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News & Notes ** **Abstracts**

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TRENDS IN TUBERCULOSIS

In our deliberations a question often crops up. Has there been any change in tuberculosis trends in our country recently ? If so, is it increasing or decreasing ? Tuberculosis being curable and preventable now, it is usually surmised that the problem is diminishing; but it is often forgotten that tuberculosis services are extremely rudimentary in large parts of the country and even if they were adequate, reduction in the pool of infectors will take a long time to get reflected in the development of fresh cases. Besides, factors like population explosion, food shortage, initial phase of industrialisation etc. may also be influencing the trends adversely. Theplain fact is that the answer to these questions is not available.

Infection, morbidity and mortality rates are the traditional epidemiological indices employed to estimate the tuberculosis problem in any community or country. Since infection is not always followed by disease and the percentage of infected individuals developing disease is not constant, infection rate may only be an indirect index of the extent of disease. Further, for want of a standard interpretation of the tuberculin reaction and due to mass BCG vaccination, the tuberculin test as an indicator even of infection is unreliable.

In the pre-antimicrobial era, there was a parallelism between mortality and morbidity rates. With the advent of these drugs, mortality rates have fallen precipitously without a corresponding and simultaneous fall in the morbidity rate. Notifications of disease (even if all cases were faithfully notified) are not an authentic measure of total morbidity because of the 'Iceberg' phenomenon. Prevalence of drug resistant bacilli in a population is a new criterion which is being employed to study the trends of disease but systematic studies on primary drug resistance being rather recent and few, not much information can be gleaned from these findings either.

Another difficulty in determining the trends is caused by built-in handicaps. Epidemics of an acute disease show well-marked up-swings and down-swings over a comparatively short period. Epidemic curve in tuberculosis, on the contrary, has a slow growth and owing to its chronicity, the swings are spread out. Frost had therefore recommended studies in epidemiology of tuberculosis to be carried out not only in cross section but also in longitudinal section.

Thus, properly planned and meticulously carried out longitudinal surveys alone can provide an answer. The National Sample Survey for the first time gave an approximate idea of the extent of disease in the country. Longitudi-

nal studies to provide information about the incidence and trends have been carried out only in Bangalore, Madanapalle and Delhi. Bangalore results are not yet available. Madanapalle studies have shown a reduction in the prevalence of bacillary disease whereas the Delhi studies do not show any such decrease. This apparent contradiction is, however, understandable. Neither the size of the population nor environmental factors in the two studies are comparable.

It may be recalled that tuberculosis had started declining in the West long before Robert Koch isolated the bacillus and proved it to be the causative micro-organism and long before present-day preventive measures could be elaborated. Moreover, discovery of the bacillus and the development of preventive measures did not hasten the trend to any appreciable extent. Infection is not the only factor involved in the development of disease. Even more important than infection are the 'host' and environmental factors. They are not only diverse but also impossible to quantify. And yet, any sharp variation in any one of them may not only halt but even reverse the trend.

Apart from epidemiological considerations, the situation regarding trends in clinical manifestation is no better. It is said that late post-primary disease is less advanced and less severe now than some years ago; that tumorous glands in the neck often leading to sinus formation are seldom seen nowadays; that miliary and meningeal disease is declining and so on and so forth. But these opinions again are based on insufficient evidence and often on impressions rather than systematically planned studies.

In short, the problem is complex. Reasonably accurate answer needs a number of cooperative studies on representative population of a fairly large size for a prolonged period, in different parts of the country. The Indian Council of Medical Research/Tuberculosis Association of India must take the initiative in this respect. Then, and then alone, will we be able to replace opinions based on impressions, surmises and speculation by authentic scientific knowledge to answer the questions posed above.

TUBERCULOSIS AMONG CIVIL SERVANTS IN DELHI

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I: Introduction

In 1953, the Government of India had under consideration a new medical aid scheme for its employees and was naturally anxious to know the extent of the tuberculosis problem in this group and adequacy or otherwise of the existing facilities for control of this disease. Since Government servants form an important section of the population of Delhi and are comparatively well-organised and easily accessible for studying the epidemiology of tuberculosis, a request from the Government of India to examine by mass radiography the entire body of the Central Government servants in Delhi was willingly accepted.

The first survey was started in March, 1953 and was completed by July, 1954. It was originally intended that such surveys should be repeated every five years. However, it was not till February, 1960 that the second survey could be taken in hand. This was completed in April, 1962 and the present report is based on data collected during and between the two surveys.

During the first survey, 44,371 persons were x-rayed. Unfortunately, and inspite of best efforts, no accurate estimate could be made of the total strength of the Central Government servants stationed in Delhi. Staff lists supplied by the various offices before the survey were often incomplete and invariably out of date by the time the survey started. Wherever the lists were reasonably accurate, the coverage was estimated to be over 90%.

In the first survey 35 mm film was used and all persons suspected to have a pulmonary lesion by at least one of the two independent readers were recalled for a large x-ray and bacteriological examination including culture of sputum (or laryngeal swab if the suspected person had no cough or sputum). After investigation, and if necessary, a follow up lasting 3 to 6 months during which at least two radiological and bacteriological assessments were carried out, all abnormal cases were broadly divided into the following groups:—

1. Pulmonary Tuberculosis—Active cases needing immediate treatment.
2. Pulmonary Tuberculosis—Inactive or 'doubtfully active' cases needing obser vation.
3. Cases with non-tuberculous chest or heart disease.

Cases in the first group were offered treatment at the New Delhi Tuberculosis Centre. They were entitled to free drugs at Government expense and under medical advice they could be granted leave on liberal terms. Hospitalization, where indicated, was also available, and with the coming of the Central Government Health Scheme, these facilities were considerably expanded. For persons defaulting in treatment, a certain amount of official pressure could usually be applied to enforce attendance. A small number, however, successfully evaded all attempts to enforce treatment.

