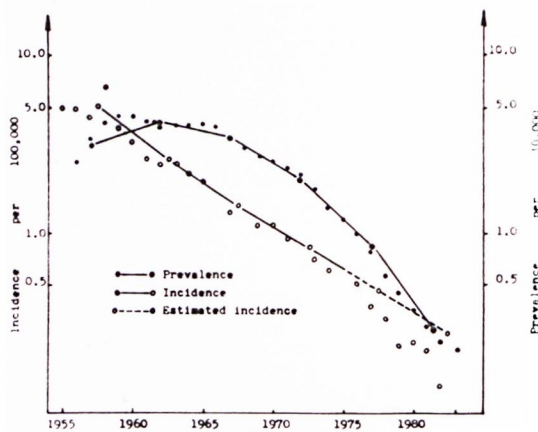


FIG. 4. Annual and five-year average annual incidence and prevalence rates, Shandong Province, 1955–1983.



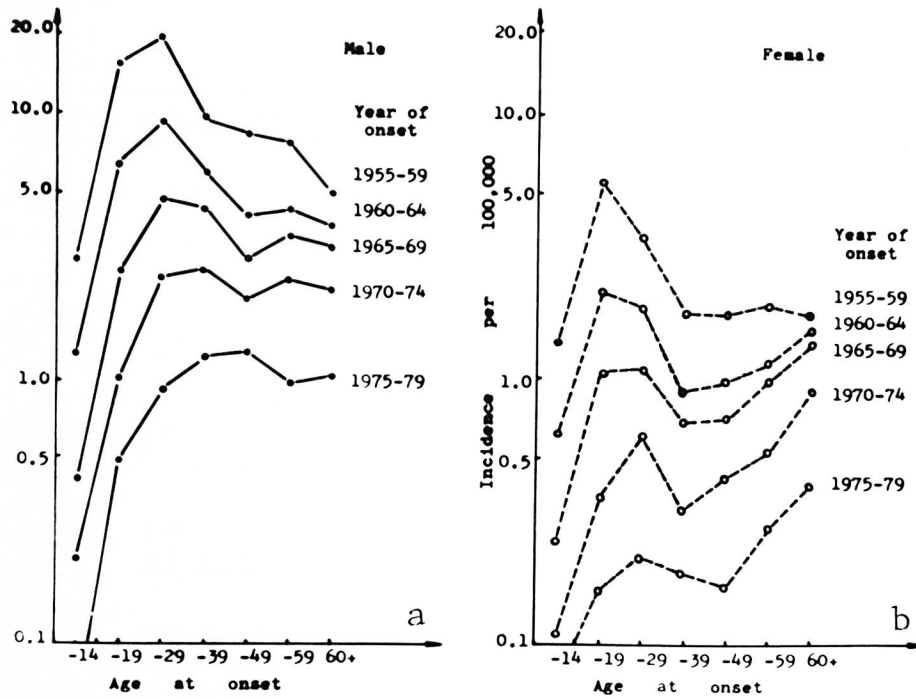


Fig. 6. Age- and sex-specific incidence rates by year of onset, Shandong Province, 1955-1979.

The L/T ratio by year of onset will be studied from cases detected during the same year as the year of onset. Further studies, involving comparisons between countries experiencing a decline in incidence rates, would no doubt clarify the epidemiological

patterns of the process of eradication of leprosy. To study the bimodality in incidence rates for paucibacillary leprosy and the difference in peak incidence between the two types of leprosy by age and sex (4) would be of particular interest.

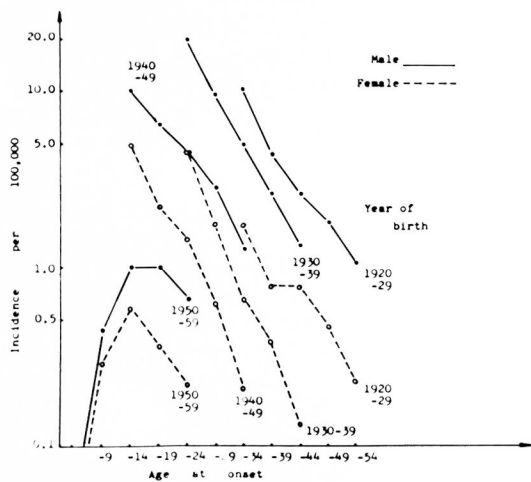


FIG. 7. Age- and sex-specific incidence rates by year of birth, Shandong Province, 1925-1955.

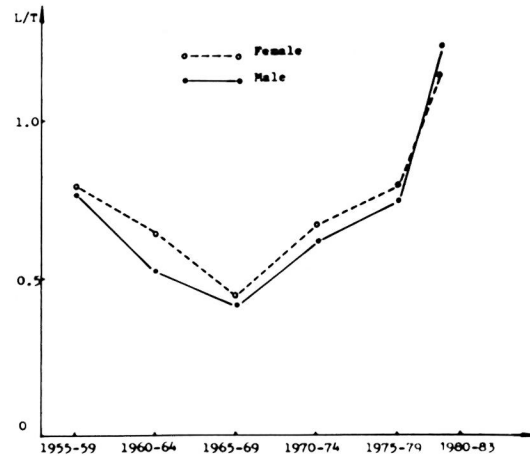


FIG. 8. L/T ratio by sex and year of detection, Shandong Province, 1955-1983.

