

**CHANGES IN TUBERCULOSIS PREVALENCE IN A SOUTH INDIAN RURAL  
COMMUNITY FOLLOWING A TUBERCULOSIS CONTROL PROGRAMME  
OVER A SEVEN YEARS' PERIOD (A preliminary report)**

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A tuberculosis programme based upon detection of bacillary cases of pulmonary tuberculosis, isolation and treatment in hospital as well as on BCG vaccination of non-infected persons was introduced in Madanapalle in 1948 and in the surrounding villages in 1950. The total study population was about 50,000, later increasing to about 60,000. The present report deals with the results obtained after a period of seven years in a population of about 40,000 living in nearly 200 villages within a radius of about ten miles of Madanapalle but excludes the town population.

In 1950-51 an X-ray survey by a mobile unit was carried out and about 21,000 persons were photographed. Between 1951 and 1954 another three rounds of X-ray examinations were done bringing the total of persons X-rayed up to nearly 32,000 and many of these had repeat X-rays. At the same time an intensive examination by tuberculin tests was done, about 25,000 persons being tested at least once. Details of these activities have been given in a previous report (Frimodt-Moller, 1960).

In 1957-58 the same population was again X-rayed. This time about 32,000 were X-rayed, the coverage being better than during the first survey. Tuberculin examinations were not done.

At all surveys, cases showing significant pulmonary pathology on X-ray were selected for further examination by large X-ray and bacteriology. The present report, however, deals only with the prevalence of tuberculosis based upon the radiological findings.

METHOD USED

In order to ensure that the X-ray films obtained at the first and the last X-ray examinations were studied alike, the whole material of films from both surveys was submitted to a new independent reading—the former readings and their results being wholly ignored. The material comprised about 21,000 films from

the first and about 32,000 from the last survey, in all about 53,000 films. In order to reduce the work load the task was divided equally between two readers. As there were 50 exposures per roll of X-ray film, 420 rolls from the first and 640 from the last survey had to be studied. One reader was given all the rolls with even serial numbers and the other the rolls with odd numbers. In order to avoid that any possible change in interpretation of the X-ray pictures on the part of the two readers during the period of studying the two series of films might introduce some bias, it was arranged that the two readers read alternately two rolls from the first and three rolls from the last survey. Subsequent analysis showed that both readers had been very consistent with themselves throughout the whole period of reading, although they differed considerably from each other.

Pulmonary pathology seen on the X-ray photographs was classified according to the code used by the Indian sample survey ('Tuberculosis in India', 1959). For the purpose of the present analysis all cases designated as 'Probably tuberculous, possibly active' and 'Probably tuberculous and probably active', irrespective of the extent of the lesions or presence of cavities, have been accepted as indication of pulmonary tuberculosis. The prevalence is based upon the average found by the two readers.

RESULTS

*Coverage.* In 1950-51, 64.3 per cent of all persons over 4 years of age were X-rayed. In 1957-58 the coverage was as high as 89.4 per cent. The coverage for males and females was almost the same—in 1950-51, 64.7 and 63.9 per cent and in 1957-58, 89.9 and 89.3 per cent respectively. The distribution of persons X-rayed according to age is shown in Fig. 1. In both surveys the coverage of males over 50 years was better than that of females at the same age.

\* From the Madanapalle Tuberculosis Research Unit, Indian Council of Medical Research. Paper read at the Eighteenth Tuberculosis and Chest Diseases Workers' Conference, Bangalore, January 1962.

TABLE I  
*Distribution of cases radiologically suggestive of probably or possibly active pulmonary tuberculosis according to readers, each reader having read half the material*