Persons in the second group were required to attend the Centre for periodic check up which included an x-ray and a laryngeal swab culture. The interval between check-ups varied from 3 months to 1 year depending upon the apparent stability or otherwise of the lesion. This observation was intended to last for a period of five years unless there was a breakdown earlier. At the time of analysis, cases originally marked as doubtfully active, were either categorised as active or inactive depending upon their behaviour during follow up. (Section II). Since these cases were asymptomatic, they resented attendance at the Centre more than the frankly active cases and in many instances even official pressure failed..

Non-tuberculous cases in the third group were informed about the nature of their disease and advised to seek treatment at appropriate hospitals.

In the second survey, 76,951 persons were x-rayed out of an estimated strength of about 95,000. Again for want of accurate lists of establishments in most offices, exact percentage covered can only be surmised and is believed to be at least 90% i.e. the same as in the first survey. Some of the offices escaped examination en bloc.

In this survey 70 mm films was used and though the procedure for reading of films and investigations of those with abnormal shadows was the same as in the first survey, the method of disposal was somewhat different. Only those with obviously healed or inactive disease were placed in the 2nd group of observation cases and all others, active and doubtfully active were given treatment.

Chief Welfare Officer of the Central Secretariat was appointed the Liaison Officer for this survey and acted through the welfare officers of the respective offices. As a result of better co-ordination and earlier experience,

the second survey was more orderly, had better daily averages and was quicker than the first survey (number of persons x-rayed per hour of working time was higher).

II: Prevalence at the Time of First Survey

The prevalence of pulmonary tuberculosis among the 44,371 persons examined at the time of the first survey is shown in Table 1.

There are no significant age differences in the prevalence of active disease (X^2= 1.13 for 4 d.f., P>0.80). Inactive disease however, shows an increasing prevalence with age, a fact noted in the National TB Prevalence Survey (ICMR 1959) as well as in many other studies. Considering that women formed a very small proportion of the total employees (only 100 being examined) no separate analysis has been made by sex.

The overall prevalence of active disease amounts to 6.2 cases per 1,000 of which nearly two-thirds are bacteriologically proved cases.

At the time of investigations following the survey and before diagnosis, a complete history was taken for each case. The number of patients who were having treatment for tuberculosis at the time of survey or had had treatment earlier (known cases) was surprisingly low as can be seen from Table 2.

Only 36% of the active cases were known and the proportion of known cases in the bacillary groups was even lower (21%). Of the inactive cases, only 13% were known cases who were obviously previously treated cases with arrested disease. In the remaining, the disease process had healed without any treatment.

The extent of disease and bacillary status of the active cases is shown in Table 3.

Of the 274 active cases, 95 (34.7%) had definite cavitation, in another 47 (17.1%) cavity was doubtful and the remaining 132 (43.2%) were non-cavitary.

An analysis was also made to see whether prevalence of tuberculosis was related to economic status. All persons x-rayed were placed into one of the three categories, according to their monthly income (but not taking into account family size). The three categories shown in Table 4 may roughly be defined as follows:

Low income group: Peons, Daftries, Sweepers, Chowkidars etc.

Middle income group: Clerks and other white collar workers upto a monthly salary of about Rs. SCO/- in 1953-54.

High income group: Officials drawing more than Rs. 500/- P.M. in 1953-54.

The prevalence of disease in these three groups is shown in Table 4.

Whatever the morbidity index considered—whether bacillary disease or total active disease—it is obvious that the low income group has a prevalence of disease nearly four times that of the high income groups. Considering the index 'active disease', the differences are highly significant statistically (X^2=79.7 for 2 d.f. P<.001). The group which constitutes nearly one fourth the strength of the Central Secretariat accounts for more than half the tuberculosis cases. What is more, a larger than the average proportion of these cases are 'unknown' as can be seen from Table 5.

Prevalence rates were also analysed according to housing conditions, but since information on this point could not be collected with any precision, no meaningful conclusions could be drawn and no data are therefore being presented.

The comparatively low prevalence of active disease now being reported probably requires an explanation. It would be of interest to record that an interim analysis of data, made about a year after the survey, had indicated the following rates:

1. Bacillary	4.0%
2. Active abacillary	0.2%
3. Activity doubtful	10.4%

The grouping of cases was not exactly the same in as much as many of the cases that are now being classified as active abacillary or inactive were at that time marked as 'activity doubtful' (Section I).

The considerable discrepancy that exists between the present and the earlier rates is explained by the fact that the former are based on a follow up in some cases lasting several years. In the light of this follow up, the class 'Doubtful Activity' has ceased to exist, some cases having been assigned to the Active Abacillary group and the remaining larger number to the 'Inactives'.

Since a very large proportion of the cases earlier labelled as of 'doubtful' activity have now been classified as 'Inactive' as a result of follow up, this has also affected the figures in Table 3 regarding extent of disease. Almost all the cases in question had minimal shadows and with their removal, the proportion of minimal cases is now much less than what is usually found in mass x-ray surveys. It must, however, be added that the figures now being presented are probably

TABLE 1

Prevalence of Pulmonary Tuberculosis by age at time of First Survey

Age		15-24 years		25—34 years		35—44 years		45—54 years		55— years		Total	
		7,589		20,964		11,021		4,118		679		44,371	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Active Cases	Bacillary	18	2.4	94	4.5	41	3.7	21	5.1	2	2.9	176	4.0
	Abacillary	24	3.2	42	2.0	24	2.2	5	1.2	3	4.4	98	2.2
	Total	42	5.5	136	6.5	65	5.9	26	6.3	5	7.4	274	6.2
Inactive Cases		89	11.7	506	24.1	337	30.6	180	43.7	19	28.0	1,131	25.5