Relapse with dapsone resistance does not seem to be as alarming a problem in Shandong as that observed in some other countries. Apparently this is due to the strict adherence to the criteria of cure laid down at the early phase of the leprosy control program and to the continuation of dapsone therapy after clinical cure. Further studies of relapsed patients as to the immunological and bacteriological status of formerly "cured" multibacillary patients are necessary. However, data from Shandong support the view of the findings from Karigiri (1) that the efficacy of dapsone has not diminished in leprosy control after its introduction more than three decades ago.

Leprosy disappeared from Norway without specific chemotherapy in 70 years, during a period of rapid industrial growth. On the basis of the present data, Shandong seems to have the prospect of eradication within 50 years with the aid of dapsone and during a time of fast socio-economic changes in the vast rural areas of China.

#### SUMMARY

A comprehensive leprosy control program was launched in Shandong Province, People's Republic of China, in 1955, with the establishment of the Provincial Skin Disease Control Institute and a network of Skin Disease Control Stations and leprosy hospitals at the county level. Through repeated different methods of case finding, dapsone monotherapy, and intensive follow up, incidence has decreased from 5.1 to 0.46/100,000 in 25 years. Findings such as the increase in the mean age at onset and in the lepromatous-to-tuberculoid ratio, and a general decline in the age-specific incidence in successive cohorts, are in concurrence with the findings in other countries where leprosy is disappearing.

#### RESUMEN

En 1955, en la provincia de Shandong, República Popular China, se inició un programa sobre el control de la lepra y se establecieron el Instituto Provincial para el Control de las Enfermedades de la Piel y una red de Centros de Control de las Enfermedades de la Piel y Hospitales a nivel nacional. Como resultado de aplicar diferentes métodos para la búsqueda de casos,

de la monoterapia con dapsona y del seguimiento intensivo de los casos, la incidencia disminuyó de 5.1 a 0.46/100,000 en 25 años. Los hallazgos sobre el incremento en la edad promedio de aparición de la enfermedad, en la relación lepromatosa/tuberculoide, y en la disminución de la incidencia por edad específica en las generaciones sucesivas, están de acuerdo con los hallazgos en otros países donde la lepra está en desaparición.

#### RÉSUMÉ

En 1955, un large programme de contrôle de la lèpre a été entamé dans la Province de Shandong, en République Populaire de Chine. Le début de ce programme a coïncidé avec l'établissement de l'Institut Provincial pour la Lutte contre les Maladies Cutanées, et avec la création dans les districts d'un réseau de dispensaires dermatologiques et d'hôpitaux spécialisés pour la lèpre. Différentes méthodes de détection ont été appliquées. La monothérapie par la dapsona a été utilisée. Le suivi des malades a été intensif. A la suite de ces mesures, l'incidence a décru de 5, 1 à 0,46 pour 100.000 en 25 ans. Une série d'observations telles que l'augmentation de l'âge moyen au début de la maladie, une modification dans le rapport des malades lépromateux aux tuberculoïdes, et un déclin général des taux d'incidence spécifiques pour l'âge dans les cohortes successives, sont en accord avec les données relevées dans d'autres pays où la lèpre est en voie de disparition.

**Acknowledgment.** The authors wish to express their gratitude to Professor Michel F. Lechat for his valuable suggestions and to Dr. Lorentz M. Irgens for reviewing the manuscript.

#### REFERENCES

1. ALMEIDA, J. C., CHRISTIAN, M. and CHACKO, C. J. G. Response to dapsone (DDS) monotherapy in leprosy patients of Gudiyatham Taluk, South India: Comparison between the 1960s and 1970s. *Int. J. Lepr.* **51** (1983) 378-381.
2. IRGENS, L. M. Leprosy in Norway. *Lepr. Rev.* **51** Suppl. (1980) 1-130.
3. LECHAT, M. F., MISSON, C. B., WALTER, J., SEAL, K. S. and SANSARRICQ, H. An information system for leprosy control (OMSLEP recording and reporting system). *Int. J. Lepr.* **48** (1980) 51-61.
4. LECHAT, M. F. and VANDERVEKEN, M. Basic epidemiological indicators for monitoring leprosy control. Proc. 4th Int. Workshop on Leprosy Control in Asia. Tokyo: Sasakawa Memorial Health Foundation, 1983, 42-65.
5. LIANG CHANG-CHI. Critical review on ancient Chinese history in leprosy. *Dermato-Vener. Rev.* **1** (1963) 51-63 (in Chinese).