

RISK OF *MYCOBACTERIUM TUBERCULOSIS* TRANSMISSION IN AN ABORIGINAL VILLAGE, TAIWAN

Chang Yung-Ming^{1,2}, Tsai Bao-Ying¹, Wu Yi-Chun¹, Yang Shih-Yan¹ and Chen Chang-Hsun¹

¹Center for Disease Control, Department of Health, Taiwan; ²Taipei Medical University Taiwan, ROC

Abstract. Tuberculosis is the leading cause of death for notifiable diseases in Taiwan. The incidence rate of tuberculosis for aborigines is 3.1 times higher than the general population, and the mortality rate for the aboriginal population is 3.2 times higher than the rate for the rest of Taiwan. The proportion of tuberculosis retreatment cases among aborigines is higher than the general population, and this is why tuberculosis is widespread in aboriginal communities. To determine the risk factors for retreatment cases living in an aboriginal village, a case-control study was performed. From January 2000 to June 2004, a total of 60 confirmed tuberculosis cases were enrolled. Tuberculosis was diagnosed by chest radiograph, sputum-smear microscopy, and culture. Epidemiological data were collected by structured questionnaires. Comparisons of proportions were done by chi-square test. Of the 60 cases, 19 were retreatment patients. Most education levels among the study subjects were elementary and junior high school. The majority of occupations were farmer and laborers. The Odds Ratios (ORs) of 'poor compliance' and 'not receiving DOTS' in the retreatment-patient group were significantly increased compared with the new patient group. In March 24, 2005, CDC-Taiwan vowed to halve the tuberculosis incidence and mortality by 2015. To accomplish this goal, CDC-Taiwan is investing funds and personnel in the National Tuberculosis Plan (2005-2015). The plan commits the government to implementing DOTS, to enhance the public health and medical networks for the country, especially for aboriginal villagers.

INTRODUCTION

Tuberculosis remains a threat to public health, especially in Southeast Asia. It is the leading cause of death for notifiable diseases in Taiwan, which has an estimated 15,000 new cases of tuberculosis, approximately 8,000 sputum-smear-positive cases every year. The incidence rate of tuberculosis for the general population is 66.7/100,000, while the mortality rate is 5.8/100,000. The incidence rate of tuberculosis for aborigines is 3.1 times higher than the general population, and the mortality rate for the aboriginal population is 3.2 times higher than that for the rest of Taiwan.

According to a previous study in South Africa, being a tuberculosis retreatment patient was a risk factor for clustering (Verver *et al*, 2004). Nearly 3,000 people experience tuberculosis retreatment in Taiwan every year. The proportion of retreatment cases among aborigines is higher than the general population, and this is why tuberculosis is widespread in aboriginal communities in Taiwan. The Center for Disease Control, Taiwan (CDC-Taiwan) conducted a case-control study to determine the risk factors for

retreatment cases living in an aboriginal village.

We analyzed data from one aboriginal village, which had a high incidence and mortality from TB, in eastern Taiwan. Several studies have been published on this area, but few have reported the risk factors for tuberculosis retreatment cases.

MATERIALS AND METHODS

Setting

The aboriginal village had a total population of 5,827 (Statistics Taiwan, 2005), and spanned an area of 740.7 km². Residents of the area were of low socioeconomic status. A relatively low proportion of the population was infected with HIV. The study area had an extremely high notified disease rate for tuberculosis (321.1/100,000 per year for all forms of tuberculosis: 152.1/100,000 per year for new sputum-smear-positive cases).

Study population

Tuberculosis was diagnosed by chest radiograph, sputum-smear microscopy, and culture. A case of tuberculosis was defined as one that had been bacteriologically confirmed or diagnosed by a clinician. All confirmed pulmonary tuberculosis patients were eligible for this study if they were reported to CDC-Taiwan between January 2000 and June 2004, and were resident at any time during this period in the village. Informed consent for the use of clinical data was obtained from the patients or their parents.

Correspondence: Dr Chang Yung-Ming, 7 F, No. 9, Sec 1, Jhongsiao E Road, Taipei City 100, Taiwan, Republic of China.

Tel: 886-2-33936184, Fax: 886-2-33936149

E-mail: cchang@cdc.gov.tw

We included sputum-smear-positive and -negative patients whether the culture had to be positive or just the chest radiograph was compatible with tuberculosis pulmonary tuberculosis, and those with and without a history of previous treatment (designated 'retreatment' and 'new' tuberculosis case, respectively)(Verver *et al*, 2004). All subjects were required to complete a structured questionnaire administered by a trained interviewer.

Data collection and statistical analysis

Data were collected through structured interviews. The structured questionnaire used in this study was divided into four parts: basic characteristics, socio-demographic data, past history, family history of tuberculosis. The data collection and interview forms were checked for completeness and then double-entered and validated. The Statistical Analysis System Software Version 9.1 was used for data processing. In

Table1
Distribution of characteristics among the study cohort stratified by gender.