TABLE 2

Proportion of 'Known' and Unknown cases at time of First Survey

		Known cases	Unknown eases	Total
Active	Bacillary	37 (21%)	139	176
	Abacillary	61 (62%)	37	98
	Total	98 (36%)	176	274
Inactive		141 (13%)	990	1,131

TABLE 3

Extent of disease and bacillary status of Active Cases at lime of First Survey

Bacillary Status / Extent of Disease	Positive				Negative	Bact,. Exam, not done	Total
	Sputum D.S.	Sputum culture	Laryn-geal swab culture	Total Positve			
Minimal	1	1	13	15	17	3	35 (12.8%)
Mod. Advanced	22	11	33	66	52	1	119 (43.4%)
Far Advanced	68	10	15	93	13	3	109 (39.8%)
Pleurisy with Effusion	—	—	—	—	6	1	7 (2.6%)
Operated Cases	2	—	—	2	2	-	4(1.5%)
Total	93 34.7%	22 8.2%	61 22.8%	176 65.7%	90 33.6%	8	274 (100%)

TABLE 4

Prevalence of Tuberculosis by Income groups at time of First Survey

			Low income group	Middle income group	High income group	Income not recorded	Total
Number examined			11,747	25,257	2.807	4,563	44,371
Active cases	Bacillary	No.	103	58	5	10	176
		%	8.8	2.3	1.8	—	4.0
	Abacillary	No.	39	47	4	8	98
		%	3.3	1.9	1.4	—	2.2
	Total	No.	142	105	9	18	274
		%	12.1	4.2	3.2	—	6.2
Inactive cases		No.	493	536	37	65	1,131
		%	42.0	21.2	13.2	—	25.5

TABLE 5

Percentage of unknown cases in different income-groups at time of First Survey

		Low income group		Middle income group		High income group		Total	
		Known	Un-known	Known	Unknown	Known	Un-known	Known	Un-known
Active cases	Bacillary	14.6	85.4	27.6	72.4	20.0*	80.0*	21.0	79.0
	Abacillary	64.1	35.9	63.8	36.2	50.0*	50.0*	62.2	37.8
	Total	28.2	71.8	43.8	56.2	33.3*	66.7	35.8	64.2
Inactive cases		7.7	92.3	14.9	85.1	32.4	67.6	12.5	87.5

*Based on small numbers

nearer the mark since they are based on long follow up.

Ill: Subsequent Fate of Persons Adjudged Abnormal in the First Survey

A. Active Cases

Of the 1,405 abnormals present at the time of the first survey, only 274 were active including 176 bacillary cases. These cases were all prescribed treatment and their status at the time of the second survey is shown in Table 6.

Because of the long interval between the two surveys it was probably inevitable that correct status of many cases would be difficult to ascertain. Thus, no information about the present status was available in respect of 57 cases. Of these, 26 had retired from service and 31 were otherwise not available for examination. As one would expect, 79% of the remaining bacillary cases and 84% of the abacillary cases had been rendered inactive. Another 5.6% although still active were non-infectious. Nearly 9% are known to have died during the interval i.e. a known death rate of 1.4% per year. This obviously includes a certain amount of natural mortality which cannot be ascribed to their tuberculous disease.

B. Inactive Cases

It would be remembered that there were 1,131 cases who were labelled as 'Inactive' at the time of the first survey. Of these, 141 had definite history of previous treatment and in the remaining 990 the disease process may be presumed to have healed without any treatment. These cases were labelled as inactive, after a follow up of 3-6 months with repeated culture and x-ray examination. If the breakdown rates among these approximate those found among previous x-ray negatives, they may truly be considered as having healed; if there is a wide difference, it would be obvious that, at least in our environment, such cases cannot be considered to be stable.

As has been described in the preliminary chapter, these inactive cases were kept under observation. During the first few years they were required to attend for x-ray and bacteriological examination once in three months; later this interval was increased to 6 months and then to 1 year. This follow up was to last a minimum of 5 years, unless of course the case broke down earlier. Not all cases however completed the stipulated length of follow up as would be seen from Table 7. Also, because of the second survey, a number of these cases could be re-examined after an interval of upto 10 years. Cases which broke down during follow up were taken off the check-up lists, each case being prescribed treatment according to individual requirements.

The breakdowns among these 'Inactive' cases during successive years of follow up are shown in Table 8. The number of 'person-years at risk' forms the base for calculation of the breakdown rates for each year. To avoid small numbers, the period beyond 6 years has been combined into a single group.

The breakdown rates are obviously much higher than those for former x-ray negatives (Section IV) thus suggesting that such cases continue to be a high-risk group inspite of all clinical and radiological evidence to the contrary available at the time of initial diagnosis. As might be expected, the breakdowns are lower in the year immediately following the first survey.

In Table 9 are shown the breakdown rates according to age. The period has been broken up into two—the first 5 years following initial diagnosis and the next 5 years.

There are no great age differences in the frequency of breakdown but these are somewhat more common in the first five years after diagnosis although by no means rare in the subsequent period. It would be seen that nearly half the cases were bacillary at the time of breakdown.

It is of some interest to note how these 'breakdowns' were detected as it would bring out the relative importance of routine check up of inactive cases, re-surveys etc. This is brought out in Table 10; cases are sub-divided according to "degree" of infectiousness.

It would appear that 68% of the total breakdowns were detected during the routine periodic check up following the first survey diagnosis. Since such check ups were at fairly short intervals, only 5.9% of the cases were found having a positive sputum by direct smear at the time of detection of breakdawn (48.8% being positive by one method or other). This is in contrast to the cases that reported with symptoms (either between check ups or subsequent to the stoppage of routine check up). Of these cases (which form 27.4% of the total breakdowns) 31.4% were positive by direct smear, the total bacillary rate being 55.9%. Very few fresh active cases (only 4.3%) were detected at the second survey and although all except one of these were bacillary, none had a positive sputum by direct smear. Because of the long interval between the two surveys, it is obvious that only cases developing symptoms serious enough to warrant a

TABLE 6

Subsequent fate of Active Cases found at the time of First Survey.

