

Epidemiology Bulletin

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A Survey of Tuberculosis
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Of intimate contacts of patients of infectious tuberculosis, particularly the tuberculin positive ones, around 2-4% will develop tuberculosis within one year. The recently infected ones whose tuberculin testings have converted into positive in the last two years, also have higher chances of developing tuberculosis with likely more serious outcomes, specially among children under five years of age who would have been infected within the last five years. (1-3)

There have not been any long-term cohort follow-up observations of the tuberculosis infection of those native pre-school children aged 0 through 5 years who have been identified tuberculin positive. Tuberculosis control program for children of this age group includes preventive measures such as BCG vaccination and preventive treatment⁽⁴⁻⁵⁾. How effective these measures are against tuberculosis infection has not yet been objectively evaluated. The present study, without interfering the control program, intends to answer the above-mentioned questions by following up 342 pre-school children of Hsiu-lin, Hsin-cheng and Nan-au townships of Hualien County who were identified tuberculin positive in a blanket tuberculosis screening in 1986 and 1988 under the comprehensive tuberculosis control program.⁽⁴⁻⁵⁾ This survey also intends to serve as a pilot study for the follow-up of children in 30 aboriginal townships who were identified as tuberculin positive in the mass screening programs conducted under the comprehensive tuberculosis control program in 1988 through 1990.

Subjects of the survey are 342 pre-school (0-5 years) children, 162 males and 180 females, who were identified as tuberculin positive in 1986 in Hsiu-lin and Hsin-cheng of Hualien County and Nan-au of Ilan County, and in 1988 in Hsiu-lin of Hualien County. By using the purified protein derivative, PPD 1 T.U. + Tween 80 with the Mantoux test, a lump of 10 mm or larger is considered positive⁽⁶⁾. Of all children, 247 came from Hsiu-lin, 44 from Nan-au, and 51 from Hsin-cheng. They were tuberculin-tested at an average age of 3.61 ± 1.71 years (see Table 1).

Data collected include: background data (name, sex, date of birth, address and ethnic group), data of tuberculin test (date and reaction), other background information (BCG scar, any infectious tuberculosis patient among family members, number of family members living together, acceptance of preventive isoniazid treatment),⁽¹⁾ and data of tuberculosis infection.

Subjects were interviewed of their histories. Data concerning their infection were collected from the registration of the Taiwan Provincial Chronic Disease Control Bureau and relevant hospitals.

The interviewers also notified subjects to come for examination either at the Nan-au Health Station or the Chronic Disease Control Center of Hualien County.

X-ray films of 14×14 standard were used for examination. They were studied by two chest specialists of the Bureau and by a third chest specialist if the readings were not consistent. A diagnosis was made after some discussion.

Swab specimens were collected for culture in Lowenstein-Jensen media for eight weeks at 37°C.⁽⁷⁾

Data were analyzed with SAS/PC software for Chi-square, Fisher's exact test and t-test.

A total of 287 children (84%) completed the X-ray and bacteria tests, 96% in Nan-au and Hsin-cheng and 79% in Hsiu-lin. No significant difference was found between those examined and those not examined in terms of the BCG scar, the acceptance of preventive treatment and the reaction to tuberculin test. Those who did not show up for examination, 46 (74%) of them had moved out of the township, 6 (11%) refused the examination, 3 (5.5%) died of drowning. The ethnic distribution of those examined is shown in Figure 1: 79% aboriginal and 21% non-aboriginal.

Nine children were infected with pulmonary tuberculosis at an average age of 4.17 ± 2.58 years (0.88–9.45 years); of them, five were found infected either at or before the time of tuberculin testing (0 year of follow-up). The rest 282 children have been followed-up for an average of 4.75 ± 0.54 years (1.89–5.21 years) for a total of 1,340 person-years. Of those followed-up, two children developed tuberculosis two years after, another two became infected five years after the follow-up, giving an incidence rate of 2.99 per 1,000 person-years, or 0.3% per year.

Of the 271 children with BCG scars, five became infected at an average age of 4.62 ± 3.19 years; three developed tuberculosis at the 0 year of follow-up. The rest 268 children have been followed-up on average for 4.78 ± 0.50 years totaling 1,280 person-years. Of them, two became infected at the fifth year of follow-up, giving an incidence rate of 1.56 per 1,000 person-years.

Of the 16 children without BCG scars, four became infected at an average age of 3.64 ± 1.85 years; two developed tuberculosis at the 0 year of follow-up. The rest 14 children have been followed-up on average for 4.32 ± 0.99 years totaling 60 person-years. Of them, two became infected at the second year of follow-up, giving an incidence rate of 33 per 1,000 person-years, or 3.3% per year.

With or without BCG scars, whether one developed tuberculosis in the five years of follow-up is found not related to the township of residence, sex, aborigines or not,

the acceptance of preventive treatment, with or without infectious patient at home, and the reaction to tuberculin testing. Nor significant difference was found between tuberculosis patients and healthy persons in terms of the age when tuberculin testing was conducted or the number of family members living together (see Table 2 and 3).