	Male No. (%)	Female No. (%)	Total No. (%)
Current age (Yrs)			
(mean±SD)	(43.4 ± 19.9)	(55.5 ± 20.9)	(47.1 ± 20.8)
30-50	9 (21.4)	3 (16.7)	12 (20.0)
≥30-<50	18 (42.9)	5 (27.7)	23 (38.3)
≥50	15 (35.7)	10 (55.6)	25 (41.7)
Patient category			
New	26 (61.9)	15 (83.3)	41 (68.3)
Retreatment	16 (38.1)	3 (16.7)	19 (31.7)
Education			
Elementary school	19 (45.2)	10 (55.5)	29 (48.3)
Junior high school	15 (35.7)	5 (27.8)	20 (33.3)
Senior high school	7 (16.7)	3 (16.7)	10 (16.7)
College	1 (2.4)	0 (0.0)	1 (1.7)
Occupation			
Farmer	12 (28.6)	3 (16.7)	15 (25.0)
Labor	21 (50.0)	2 (11.1)	23 (38.3)
Civil official	3 (7.1)	0 (0.0)	3 (5.0)
Unemployed	6 (14.3)	13 (72.2)	19 (31.7)
House size			
>10 m ²	4 (9.8)	2 (10.5)	6 (10.0)
10 m ²	37 (90.2)	17 (89.5)	54 (90.0)
Household size			
4	27 (64.3)	10 (55.6)	37 (61.7)
>4	15 (35.7)	8 (44.4)	23 (38.3)
BCG vaccination			
Yes	27 (64.3)	8 (44.4)	35 (58.3)
No	15 (35.7)	10 (55.6)	25 (41.7)
Diabetes mellitus history			
No	39 (92.9)	16 (88.9)	55 (91.7)
Yes	3 (7.1)	2 (11.1)	5 (8.3)
Cancer history			
No	41 (97.6)	17 (94.4)	58 (96.7)
Yes	1 ^a (2.4)	1 ^b (5.6)	2 (3.3)
Family tuberculosis history			
No	27 (64.3)	13 (72.2)	40 (66.7)
Yes	15 (35.7)	5 (27.8)	20 (33.3)
Total	42 (100.0)	18 (100.0)	60 (100.0)

BCG vaccination: Bacille Calmette-Guerin vaccination; ^a: prostate Cancer; ^b: Cervical Cancer

univariate analysis, chi-square tests were performed to test associations of categorical variables with patient category. Odds ratios and their 95% confidence intervals were estimated. For all statistical tests, associations were considered significant at p-value 0.05.

RESULTS

Study population

From January 2000 to June 2004, a total of 60 confirmed pulmonary tuberculosis cases were enrolled. Most of the study subjects were males (70%). The distributions of individual members classified by gender, current age, patient category, education level, occupation, house size, household size, Bacille Calmette-Guerin (BCG) vaccination, diabetes mellitus, cancer history, and family tuberculosis history, are shown in Table 1. The mean age of the 60 study subjects was 47.7 years (range 3-84 years). Only 20% were aged < 30 years.

Of the 60 cases, 19 were retreatment patients. The BCG vaccination rate was 58.3%. Most education levels were elementary (48.3%) and junior-high school (33.3%). The majority of occupations were laborers (36.7%) and farmers (25%); the unemployment rate was 31.7%. The mean house and household size of these subjects were 8.0 m² (range 4-18 m²) and 3.9 persons (range 1-8 persons), respectively. Two (male:1; female:1) of the 60 study subjects had a history of cancer; the sites were the cervix and the prostate.

None was a victim of pneumoconiosis. Five (male:3; female:2) had a history of diabetes mellitus.

Risk factors

Retreatment tuberculosis was not associated with gender, education level, occupation, house and household size, family tuberculosis history, or history of diabetes mellitus or cancer . No significant demographic risk factor was identified for retreatment cases.

The Odd Ratios (ORs) of ‘poor compliance’ (OR=6.9) and ‘not receiving DOTS’ (directly observed therapy, short course)(OR=6.5) in the retreatment patient group were significantly increased when compared with the new patient group. The ORs of ‘default’(OR=1.6), ‘without BCG vaccination’ (OR=1.4) and ‘sputum-smear positive’ (OR=1.7) were not significantly increased when compared with the new patient group (Table 2).