First survey status	Total case	Second survey status not known		Second Survey status known	Second survey status			
		Retired	Not examd. for other reasons		Inactive	Active Abacillary	Bacil-lary	Dead
Active Bacillary	176	22	18	136 100%	107 78.7%	7 5.1%	9 6.6%	13 9.6%
Active Abacillary	98	4	13	81 100%	68 84.0%	5 62%	2 2.5%	6 7.4%
Total	274	26	31	217 100%	175 80.6%	12 5.5%	11 5.1%	19 8.8%

TABLE 7

Length of follow-up of Inactive Cases found at lime of First Survey

	Upto 1 year	1 to 2 years	2 to 3 years	3 to 4 years	4 to 5 years	5 to 6 years	6 to 7 years	7 to 8 years	8 to 9 years	9 to 10 years	Total
Number followed up	83	211	127	67	73	107	152	195	74	42	1,131

TABLE 8

Breakdown during follow up among 'Inavtive' Cases of First Survey in successive years

			1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year & beyond	Total
Person-years at risk			1,089.5	942.5	773.5	676.5	606.5	1,217.5	5,305.5
Break-downs	Active Bacillary	No.	18	61	32	24	23	38	196
		% py	1.6	6.5	4.1	3.5	3.8	3.1	3.7
	Active Abacillory	No.	8	52	48	24	24	20	176
		% py	0.7	5.5	6.2	3.5	4.0	1.6	3.3
	Total	No.	26	113	80	48	47	58	372
		% py	2.4	12.0	10.3	7.1	7.8	4.8	7.0

TABLE 9

Breakdown of Inactive Cases of First Survey by age

			15—24 Years	25-34 Years	35-44 Years	45—54 Years	55 years and over	Total
First 5 Years	Person—Years at risk		298.5	1,842.5	1,271.5	619.0	57.0	4,088.5
	Total Break-downs	No.	30	147	81	52	4	314
		% py	10.0	8.0	6.4	8.4	7.0*	77
6th to 10th Year	Person-Years at risk		70.0	595.5	356.0	144.0	11.5	1,217.0
	Total Break-downs	No.	3	29	18	7	1	58
		% py	4.3*	4.9	4.5	4.9	8.7*	4.8
First to 10th year	Person—years at risk		368.5	2,438.0	1,667.5	763.0	68.5	5,305.5
	Total	No.	33	176	99	59	5	372
		% py	9.0	7.2	5.9	7.7	7.3*	7.0
	Bacillary	No.	19	100	47	27	3	196
		% py	5.2	4.1	2.8	3.5	4.4*	3.7

*Based on small numbers

visit to the clinic would come to light without a survey, and these are more likely to have sputum positive by direct smear than cases detected during a routine survey.

The status of the cases breaking down in terms of extent disease and cavitation is shown in Tables 11 and 12.

Comparison with cases present at the time of first survey shows that both in respect of extent of disease and cavitation, the former inactives were a better off group at the time of breakdown. To a great extent, this may be due to early detection as a result of frequent routine check up.

The incidence of breakdowns was also analysed according to economic status (Table 13). As at the time of the first survey, it was found that the low income groups are the worst sufferers. The annual breakdown rate in this group was 9.8% per year compared to 5.6% and 4.0% in the middle and high income groups respectively.

Furthermore, the importance of a regular check up of cases considered "Inactive" is obvious and a 5 year period of follow up for such cases does not appear to be sufficient. This question however is tied up with that of finances and an optimum policy needs to be worked out.

TABLE 10

Bacteriological status of previously Inactive Cases breaking down at different stages

	Sputum D.S. Pos.	Sputum D.S. Neg. Cul. Pos.	Sputum D.S. & Cul. Neg. L.S. Cul. Pos.	Negative	Total
Routine check-up following 1st Survey	15 5.9%	2 0.8%	107 42.1%	130 51.2%	254 68.3%
Reported symptomatically between Ist & IInd Survey	32 31.4%	3 2.9%	22 21.6%	45 44.1%	102 27.4%
Discovered at time of IInd Survey	—	9 56.3%	6 37.5%	1 6.2%	16 4.3%
Total	47 12.6%	14 3.8%	135 36.3%	176 47.3%	372 100%

TABLE 11

Extent of disease at time of breakdown among former Inactive Cases

Minimal	118	31.7%
Moderately advanced	185	49.7%
Far advanced	59	15.9%
Pleurisy with effusion	10	2.7%
Total	372	100.0%

TABLE 12

Extent of cavitation at time of breakdown among former Inactive Cases

No cavitation	245	65 9%
Cavitation doubtful	48	12.9%
Cavitation definite	79	21.2%
Total	372	100.0%

TABLE 13

Breakdowns during following of Inactive Cases of First Survey by Income-Groups

	Total Inactive Cases at 1st survey	Person years at risk	Breakdowns	
			Number	Per 100 per year
Low Income Group	493	2315.5	226	9.8
Middle Income Group	536	2510.0	141	5.6
High Income Group	37	125.5	5	4.0
Income not recorded	65	354.5	—	
Total	1,131	5,305.5	372	7.0

IV: Incidence Of Tuberculosis After First Survey Among Previously Healthy Persons

Of the 44,371 persons examined in the first survey, 42,692 were found not to have any tuberculous pathology whatsoever. The subsequent follow up of these has been used to estimate the incidence rate of tuberculosis in this group. Besides being useful in itself, such information would be of more general interest as, with a few exceptions (Frimodt-Moller, 1960; Sikand et al, 1959;Pamra, 1966,1968) such rates have not so far been worked out for many groups in India.