Age	Number X-rayed	MALES			Number X-rayed	FEMALES		
		Cases		X+Y Per 1000		Cases		X+Y Per 1000
		Reader X No.	Reader Y No.			Reader X No.	Reader Y No.	
I. SURVEY 1950-51								
5-9	2009	4	2	3.0	1862	12	3	8.1
10-	2859	4	2	2.1	2081	6	5	5.3
20-	1956	6	12	9.2	2165	7	3	4.6
30-	1683	11	10	12.5	1620	10	5	9.3
40-	1227	20	17	30.1	1077	9	4	12.1
50-	938	15	16	33.0	597	9	5	23.4
60+	628	20	17	58.0	273	5	3	29.3
II. SURVEY 1957-58								
5-9	2596	7	0	2.7	2487	3	0	1.2
10-	4615	10	3	2.8	3996	10	5	3.7
20-	2500	16	13	11.6	2534	15	7	8.7
30-	2500	25	14	15.6	2776	27	15	15.1
40-	1936	44	25	35.6	1653	22	7	17.5
50-	1428	41	36	53.9	1218	22	14	29.6
60+								

*Prevalence of tuberculosis in males.* The original finding of a close association between age and prevalence (Frimodt-Møller, 1960) was also found in the last survey. The prevalence was lowest in children, less than 3 per 1000, rose to 12 at 25 years, was 16 at 35 years, 36 at 45 years and reached 78 per 1000 in old people over 60 years (Table 1). The shape of the curve is very much the same as found previously (Fig. 2), but there is a difference in position corresponding to a higher prevalence in 1957-58 than in 1950-51. The difference is small and statistically insignificant, yet it is noted at all ages except in children below 10.

*Prevalence in females.* The observation made in 1950-51 that females had a much lower prevalence of tuberculosis than males is also confirmed by the last survey. This applies mainly to women over 35 years of age. Below the age of 35 the prevalence for men and women is almost the same but after the age of 35, the rate for women is nearly half that of men (Table 1). As for the difference between 1950-51 and 1957-58 we find some increase in prevalence in women over 20 but a decrease in

children and adolescents (Fig. 3). Whereas the increase is not statistically significant, the decrease in girls below the age of 10 years is significant.

*Difference between readers.* The results given above were based upon the average as obtained by the two readers. There was, however, some difference between the two. This is borne out by the graphs presented in Figures 4 and 5. These show the findings for males and females respectively according to each reader. In both graphs the prevalence for 1950-51 for each age group has been considered as 100, and the prevalence for 1957-58 has been calculated in relation to that of 1950-51. The difference between the two prevalences can, therefore, be read in percent directly from the graphs.

The two readers have been remarkably close in case of the females. Both found a decrease of more than 80 per cent in girls below 10 and an increase of almost the same extent in women at 20-29 years while at higher ages the increase is less pronounced. As mentioned earlier, it is only the decrease in girls below 10 years which is statistically significant.

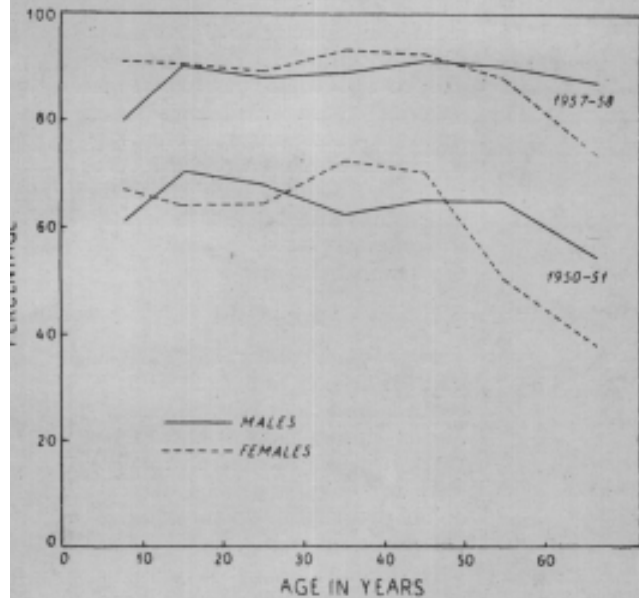


FIG. 1

Coverage by X-ray examination of the Madanapalle village population at the two surveys in 1950-51 and 1957-58 respectively.