DISCUSSION

Gender, education level, occupation, house size and household size were not risk factors for retreatment. No significant demographic risk factor for retreatment cases was identified. This result confirmed the lack of demographic risk factors found in another study in high incidence areas (Verver *et al*, 2004). In most countries, tuberculosis is more prevalent in men than women, in both routine notifications and prevalence surveys (Borgdorff , 2000, 2001). The results of the

Table2
Risk factors of retreatment tuberculosis

	New	Retreatment	OR	p-value
DOTS			6.5	p<0.05
Receiving	39	12		
Not receiving	3	6		
Compliance			6.9	p<0.05
Good	39	17		
Poor	1	3		
Outcome			1.6	p>0.05
Non-default	32	13		
Default	9	6		
BCG vaccination			1.4	p>0.05
Yes	25	10		
No	16	9		
Sputum-smear			1.7	p>0.05
Negative	18	5		
Positive	25	12		

DOTS: directly observed therapy, short course; BCG vaccination: Bacille Calmette-Guerin vaccination

present study were consistent with previous findings. The risk factors for the tuberculosis retreatment patients identified in this study population were 'poor compliance' and 'not receiving DOTS'. Understanding the reasons behind successful treatment is clearly an important step towards decreasing the rate of tuberculosis retreatment.

The findings of this study both confirm and extend our understanding of tuberculosis control. We highlight the urgent need for DOTS in confronting tuberculosis. The WHO and the International Union Against Tuberculosis and Lung Disease have adopted DOTS as the main strategy for programmatic tuberculosis control. DOTS consists of five principal elements: sustained political commitment, case detection by sputum-smear microscopy, use of efficacious regimens with DOTS, uninterrupted supply of all essential drugs, and a standard reporting and surveillance system (WHO, 2002; Christophen *et al*, 2005). Recent tuberculosis research gives prominence to the importance of strategies for tuberculosis control, including education, improved tuberculosis diagnosis and the multidisciplinary team to encourage health education and treatment compliance (Tom *et al*, 2004). Numerous articles have shown that education by health professionals is a vital strategy for improving patient compliance. This education must take place at the patient, physician, and national levels, and should be carefully targeted, to overcome cultural barriers (Tom *et al*, 2004; Shrestha-kuwahara R *et al*, 2003; Aguilar *et al*, 2004). In conclusion, to enhance patient compliance using DOTS is an important strategy for preventing retreatment cases. The lack of active involvement by healthcare staff could call into question the future sustainability of any control program. New socio-behavioral insights and technological innovations are needed to make this intervention most efficient and effective (Tornee *et al*, 2004; DeRiemer *et al*, 2005).

On March 24, 2005, CDC-Taiwan vowed to halve the tuberculosis burden by 2015, relative to 2005. In order to accomplish this goal, CDC-Taiwan issued a National Tuberculosis Plan (2005-2015), which commits the government to utilizing DOTS as part of primary healthcare for tuberculosis control. Following the internationally recommended DOTS strategy, CDC-Taiwan enhanced the public health network for providing a treatment partner or supporter acceptable to patients, to reinforce their motivation to continue treatment. Besides, tuberculosis laboratories and medical networks were strengthened to upgrade the quality of laboratory examinations and encourage the admission of infectious tuberculosis patients, to prevent widespread infections in communities. To

achieve this mission, the government is investing funds and personnel for the country, especially for aboriginal villages.

ACKNOWLEDGEMENTS

We especially thank the Department of Health of I-Lan County for providing the basic and demographic data of the study subjects.

REFERENCES

- Aguilar R, Garay J, Villatoro M, *et al*. Impact of a model training course for private and public specialist physician in EI Salvador. *Int J Tuberc Lung Dis* 2004;8:473-9.
- Borgdorff MW, Nagelkerke NJD, deHaas PEW, *et al*. Transmission of mycobacterium tuberculosis depending on the age and sex of source cases. *Am J Epidemiol* 2001;154:934-43.
- Borgdorff MW, Nagelkerke NJD, Dye C, *et al*. Gender and tuberculosis: comparison of prevalence surveys with notification data to explore sex difference in case detection. *Int J Tuberc Lung Dis* 2000; 4:123-32.
- Christophen D, Catherine JW, Daniel MB, *et al*. Evolution of tuberculosis control and prospects for reducing tuberculosis incidence, prevalence, and deaths globally. *JAMA* 2005;293:2767-75.
- DeRiemer K, Garcia-Garcia L, Bobadilla-del-valle M, *et al*. Does DOTS work in populations with drug-resistant tuberculosis? *Lancet* 2005;365:1239-45.
- Shrestha-kuwahara R, Wilce M, Deluca N, *et al*. Factors associated with identifying tuberculosis contact. *Int J Tuberc Lung Dis* 2003;7(suppl 3): S510-S516.
- Tom P, David AJM, Robert G, *et al*. Recent tuberculosis advances in Latin America. *Curr Opin Infect Dis* 2004;17:397-403.
- Tornee S, Kaewkungwal J, Fungladda W, *et al*. risk factors for tuberculosis infection among household contacts in Bangkok, Thailand. *Southeast Asian J Trop Med Public Health* 2004;35:375-83.
- Verver S, Warren RM, Munch Zahn, *et al*. Transmission of tuberculosis in a high incidence urban community in South Africa. *Int J Epidemiol* 2004;33:351-7.
- WHO. An expanded DOTS framework for effective tuberculosis control. Stop TB communicable disease. *WHO/CDS/TB/2002:297:1-20*, 2002.