In the second survey 22,155 (49.9%) of the 42,692 'x-ray negatives' of the first survey were re-examined. Besides these, another 397 (0.9%) out of this group had reported symptomatically at the New Delhi TB Centre before the second survey and had been diagnosed tuberculous. Thus, nearly half of the x-ray negatives of the first survey could not be examined a second time. Their reasons for not undergoing a second examination are not known; some certainly would have retired from service or would have been transferred out of Delhi, but it may be presumed that quite a few of them were either absent during the survey of their office or did not offer themselves for x-ray. On the other hand, it is virtually impossible for a person developing tuberculosis between the surveys to have escaped the Centre's notice as long as he was staying in Delhi, since all CGHS dispensaries where he would go for diagnosis or treatment were required at that time to refer such cases to the New Delhi Tuberculosis Centre. It is possible that some may have taken treatment privately but their number is likely to be extremely small. It would thus be clear that the normal method of calculating an incidence rate by relating the total of newly developed cases [whether (i) reporting symptomatically between the surveys or (ii) found at time of second survey] to the total number of x-ray negative persons at the time of first survey would not be applicable without some modification. The basic data to which this modification has to be applied is given in Table 14.

Whereas all the cases found at the time of second survey can be related to the base of 22,552 re-examinations, it is obvious that the symptomatic breakdowns before the second survey cannot be treated in the same manner, as the incidence rate would be over-estimated by this procedure. On the other hand, there is no suitable method for altering the denominator. The only logical method that suggests itself is to include in the numerator (apart from the cases found in the second survey) only as many cases of "symptomatic" breakdowns as would have attended the second survey, assuming that the re-examination percentage of these cases was the same as that

TABLE 14

New Cases of Tuberculosis arising out of x-ray negatives of First Survey

Age		15—24	25-34	35-44	45—44	55 and over	Total
Number re-examined		3,408	11,991	5,700	1,382	71	22,552
Symptomatic cases arising between the two surveys	Active Bacillary	49	118	40	18	—	225
	Active Abacillary	26	80	38	6	—	150
	Inactive	1	10	5	—	—	16
Cases found during llnd Survey	Active Bacillary	13	35	18	4	—	70
	Active Abacillary	16	50	25	16	—	107
	Inactive	60	260	163	61	—	544

for the entire group. In other words the number of 'symptomatic' breakdowns to be included in the numerator should bear the same ratio to the observed number of 'symptomatic' breakdowns as the number of re-examinations at the second survey does to the number of x-ray negatives at the first survey. Since re-examination rates vary considerably for different age-groups, such estimation has been made separately for each age-group to obtain greater precision. Thus, for example, in the age-group '15 to 24 years', there were 7,589 x-ray negatives at the time of first survey; of these, 3,408 (i.e. 45%) attended for re-examination during the second survey. In the same age-group 75 new active cases of TB had been diagnosed before the second survey and 29 more were found during the survey. According to the above reasoning the number of new active cases arising out of 3,324 persons would be taken as

$$29+\frac{75 \times 45}{100}=62.8$$

instead of 29+75= = 104

The number of cases in different age-groups, adjusted according to the above method is given in Table 15. For calculation of average incidence rates per annum, the number of persons re-examined has been transformed into "person-years at risk", taking into account the interval between the two examinations. (This interval, on an average, was 7.5 years).

Since all new cases found inactive at re-examination must have been active at some point between the two surveys, it is the index "Total New Cases" which is probably most appropriate for comparison. With the passage of time (nearly 7½ years) age-groups would have lost some of their meaning but a comparison, for what it is worth, suggests that the age differences may be real. A significance test (based obviously on actual numbers and not on person-years shown in Table 15) showed $X^2=20.0$ for 3 d. f., $P<.01$. It is however worth remarking that this significant result is due mainly to the higher contribution of 'inactive' cases in the age-group 45-54 years. This suggests that this age-group may have a higher incidence rate as well as a higher proportion of self-healing type of disease. Age-groups below 45 years have nearly the same incidence rates. This is similar to the findings in a general population resurvey in Delhi (Pamra, 1966).

Nearly half the cases were excreting bacilli when diagnosed and from Table 14 it would appear that those who attend with symptoms, have a higher proportion of bacillary cases (60%) than those who were discovered during the second survey (40%), which is not surprising.

From Tables 16 and 17 it can be seen that from the point of extent of disease and cavitation too, the cases reporting with symptoms were a worse group.

Since the prevalence of disease at the first

TABLE 15

Estimated Incidence of fresh disease among x-ray negatives of 1st survey

Age at time of 1st survey			15-24 years	25-34 years	35-44 years	45-44 years	55-year	Total years
Person-years at risk			23,279	84,888	40,156	9,691	471	158,485
Estimated fresh disease	Active Bacillary Cases	Number	35.1	102.3	38.8	10.1	—	186.3
		per 1000 p-y	1.5	1.2	1.0	1.0	— *	1.2
	Active Abacillary Cases	Number	27.7	95.6	44.8	18.0	–	186.1
		per 1000 p-y	1.2	1.1	1.1	1.8	– *	1.2
	Total Active Cases	Number	62.8	197.9	83.6	28.1 2.9	—	372.4
		per 1000 P-y	2.7	2.3	2.1		— *	2.3
	Inactive Cases	Number	60.5	265.7	165.6	61.0	—	552.8
		per 1000 p — y	2.6	3.1	4.1	6.3	— *	3.5
	Total new cases	Number	123.3	463.6	249.2	89.1	—	925.2
		per 1000 p— y	5.3	5.4	6.2	9.2	— *	5.8

*Based on small numbers

survey was found to be higher in the low income groups, incidence data too were analysed according to economic status and the results are shown in Table 18.

