

THE EFFECT OF BCG VACCINATION UPON THE OCCURRENCE  
OF LEPROSY IN NURSERY CHILDREN<sup>1</sup>

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The facts that the inoculation of BCG to healthy, tuberculin-negative schoolchildren who react negatively to lepromin results in transformation to lepromin positivity in more than 70 per cent of the subjects, and that BCG vaccination of rodents is effective in preventing experimental infection by murine leprosy, gave rise to the question of whether or not BCG vaccination is also effective with respect to human leprosy.

This question led to an investigation of the leprosy morbidity rates among children who had received BCG vaccination and those who were tuberculin-positive in comparison with those who were tuberculin-negative, in nurseries of our country. What I refer to as "nurseries" are the accommodations provided at leprosaria for all children of the families of leprosy patients. All of them are healthy when admitted, and after admission they are kept separated from any leprosy patients. However, most of them may of course have been infected before their admission to the nursery.

*Total morbidity.*—Out of 6 nurseries, 248 children were selected who had known histories concerning their reactivity to tuberculin and whether or not they had received BCG vaccination, and they were divided into the following three groups:

*Group 1.*—Those who were already tuberculin positive when admitted, and so were not suitable for BCG vaccination.

*Group 2.*—Those who were tuberculin negative at first but who had repeatedly received BCG vaccination and tuberculin tests to see if they became positive, with intervals of 1 to 2 years.

*Group 3.*—Those who were tuberculin negative when admitted but had not received BCG vaccination.

The leprosy morbidity rates of these three groups (Table 1)<sup>2</sup> were: first group, 5.1 per cent; second group, 1.5 per cent; and third group, 47.2 per cent. It is seen that the morbidity rate among the children who were tuberculin negative and had not received BCG vaccination was very high. However, the type of the disease among those who manifested lesions of leprosy showed no differences among these groups.

<sup>1</sup>Read, in a somewhat condensed form, in representation of the Japan Leprosy Research Committee, at the VIIth International Congress of Leprology, Tokyo, November 12-19, 1958.

<sup>2</sup>The tables mentioned, which did not accompany the manuscript, will appear in the full paper in the transactions of the Congress.

*Morbidity according to source of infection.*—Among the children who manifested leprosy, a further analysis was made to determine the relation between the type of the disease in the source of infection, and also the incubation period between contact and appearance of the disease (Table 2). Persons with the lepromatous type predominate among the source of infection; in fact, only one case was found resulting from contact with a nonlepromatous patient. As to the period between contact and disease manifestations, the time with the tuberculin-negative group (Group 3) seemed to be a little shorter than with the other two groups.

Since the greater part of the disease manifestations occurred after contact with lepromatous-type patients, it seems reasonable to compare the morbidity rates on the basis of the contact with such lepromatous cases. Re-examining the data from this point of view it was found that the number of children who had previously had contact with lepromatous cases in the first group was 53, in the second group 100, and in the third group 32. The morbidity rates calculated on this basis (Table 3) again show clearly that the morbidity rate in the third group, the tuberculin-negative children, is very high, 50 per cent, whereas in the first group it was only 7.5 per cent and in the second group 2.0 per cent.

*Significance of the differences.*—Now, when we consider whether these differences are significant or not, it is necessary to take into consideration the following factors:

1. Observation period: The observation periods of the children in the study (Table 4) over 12 years for each group: Group 1, 12 years 3 months; Group 2, 12 years 11 months; and Group 3, 12 years 8 months.

2. Social condition at the time of infection: The disease manifestation may be influenced greatly by various environmental factors. In our country the general living conditions were very bad after World War II, and this point should be carefully considered in our analysis. It is found (Table 5) that the majority of the children of the first and second groups had been infected during the war (from 1940 to 1944) or in the stricken post-war period (from 1945 to 1949). Logically, therefore, the morbidity rates in these two groups should have been higher than in the third group, unless influenced by other factors, whereas in fact the morbidity rate of the third group was much the highest. This fact means that there did exist a factor which compensated the malnutrition and contributed to the prevention of disease manifestations in the first and second groups.

3. Age: The age of the children when infected may be another big factor. The data (Table 6) show that in each group the majority of the cases showing manifestations of the disease appeared to have contacted with patients during the first year of life. That is, what seems to have been their source of infection was in close contact with them already at the time of their birth.

Another report informs us that most of the sources of infection are

the patients' parents. Of interest in that connection is the fact that most of those children who became infected, i.e., 20 out of 22, had contact with the infection source when they were less than 1 year old. Of Group 3, 28 children were in contact with leprosy in their first year and remained tuberculin negative without receiving BCG vaccination, and 14 of them, or 50 per cent, developed manifestations of the disease, while in the other groups the morbidity rate among those who were tuberculin positive (Group 1) was 4 out of 29, or 13.8 per cent, and among those who were tuberculin negative but received BCG vaccination (Group 2) it was 2 out of 64, or 3.1 per cent.

4. Sex difference: When the children were grouped according to sex (Table 7), the ratio of male to female in the first group was 54.7 to 45.3, in the second group 51.0 to 49.0, and in the third group 43.7 to 56.3. Thus there was no marked difference of sex distribution among these three groups.

All of these considerations involve possible factors which might influence the morbidity within the reach of our investigation, and it is consistently shown that the morbidity rate among the children who were tuberculin negative and received no BCG vaccination reached an extremely high figure as compared with those who were tuberculin positive or who were tuberculin negative but received BCG vaccination. I believe, therefore, that this difference is clearly significant.

*Time of BCG inoculation.*—Attention may also be called to the fact that the effect of the BCG vaccination upon leprosy is entirely different from the case of tuberculosis prophylaxis. In the case of tuberculosis, many investigators have shown that the beneficial effect of BCG vaccination can be expected only when it is performed before the primary tuberculosis infection. But in our present investigation of children of leprous parents, it is highly probable that infection with leprosy preceded the BCG vaccination in all the children receiving it. (The estimation of the period from infection to the first BCG inoculation is recorded in Table 8.)

This fact seems to indicate that the bacterial multiplication and development of immunity in the infected human being is very slow in the case of leprosy as compared with that of tuberculosis. From these results it may be permissible to conclude that, unlike the case of tuberculosis prophylaxis, the prevention of leprosy can be attained by the BCG vaccination even when the vaccination is done after infection.