

## Tuberculosis in female nurses in British Columbia: implications for control programs

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All 57 cases of active tuberculosis in women in nursing and related assisting occupations (henceforth called nurses) notified in British Columbia between 1969 and 1979 were reviewed. This represented a mean annual incidence of active tuberculosis of 2.6/10 000, similar to that in other women, adjusted for age and birthplace. The rate varied according to birthplace: among nurses born in Canada the rate was 2.0, almost twice that of other women born in Canada, and among those born in Asia it was 24.8, less than half that of other women born in Asia. The nurses born in Canada who had received BCG (bacille Calmette-Guérin) during their training were least likely to contract tuberculosis, the incidence rate being comparable to that among other women. Those whose results of tuberculin testing were negative but who were not vaccinated were twice as likely to contract tuberculosis, whereas those whose results were positive at the start of training were four times as likely to contract tuberculosis. The feasibility and implications of a tuberculosis screening and surveillance program are discussed.

Parmi les infirmières diplômées et autres soignantes (qu'on appellera infirmières) en Colombie-britannique, on a rapporté, de 1969 à 1979, 57 cas de tuberculose évolutive, qui font l'objet du présent rapport. Il s'agit d'une incidence annuelle de 2,6/10 000, un taux semblable à celui pour l'ensemble des femmes compte tenu de l'âge et de l'endroit de naissance. Chez les infirmières le taux varie de 2,0 pour celles qui sont nées au Canada, soit le double du taux de l'ensemble des femmes nées au Canada, à 24,8 pour celles qui sont nées en Asie, ce qui se situe à moins de la moitié du taux qu'on observe dans l'ensemble des femmes nées en Asie. Le taux le plus bas, comparable à celui de l'ensemble de la population, se voit chez les infirmières nées au Canada qui ont reçu la bacille de Calmette et Guérin lors de leur formation. Celles qui, en dépit d'un résultat négatif de la cuti-réac-

tion à la tuberculine, n'ont pas reçu le vaccin montrent un risque doublé de contracter une tuberculose. Mais chez celles dont le résultat était positif au moment de leur formation, ce risque est multiplié par quatre. On discute de la possibilité d'un programme de dépistage et de surveillance de la tuberculose, et de ce qu'il comporte.

One of the recognized hazards of health care professions is exposure to tubercle bacilli, with consequent development of tuberculosis. In the third and fourth decades of this century a number of articles appeared relating the relative risk of tuberculosis among nurses. Heimbeck,<sup>1</sup> in Norway, observed that the minority of student nurses who had negative results of tuberculin testing at the time of entry to nursing school invariably had positive results and a high rate of infection by the time they completed their training. A similar observation was made by Ross<sup>2</sup> in Manitoba. Bow<sup>3</sup> reported the incidence of tuberculosis among student nurses in Saskatchewan to be 1.3%; this was apparently eight times greater than that among school students of about the same age. Amberson and Riggins<sup>4</sup> found a rate of 1.7% among student nurses during their 3-year training period at Bellevue Hospital, New York. This was compared with an annual rate of 0.3% among 4000 women of the same age employed at the Metropolitan Life Insurance Company. Perhaps the most thorough study of tuberculosis in nurses was the Prophit Tuberculosis Survey, which was performed under the auspices of the Royal College of Physicians of London; the findings were reported in 1948.<sup>5</sup> Over 5000 nurses from different hospitals were recruited into the study between 1934 and 1943. Just over 80% of them had positive results of tuberculin testing at the time of entry, and among those who initially had negative results, the results converted to positive in 54% to 80% during the first year. The incidence of tuberculosis among all the nurses was about twice that among controls of the same sex and age. The rate was 1.3% among those with initially positive results of tuberculin testing and 4.0% among those with initially negative results.

The findings of all these studies have led to the creation of special control programs for hospital staff, particularly nurses, and such programs, in one form or another, persist. Large-scale programs of this sort are relatively costly. This consideration, along with concern over unnecessary x-ray exposure, however minimal, has made the evaluation of all the existing screening programs timely.

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We performed a study to assess the current relative risk of tuberculosis in women in nursing and related assisting occupations. In the light of our findings we discuss here the need for and the design of appropriate surveillance programs.

## Methods

We reviewed all notifications of active tuberculosis among health care professionals in British Columbia to the registry, Division of Tuberculosis Control, Province of British Columbia, over the 11 years from 1969 to 1979. Because other health care professionals and men in nursing represented only a relatively small population at risk and presented only a small number of cases, we restricted our attention to women in nursing and related assisting occupations (henceforth referred to as nurses), without qualification as to type and size of institution or other place of work. We reviewed the case file in each instance, noting date and country of birth, history of BCG (bacille Calmette-Guérin) vaccination, results of tuberculin testing, type and site of disease, and results of bacteriologic examination.