It is easy to see that the poorer classes have an incidence rate far higher than the average. Every year 13.6 out of 100 healthy persons in this income group developed fresh disease; the comparative figure for middle and high income groups is 4.8 and 3.9 respectively. It was noticed that nearly 1/10th of the healthy persons in this group developed diseses (including disease which healed itself) over an inter-survey period of 7½years.This obviouly is a very disturbing figure by any standards, Besides, there are many other points of interest, The proportion of bacillary cases to total active cases is also higher in the low income

TABLE 16

Extent of disease among Active Cases reporting symptomatically between surveys and those discovered during Second Survey

	Minimal	Mod. Advanced	Far Advanced	Pleurisy with Effusion	Total
Symptomatic Cases arising between the two surveys	55 15%	101 27%	177 47%	42 11%	375 100%
Cases found during Second Survey	100 56%	46 26%	22 13%	9 5%	177 100%

TABLE 17

Cavitation among Active Cases reporting symptomatically between surveys and those discovered during Second Survey

	Definite cavitation	Doubtful cavitation	No cavitation	Total
Symptomatic cases arising between the two surveys	171 46%	48 13%	156 41%	375 100%
Cases found during Second Survey	21 12%	13 7%	143 81%	177 100%

TABLE 18

Incidence of fresh disease between the two surveys by income group

	Number re-examined	Person— years at risk	Fresh Cases of Pul. Tuberculosis	
			No.	% 0 per year
Low Income Group	5,687	39,980	542	13.6
Middle Income Group	11,822	83,109	400	4.8
High Income Group	941	6,615	26	3.9
Total*	22,552	158,485	1,111	7.0

* includes persons whose income was 'not recorded'

TABLE 19

Prevalence of tuberculosis by age at time of Second Survey

		15—24		25—34		35—44		45-54		55 and over		Total	
Number examd.		13,422		32,511		21,867		7,733		1,418		76,951	
		No.	% 0	No.	% 0	No.	% 0	No.	% 0	No.	% 0	No.	% 0
Active Cases	Bacillary	48	3.6	126	3.9	82	3.7	64	8.3	15	10.6	335	4.4
	Abacillary	57	4.2	169	5.2	124	5.7	124	16.0	33	23.3	507	6.6
	Total	105	7.8	295	9.1	206	9.4	188	24.3	48	33.8	842	10.9
Inactive Cases		179	13.3	954	29.3	1153	52.7	541	70.0	140	98.7	2967	38.6

group than in the others. Also, fewer of these cases report symptomatically for treatment—which suggests that frequent case-finding surveys are needed for this group more than for the others.

V : Prevalence At The Time Of Second Survey

The second survey covered 76,951 persons as compared to 44,371 x-rayed at the time of first survey. Of these, 23,596 had been previously x-rayed in the first survey and the remaining represented new additions to the group or those who were absent in the first survey. The new entrants might have joined service anytime after the first survey or could have been transferred to Delhi from elsewhere. For the former, there is a pre-recruitment health check but only in the case of higher paid jobs does this include a chest x-ray. It is therefore not possible to say how many of the cases in this group had disease even when they joined the group and how many developed later.

Table 19 shows the overall prevalence of disease at the second survey and Table 20 a comparison of the important morbidity indices at the time of the first and second surveys.

The apparent rise in the prevalence of active disease compared to the first survey is not real. The treatment policy had changed in the intervening years, with the result that many cases which formerly would have been left without treatment, as being of doubtful activity, were now prescribed treatment and are hence included in the category of 'Active Abacillary'. Thus the only valid comparison between the two surveys is in terms of 'bacillary' cases. The prevalence of these has remained virtually unchanged (4.0 per 1000 in the first survey, 4.4 per 1000 in the second survey). As in the first survey, women formed a very small proportion of the total employees. The 76,951 persons examined in the second survey included only 1,835 women, 3 of whom were found to have active disease (Table 21). Because of the small numbers, women have not been classified separately in subsequent tables.

The prevalence of disease in the second survey was also analysed for the sub-groups comprising (i) persons examined for the first time and (ii) persons examined in both surveys. The rates for these sub-groups are given in Table 22.

Those examined for the first time have more or less the same amount of disease as the newly examined ones of the first survey. The very high amount of inactive disease in the re-examined persons of the second survey is explained by treatment given to the active cases of the first survey.

TABLE 20

Comparative prevalence rates of tuberculosis at the two surveys

		First Survey	Second Survey
Number examined		44,371	76,951
Prevalence rates per 1000 examined	Active Bacillary	4.0	4.4
	Active Abacillary	2.2	6.6
	Total Active	6.2	10.9
	Inactive	25.5	38.6

TABLE 21

Prevalence of tuberculosis among female Government of India employees at the time of Second Survey

		15-24	25-34	35-44	45-54	55—	Total
Number examined		793	765	209	68	—	1835
Tuber-culosis Cases	Active	—	2	1	—	—	3 (1.6%)
	Inactive	6	5	7	2	—	20 (10.9%)
	Total	6	7	8	2	—	23 (12.5%)

TABLE 22

Prevalence of disease at time of Second Survey among freshly examined and re-examined persons

		Examined for the first time in Second Survey	Re-examined in the Second Survey
Number examined		53,355	23,596
Prevalence rates per 1,000 examined	Active Bacillary	3.9	5.3
	Active Abacillary	5.5	9.1
	Total Active	9.4	14.4
	Inactive	25.3	77.6

Tables 23 and 24 show the extent of disease and the bacteriological status of active cases at the time of second survey. Compared to the first survey, the proportion of minimal cases seems to have increased considerably (49.8% against 12.8%). Similarly, the proportion of cases positive by sputum direct smear examination has also registered a considerable fall (7.2% as against 34.7% in the first survey). Even allowing for the fact that (as explained earlier in Section II) a number of cases formerly classified as 'doubtfully active' are now included in the 'Inactive' group, this change is remarkable. This is further corroborated by the fact that whereas nearly 53% of the bacillary cases of the first survey were positive by sputum direct smear examination, the corresponding figure for the second survey is 18%. Apparently cases are being diagnosed in an earlier stage now than before.