Discussion:

The population at the end of 1986 was 14,224 for Hsiu-lin, 19,135 for Hsin-cheng and 5,504 for Nan-au. At the mass examination in 1986, 10% of the pre-school children were found without BCG scars. Of them, the tuberculin positive rates were 1.39% for Hsin-cheng, 14.8% for Hsiu-lin and 13.5% for Nan-au.⁽⁸⁻⁹⁾ The natural infection rate seems to be ten times higher in the aboriginal areas than the neighboring plane areas. In the high infection areas, the protective effect of BCG should be high.⁽¹⁰⁻¹⁵⁾ Literatures shows that the protective effect of BCG ranges from 0% to 80%.⁽¹⁶⁾ Use of adequate BCG vaccines in some areas can produce a protection rate of 50-80%.^(10,16)

The current tuberculosis control program gives BCG vaccination to every tuberculin-negative (not infected by tuberculosis bacteria) child without BCG scar.⁽⁴⁻⁶⁾ Children not BCG-vaccinated and not infected will be vaccinated eventually. This practice makes it impossible for the long-term observation of tuberculosis infection among children who are not infected and are not protected by BCG. That is, a matching study of the later development of tuberculosis infection of the non-infected newborns or infants either protected or not protected by BCG is not possible. Unless the current control practice is modified (not to give BCG vaccination to children not infected and without BCG scar), it is not possible to directly study the protective effect of BCG vaccines against tuberculosis on native children.

Of the tuberculin-positives, those without BCG scars are the result of natural infection; those with BCG scars, most of them are the result of artificial infection by BCG and a small part the result of natural infection. The natural infection rate of pre-school children in the aboriginal areas is about 10%.^(8,9) BCG vaccination is relatively protective against re-infection.^(10,14) It is difficult to estimate the proportion of natural infection among tuberculin-positive children with scars.

In the present study, for the tuberculin-positive children without scars, after five years of follow-up, the average incidence rate is 33 per 1,000. Literature show that after long-term observation of tuberculosis infection of tuberculin-positives, the average incidence rates are found to be between 0.57 and 27.0 per 1,000, varying from the criteria of tuberculin reactions used by various researchers, the area, the ethnic groups, the time of study and the age of the subjects studied.⁽¹⁶⁾ This difference reflects the prevalence of tuberculosis in different areas, at different time and among different ethnic groups; and the higher incidence rate found in the present study could also be due to the relatively small size of samples.

For those who have already been infected but have not developed disease, a preventive treatment with Isoniazid for six to twelve months will have a protective effect of 50-80% against later development of disease.⁽¹⁾ The present study has failed to discover

any protective effect of the preventive treatment. This, again, is perhaps due to the small size of samples and the shorter period of follow-up as well.

Tuberculosis control program in the past tended to accept a lump larger than 20 mm (the so-called extra-positive) of persons with BCG scars as the result of re-infection. They were classified as high risk groups and were given X-ray and tuberculosis testings.⁽⁴⁻⁶⁾ The present study, however, found that the infection of persons with BCG scars is not related to the size of tuberculin reaction. Though the sample size was small (only five persons with scars were infected) and no conclusion could be made, in the practice of tuberculosis control it might be practical to consider tuberculin positives as persons infected with tuberculosis.

Long-term observation of the tuberculosis infection of a group may be time-consuming, but it can provide most valuable information. Beginning 1st September 1991, the Taiwan Provincial Chronic Disease Control Bureau has taken action to register all active tuberculosis cases. In the future, annual tuberculosis incidence rate can be easily obtained by comparing the newly registered cases for each year against the cases studied by the present study. The present study also plans to follow-up all tuberculin positive children in 30 townships (including the Orchid Island) identified as tuberculin positive in the 1988 to 1990 comprehensive tuberculosis control program, hoping to obtain more conclusive findings.

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Erratum: The first line in the first page of the Vol. 8 No. 3 1992 E. B. is changed to On 10 November 1991.