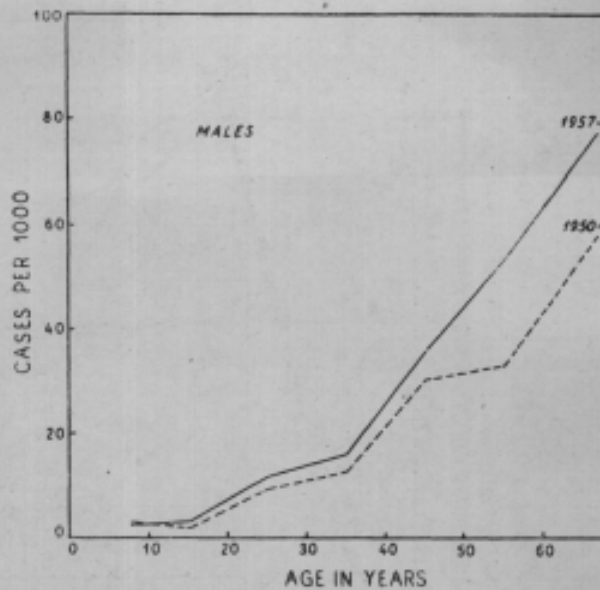


FIG. 2

Prevalence of tuberculosis in males according to cases classified as possibly or probably active on basis of mass miniature X-ray photographs.

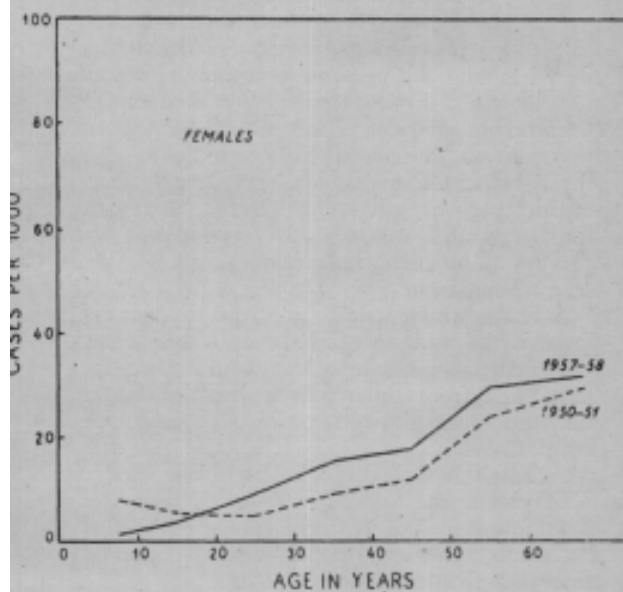


FIG. 3

Prevalence of tuberculosis in females according to cases classified as possibly or probably active on basis of mass miniature X-ray photographs.

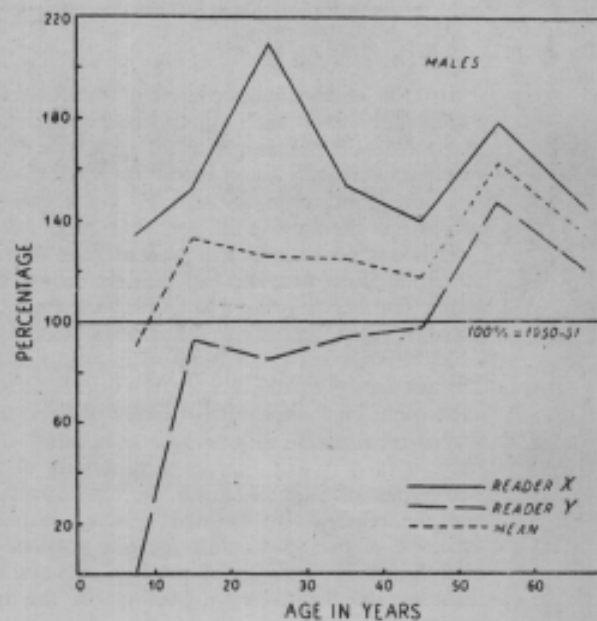


FIG. 4

The prevalence of tuberculosis in males at the 1957-58 survey in relation to that of the 1950-51 survey, the latter calculated as 100 for each age group and X-ray reader.

from which the relative prevalence could be compared. An estimate of the prevalence less open to personal vagaries would be findings based upon the bacteriological follow-up. This analysis has not yet been completed. However, there would be other difficulties such as difference in technique as well as in number of examinations made.