Mention was made earlier in the report about the relationship between economic status

TABLE 23 *Extent of disease among Active Cases at the time of Second Survey*

	Examined for first time in Second Survey		Re-examined in the Second Survey		All persons examined in Second Survey	
	No.	%	No.	%	No.	%
Minimal	251	49.9	168	49.6	419	49.8
Mod. Advanced	168	33.3	109	32.2	277	32.9
Far Advanced	66	13.1	40	11.8	106	12.6
Pleurisy with Effusion	11	2.2	10	2.9	21	2.5
Mediastinal T.B.	4	0.8	5	1.5	9	1.1
Operated Cases	3	0.6	7	2.1	10	1.1
Total	503	100.0	339	100.0	842	100.0

TABLE 24

Bacteriological status of Active Cases at the time of Second Survey

	Examined for first time in Second Survey		Re-examined in the Second Survey		All persons examined in Second Survey	
	No.	%	No.	%	No.	%
Sputum D.S. Positive	38	7.6	23	6.8	61	7.2
Sputum D S. Negative Culture Pos.	28	5.6	11	3.2	39	4.6
L.S. Culture Positive	144	28.6	91	26.8	235	27.9
Negative or not examined	293	58.2	214	63.1	507	60.2
Total	503	100.0	339	100.0	842	100.0

and the prevalence of tuberculosis. A strong association between the two was discovered in the first survey but no such analysis is possible in the second survey as, due to some misunderstanding about punching instructions, information on this point was not accurately recorded on the punch cards.

It would have been interesting to compare the proportion of 'known' to total active or bacillary cases in the first survey with the corresponding figures in the second survey. However the very fact that a survey had been carried out and that a large number of inactive cases who make a substantial contribution to the pool of active cases were under continuous follow up in the period between the two surveys makes such a comparison meaningless and this therefore is not being attempted.

VI : Extent Of Disability Among Patients Put On Treatment

Active cases, whether found in the one of the surveys or breaking down in between, were advised a period of rest lasting at least as long as they were infectious. It would be interesting to assess the extent of disability which this enforced rest imposed upon the patients. However, it is important to bear in mind two limitations of such an assessment. In the first place, the length of disability depends a great deal on the initial extent of disease and this latter, as can be seen from Table 25, varied considerably according to whether a patient was diagnosed in the first or the second survey or reported symptomatically between the surveys. Secondly, as has been stated earlier in this report, treatment policies have changed considerably over the years and lately many more cases have been treated while on work than was possible in earlier years.

Table 26 shows the length of disability in three groups of patients according to the time of their first diagnosis. It may be pointed out that 'abnormals of the first survey' in this table includes not merely all the active cases diagnosed in this survey but also inactive cases of this survey who broke down in later years. It can be seen from Table 26 that active cases discovered in the second survey (who in general were less advanced than those in the two other groups) had a much shorter period of rest than the others. Thus nearly two thirds of these cases were not taken off work at all and only 12.7% had to take more than 6 months leave.

Table 27 shows the disability suffered by patients who had their entire treatment in the home and others who were admitted to hospitals, for surgery or for other reasons. Since allocation to one or the other of these categories was not at random but was determined by other considerations e.g. medical indications, social or economic reasons, availability of beds etc. a comparison is neither intended nor possible. The significance of the table is rather in bringing out the load which the domiciliary service took off the hospital beds. It is only natural that hospitalized patients had to stay away longer from their jobs, especially if they had to undergo surgery, It can also be seen from this table that only about 7% of the active cases needed hospitalization for surgery.

It follows from this and the previous sections that the policy of having a home-based treatment scheme for tuberculosis patients is both sound and economical. Except for nearly 7% of the patients who would require surgical intervention, the remaining can be taken care of in their homes with satisfactory results and at much less cost to the public exchequer. Additional strength is lent to this

TABLE *25*

Initial extent of disease of Active Cases of Pulmonary Tuberculosis diagnosed at different stages

	Diagnosed in 1st Survey	Diagnosed in IInd Survey	Former negatives reported sympto-matically between 1st & IInd Surveys
Minimal	35 (12.8%)	251 (49.9%)	55 (14.7%)
Mod. Advanced	119 (43.4%)	168 (33.3%)	101 (26.9%)
Far Advanced	109 (39.8%)	66 (13.1%)	177 (47.2%)
Pleurisy with Effusion	7 (2.6%)	11 (2.2%)	42 (11.2%)
Mediastinal Tuberculosis	— (0.0%)	4 (0.8%)	- (0.0%)
Operated	4 (1.5%)	3 (0.6%)	- (0.0%)
Total	274 (100.0%)	503 (100.0%)	375 (100.0%)

TABLE 26

Length of disability among Active Cases diagnosed at various period

	Total cases	Length of disability						
		Nil	0-3 months	3-6 months	6-9 months	9-12 months	12-months	No ** record
'Abnormals' of Ist Survey*	646 100.0%	146 26.4%	37 6.7%	103 18.6%	64 11.6%	49 8.8%	155 28.0%	92
Negatives of Ist Survey developing active disease before IInd Survey	375 100.0%	29 8.7%	27 8.1%	74 22.2%	74 22.2%	42 126%	87 26.1%	42
Active Cases first diagnosed in IInd-survey	680 100.0%	445 66.4%	46 6.9%	92 14.0%	46 6.9%	16 2.3%	24 3.5%	11
All Active Cases	1,701 100.0%	620 39.8	110 7.1%	269 17.3%	184 11.8%	107 6.9%	266 17.1%.	145

* Including Inactives of 1st Survey who broke down later needing treatment.
** Including patients who were prescribed but did not take any treatment.

argument by the fact that in several recent studies (Sikand et al, 1961 ; Andrews et al, 1960) the risk to household contacts of tuberculosis patients treated at home has been proved to be no higher than the corresponding figure in hospitalized patients.