Fig. 1. Ethnicity of Children Examined

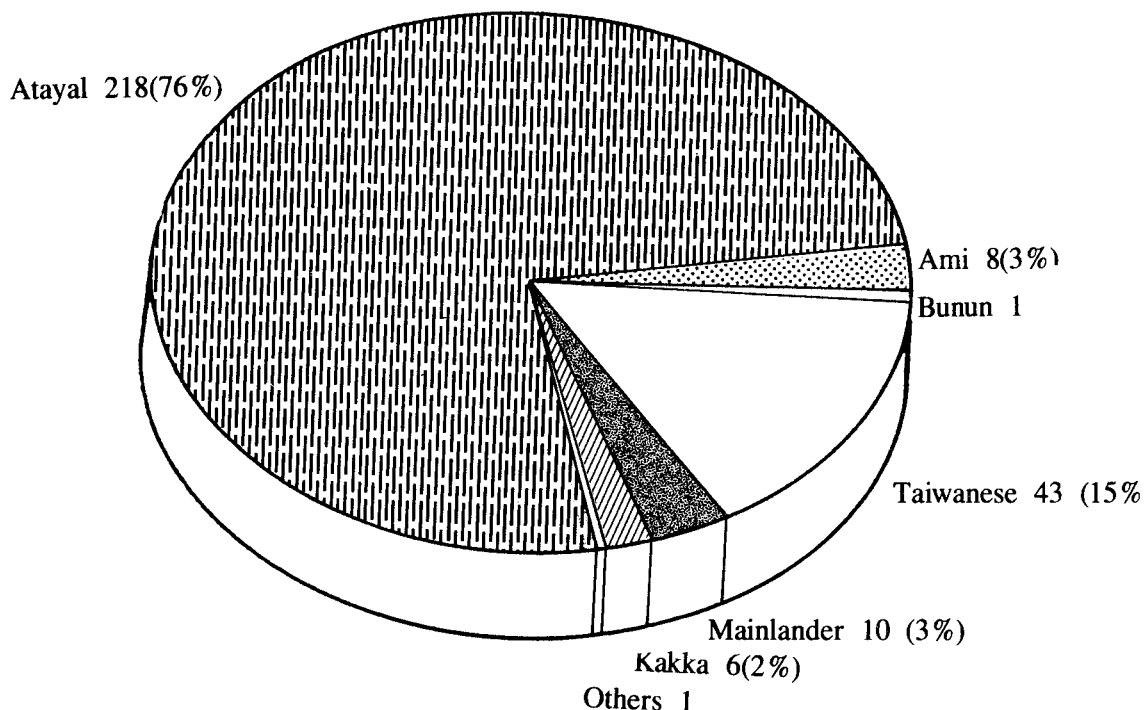


Table 1. Findings of Folow-Up Examination

	No (%) Examined	No. (%) Not Examined	Total	p Value
Total	287 (84%)	55 (16%)	342	
<u>Township</u>				
Nanau	43	1	44	0.01
Hsiulin	196	51	247	
Hsincheng	48	3	51	
<u>Sex</u>				
Female	151	29	180	NS
Male	136	26	162	
<u>BCG Scar</u>				
Yes	271	48	319	NS
No	16	7	23	
<u>INH Prevention</u>				
Yes	196	29	225	0.05
No	91	26	117	
<u>Age Tuberculin-Tested</u>				
0 year	24	7	31	NS
1	42	11	53	
2	32	8	40	
3	46	5	51	
4	66	10	76	
5	77	14	91	
	<u>Average SD</u>	<u>Average SD</u>		
Tuberculin test	3.66	3.37		NS
Age tested	1.70	1.80		
Tuberculin test	16.18	15.76		NS
Size of reaction	4.00	4.39		

Table 2. Analysis of Risk Factors (for Children with BCG Scars)

	No. (%) Infected	No. (%) Not Infected	Total	p Value
Total	5 (2%)	266 (98%)	271	
<u>Township</u>				
Nanau	1	36	37	NS
Hsiulin	4	184	188	
Hsincheng	0	46	46	
<u>Sex</u>				
Female	3	140	143	NS
Male	2	126	128	
<u>Aborigine</u>				
Yes	5	207	212	NS
No	0	59	59	
<u>INH Prevention</u>				
Yes	1	180	181	NS
No	4	86	90	
<u>Infectious case in family</u>				
Yes	2	66	68	NS
NO	3	200	203	
<u>Age tuberculin-tested</u>				
0 year	1	23	24	NS
1	0	40	40	
2	1	27	28	
3	0	43	43	
4	3	60	63	
5	0	73	73	
<u>Size of reaction</u>				
10-14 mm	2	82	84	NS
15-19	3	118	121	
20+	0	66	66	
	<u>Average SD</u>	<u>Average SD</u>		
Tuberculin test	3.12	3.67		NS
Age tested	1.67	1.71		
Tuberculin test	14.20	16.14		NS
Size of reaction	3.42	4.01		
Family members	6.40	6.45		NS
Living together	1.95	2.77		

Table 3. Analysis of Risk Factors (for Children without BCG Scars)

	No (%) Infected	No. (%) Not Infected	Total	p Value
Total	4 (25%)	12 (75%)	16	
<u>Township</u>				
Nanau	1	5	6	NS
Hsiulin	3	5	8	
Hsincheng	0	2	2	
<u>Sex</u>				
Female	1	7	8	NS
Male	3	5	8	
<u>Aborigine</u>				
Yes	4	11	15	NS
No	0	1	1	
<u>INH Prevention</u>				
Yes	2	11	13	NS
No	2	1	3	
<u>Infectious case in family</u>				
Yes	1	2	3	NS
No	3	10	13	
<u>Age tuberculin-tested</u>				
0 year	0	0	0	NS
1	1	1	2	
2	2	2	4	
3	1	2	3	
4	0	3	3	
5	0	4	4	
<u>Size of reaction</u>				
10-14 mm	2	2	4	NS
15-19	1	4	5	
20+	1	6	7	
	<u>Average SD</u>	<u>Average SD</u>		
Tuberculin test	2.61	4.09		NS
Age tested	0.70	1.51		
Tuberculin test	16.25	18.00		NS
Size of reaction	5.06	3.46		
Family members	6.00	6.75		NS
Living together	1.73	1.76		