#### DISCUSSION

It is quite remarkable that in spite of a fairly intensive effort to control tuberculosis by all existing means during a period of seven years, it is not possible to demonstrate any obvious general decrease in the prevalence. What could be the reason for this?

In case of the males the two readers differ much more from each other. Reader X found an increase in prevalence at all ages whereas Y found a decrease in boys below 10 years, almost no change between 15 and 45 years and an increase in men above 50.

It is not possible at the present time to give an explanation why the two readers differed so much from each other, and why they should do so in case of males but not in case of females. Since the two materials read by the two readers are not likely to be inherently different from each other, the difference is likely to lie in the way the readers interpreted the films. As there is no way of judging the reliability of the two types of interpretation without applying another reading by a third reader, the best estimate of the prevalence for the purpose of comparing the findings of the two surveys has been to take the average findings of the two readers.

It has not been the purpose of the present analysis to estimate the absolute prevalence at the two surveys but only to provide a material

In 1950-51 about 36 per cent were absent from the X-ray examination, in 1957-58 only 11 per cent; perhaps a number of cases were missed in the first survey but picked up in the last. This might be true if the absentees represented a group of persons with a higher prevalence of tuberculosis than was found among the persons X-rayed. This was not the case. From the surveys subsequent to the first one in 1950-51 there was no evidence that patients with manifest tuberculosis evaded the X-ray examination in a higher degree than healthy persons. It seems justified to regard the two groups of persons X-rayed in the two surveys under review as random samples of the study population.

A factor which tends to increase the prevalence is the wide use of antibiotics which has kept many patients alive who would otherwise have died from tuberculosis. It was found that the tuberculosis mortality had decreased between 1950-51 and 1954 from well over 200 per 100,000 to only 21 (Frimodt-Moller, 1960). This means that among the X-ray abnormal cases found in 1957-58 there will be many who had been treated by ourselves in the interval since the first survey.

As the prevalence at the last survey is a result of various factors such as the survival of the cases which were present at the first survey plus fresh cases arising in the population

plus new ones who would have moved in, minus those who died or moved out, each of these groups would have to be studied carefully. The most important is the group of fresh cases occurring since 1950-51. Going over their records with respect to their status of tuberculin sensitivity at the initial Mantoux tests given, we find that over 80 per cent were already tuberculin positive when examined the first time. It is clear that this group which forms the great majority of cases contributing to the prevalence in 1957-58 has been unaffected by the result of our control measures as they were already infected before we began our present control project.

We must therefore look to those who were not yet infected in 1950-51, if we shall demonstrate a result of our control measures. It must therefore be mainly among the children. It is very significant that it is just in that group that we have been able to find a decrease in prevalence. Our observation that girls below the age of ten in 1957-58 had a significantly lower prevalence than girls of the same age in 1950-51 is a pointer that our efforts have not been without a result. Given a longer period of observation we may expect to find a reduction in prevalence among the older age groups, first in the group 10-19, then later on among those still older.

With the type of tuberculosis found in this population which is mainly characterized by its slow development from the time of primary infection till the first lesion is seen on the

X-ray film or clinical symptoms bring the patient to the clinic, it is necessary to have long periods of observation before it is possible to demonstrate the beneficial effect of a control programme.

#### SUMMARY

A South Indian village population of about 40,000 was examined by X-ray in 1950-51 at the start of an intensive tuberculosis control campaign. By comparing the prevalence of X-ray positive cases suggestive of active or probably active pulmonary tuberculosis as found by a new and independent reading of the 1950-51 films with that obtained by a survey done in 1957-58, children below the age of 10 showed a decrease whereas there was no change, or a small but statistically insignificant increase in the rest of the population. The absence of a decrease in the adults is ascribed to the result of keeping patients alive who would have died if they had not been treated with antibiotics and the fact that the great majority of fresh cases arising since 1950-51 were already infected with tubercle bacilli before the control campaign began.

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