To determine the incidence rates of tuberculosis in this group, we obtained from Statistics Canada and the Registered Nurses Association of British Columbia information about the population at risk during the 11-year period we studied. We were able to determine the size of the population by age, sex and birthplace. For comparison, and to calculate relative risk ratios, we also obtained from Statistics Canada data on all active cases of tuberculosis notified in Canada during this period. We were thus able to calculate the incidence

rates of active tuberculosis in females according to age, birthplace and such characteristics as the type and site of the disease and the results of bacteriologic examination. Estimates of the prevalence of BCG vaccination and the presence of a positive result of tuberculin testing at the time of training were derived from a survey of nurses employed at two hospitals selected from the British Columbia register of hospitals by means of a table of random numbers; 1 hospital was chosen from the 18 with more than 250 beds and 1 from the 23 with 100 to 250 beds.

## Results

From 1969 to 1979 there were between 14 126 and 26 538 nurses in British Columbia in any given year. During this time 57 cases of active tuberculosis, just over 5 cases per year, were notified to the Division of Tuberculosis Control. This mean annual incidence of 2.6/10 000 per year compares with the rate of 1.1/10 000 per year for the general population of women in Canada at this time. Thus, the relative risk of active tuberculosis for nurses, compared with the general population, was 0.9 when the predominance of older individuals and Asian-born nurses was taken into account by indirect standardization.

The incidence of active tuberculosis varied widely according to birthplace, and the relative risk for nurses varied inversely with the incidence (Table I), ranging from 0.4 for nurses born in Asia to 1.9 for those born in Canada.

Table II shows the incidence of active tuberculosis according to age group in nurses and other women born

**Table I—Relative risk of tuberculosis according to birthplace in female nurses in British Columbia (1969–79) compared with all women in Canada aged 15 years or older\* (1970–74)**

Birthplace	Nurses			Rate per 10 000 for all Canadian women	Age-standardized risk ratio <sup>a</sup>
	No. of person-years at risk	No. of cases	Rate per 10 000		
Canada	176 248	35	2.0	1.2	1.90
Europe	29 163	6	2.1	1.9	1.11
Asia	6 446	16	24.8	59.5	0.41
Other	6 940	0	—	—	—
<b>Total</b>	<b>218 797</b>	<b>57</b>	<b>2.6</b>	<b>1.1</b>	<b>0.91</b>

\*Excluding Indians and Inuit.

**Table II—Relative risk of tuberculosis according to age in the Canadian-born nurses compared with all Canadian-born women in Canada\* (1970–74)**

Age, yr	Nurses			Rate per 10 000 for all Canadian-born women	Risk ratio
	No. of person-years at risk	No. of cases	Rate per 10 000		
18–24	56 870	7	1.2	0.6	2.05
25–44	76 307	15	2.0	1.0	2.03
45+	43 071	13	3.0	1.8	1.71

\*Excluding Indians and Inuit.

in Canada. The ratios are remarkably similar in the different age groups, but they are slightly lower in the presence of higher rates in the reference population.

Our survey indicates that 3.3% of the nurses born in Canada and working in district hospitals did not know whether they had received BCG before or during their training. Of those who did know, 67.2% had received BCG; of the remaining 32.8%, 13.3% had not because their results of tuberculin testing had been positive, and 19.5% had not even though their results had been negative — 78% of the last group had not been offered the vaccination, and 22% had refused it.

Table III shows that the nurses who had positive results of tuberculin testing were more than twice as likely to contract active tuberculosis as the nurses who had negative results when they started their training. Furthermore, less than half as many of the nurses who had received BCG contracted tuberculosis, as compared with those with negative results of tuberculin testing who had not received BCG.

A large proportion (46%) of the nurses who contracted tuberculosis had extrapulmonary tuberculosis (Table IV), and the proportion with this form of disease was much higher in those born in Asia than in those born elsewhere (81% v. 32%). Of the nurses with extrapulmonary tuberculosis 16 (11 of whom were born in Asia) had lymphadenitis, 5 had genitourinary disease, 1 had osteoarticular disease and 1 each had peritoneal, soft tissue, ear and gastrointestinal infections.

## Discussion

Our study shows that female nurses born in Canada continue to contract tuberculosis twice as often as other women in the general population, even though the incidence of this disease among nurses has fallen dramatically.<sup>3-5</sup> Many studies have shown that the incidence of tuberculosis among nurses whose results of tuberculin testing were negative when they started training was considerably higher than that among nurses whose results were positive.<sup>1,4,5</sup> This is no longer true; in our study as well as in a previous study, in Ontario,<sup>7</sup> the rates among nurses whose results were initially positive were much higher than those among nurses whose results were initially negative. Obviously the likelihood of becoming infected with tubercle bacilli has diminished appreciably, not only in the community in general but also in the hospitals.

Our study suggests a protective effect of BCG vaccination in nurses. The rates of tuberculosis among the nurses with negative results of tuberculin testing who were offered and accepted BCG vaccination were half those among the nurses who were unvaccinated. The rate of tuberculosis among the nurses who had BCG vaccination was very similar to that in a comparable segment of the general population, whereas the rate among unvaccinated nurses whose initial results of tuberculin testing were negative was twice as high, and the rate for those whose initial results were positive was

**Table III—Incidence of tuberculosis among the Canadian-born nurses according to their results of tuberculin testing\* and to whether they had received BCG (bacille Calmette-Guérin) while in training**

Variable	% of population	No. of person-years at risk	No. of cases	Rate per 10 000 per year
Positive results of tuberculin testing	13.3	23 441	13	5.55
Negative results of tuberculin testing				
Had not received BCG	19.5	34 368	9	2.62
Had received BCG	67.2	118 439	13	1.10

\*The population in this table does not include the 3.3% of the nurses for whom this information was not known.

**Table IV—Type of disease and bacteriologic status in nurses with active tuberculosis**

Type of disease	No. of nurses with tuberculosis (and no. of bacteriologically confirmed cases)			
	Total	Birthplace		
		Canada	Europe	Asia
<b>Pulmonary</b>	<b>31 (25)</b>	<b>23 (20)</b>	<b>5 (3)</b>	<b>3 (2)</b>
Postprimary	21 (20)	16 (16)	3 (2)	2 (2)
Pleural	7 (2)	5 (2)	1 (0)	1 (0)
Primary	3 (3)	2 (2)	1 (1)	0 (0)
<b>Extrapulmonary</b>	<b>26 (11)</b>	<b>12 (4)</b>	<b>1 (0)</b>	<b>13 (7)</b>
Lymphadenitis	16 (8)	5 (2)	—	11 (6)
Genitourinary	5 (2)	5 (2)	—	—
Osteoarticular	1 (0)	1 (0)	0 (0)	0 (0)
Other	4 (1)	1 (0)	1 (0)	2 (1)

four times as high. These data must be interpreted with caution, however, since the number of cases was small, and it may not always have been possible for the nurses to recall whether they had received BCG vaccination in the past.

The rate of tuberculosis in the nurses born in Asia was much greater than that in those born in Canada. Although the numbers are small, other studies have also demonstrated this difference.<sup>7</sup> It is interesting that the nurses born in Asia were considerably less likely than other women born in Asia to contract tuberculosis. This may be the result of a higher socioeconomic level among the nurses.

Before we can consider how these findings can be used in the development of a rational program of tuberculosis screening and surveillance we must consider the aims of such a program. One of the most important is the protection from infection of nurses who are in contact with patients with active tuberculosis. In the complex modern hospital, the chances of contracting tuberculosis vary a great deal from area to area. In about half of the nurses born in Canada who contract tuberculosis, the disease is occupationally acquired. Another important aim is the protection from infection of patients who are being treated by a nurse who has undiagnosed tuberculosis. This occurrence is of greatest consequence in infants or immunosuppressed patients.

When the findings of our study are viewed with the above aims in mind several conclusions can be made.

Some will say that no program is necessary since the incidence rates are so low. Is it worth while to impose one on thousands of nurses in order to detect five cases of tuberculosis a year, only one of which will be infectious tuberculosis? Others, like ourselves, may feel that such programs should continue for some years for the protection of both nurses and other staff and patients. Such programs should be incorporated into the initial health screening process, with account taken of the likelihood of tuberculosis developing in the various groups. The highest rates are among nurses born in countries with a high prevalence of tuberculosis. Limiting the programs to this group, however, might be construed as a form of discrimination. Perhaps it would be more appropriate to concentrate on nurses who have positive results of tuberculin testing at the time of their entry to the nursing profession. This would include most of the nurses from countries with a high prevalence of tuberculosis as well as a small proportion of those born in North America and Europe. These individuals could be offered a course of chemoprophylaxis, which would substantially diminish their likelihood of subsequently becoming infected. Those who do not receive chemoprophylaxis should be enrolled in a selective annual surveillance program that is based on the risk factors peculiar to that individual. Among most nurses who have negative results of tuberculin testing the likelihood of active tuberculosis developing is very small, and it could possibly be cut in half by voluntary BCG vaccination; hence, routine surveillance would not be justified.

Regardless of which approach is used, attention should be paid to educating nurses about the symptoms of tuberculosis and to educating doctors about the need to include tuberculosis in the differential diagnosis.<sup>8</sup>

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