VII : Discussion

Apart from finding unknown cases with a view to treat them while the disease is in a relatively early stage, the main objects of repeated x-ray surveys are to determine the time trends of the disease in the group or the community under surveillance, and to formulate rational policies regarding control measures.

The two surveys carried out in the Government of India Secretariat have shown that the prevalence of bacillary disease has remained practically unchanged at about 4 per 1000 during the 7 years which separated the two surveys. The prevalence of abacillary disease (judged active on radiological evidence) however, was 6.2 per 1000 in the second survey as against 2.2 in the first. This does not necessarily mean that the prevalence has

TABLE 27

Length of disability among Active Cases treated at home and/or in hospital

	Total* Cases	Length of disability					
			0-3 months	3-6 months	6-9 months	9-12 months	12- months
Cases treated entirely at home	1,000 100.0%	620 62.0%	105 10.5%	176 17.6%	63 6.3%	17 1.7%	19 1.9%
Cases treated at home but hospitalized for surgery	104 100.0%	–	—	—	10 9.6%	10 9.6%	84 80.8%
Cases treated partly at home & partly in hospital (excluding surgery cases)	452 100.0%	—	5 1.1%	93 20.6%	111 24.6%	80 17.7%	163 36.1%
	1,556 100.0%	620 39.8%	110 7.1%	2691 7.3%	184 11.8%	107 6.9%	266 17.1%

* Excluding cases about whom complete information was not available.

increased and the difference may only be apparent. Subjective variations in the assessment of radiological activity of abacillary cases are well known. Further, the label of activity is often conditioned by current policies regarding treatment. By the time the second survey was taken up, the tendency was to treat many cases which at the time of the earlier survey would have been marked as 'observation' cases because of doubtful activity and treated only if there was radiological deterioration or a positive culture during the period of observation. In an interim analysis about a year after the first survey, 10.4 cases per 1000 were marked as 'doubtfully' active needing observation. When the final analysis was made and these cases had remained under observation for a period up to 7 years, only 2 per 1000 of these proved to be active and the remaining 8.4 per 1000 were included in the category of 'inactives' and the category of 'doubtfully' active was completely eliminated. At the time of second survey, when the assessment was made three months after the survey, no case was marked as 'doubtfully' active, and if the lesion did not radiologically appear to be fully healed and stabilized, the case was marked as presumably 'active' and given treatment. Even though this may seem to explain the apparent increase in 'active abacillary' category from the first to the second survey, it is desirable that the basis of comparison should not be liable to such subjective variations. Since the bacillary disease, not subject to such variations, has remained unchanged it may be reasonable to conclude that the prevalence has remained more or less constant. Seven years is too long a period for elimination of the 'unknown cases' to have any effect whatsoever on the prevalence. Wallace (1964) reported that the effect of a case-finding programme on fresh notifications in any community subsequently is expended in about three years.

Pool of active disease in a group like the Central Secretariat depends mainly on the incidence of fresh cases among previous 'Negatives' and 'Inactives' and immigration and emigration of persons with disease, in addition to the efficiency and adequacy of treatment facilities. No previous surveys having taken place, incidence trends are not known. Similarly pre-recruitment x-ray not having been taken as a routine, it is difficult to determine what factor or factors are responsible for unchanged prevalence.

It may however be mentioned that even though the bacillary rate has not diminished, the cases in the second survey were less advanced, on the whole than in the first survey. Of the bacillary cases, 2.7 per 1000 were positive by direct smear in 1953-54 as against 0.8 per 1000 in 1960-62. The bacillarity of 1.4 per 1000 was of a very low order (positive by laryngeal swab only) in the first survey as against 3.1 per 1000 in the second survey. Furthermore, whereas 42% cases in the first survey were 'far advanced', only 14% were placed in this category in the second survey.

If this is an index of future trend, it is a very welcome sign and may be harbinger of a subsequent fall in prevalence.

A good clinic service has been available to this group all through these years. This is also reflected in the rates of 'Inactives', in the two surveys. The rate of inactives disease was 24.8 per 1000 in the first survey as against 34.3 per 1000 in the second. The same trend has been noticed, in a population of about 30,000 in the city of Delhi (Pamra 1968), which enjoys a good clinic service.

The comparative fate of the "actives" and "inactives" of the two surveys could also have provided useful information regarding time trends of the disease, but, unfortunately, the fate of actives and inactives of the second survey is not fully known. Upto 1962, all Government servants suffering or suspected to be suffering from tuberculosis were required to attend the New Delhi TB Centre for advice. Soon after the second survey, this procedure was changed and the city was divided into 4 zones, each zone being attached to one of the clinics in Delhi for purposes of advice. Thus, persons living in the zone attached to New Delhi TB Centre only could be followed up. All attempts to obtain reports regarding treatment or follow up from the other clinics were ineffectual. Thus whereas the data regarding fate of 'actives' and 'inactives' of the first survey were authentic and reasonably complete, the same could not be said about the second survey, and the value of this important index is lost for comparative purposes because of proliferation of services.

It would however be interesting to compare the data of the Central Secretariat Survey with other groups of population in Delhi under surveillance of this Centre. A population of nearly 40,000 in the city of Delhi was surveyed as a part of the National Sample Survey in 1955 (ICMR, 1959). If the age and sex specific rates of bacillary and active abacillary disease in this population were applied to the contemporary first Central Secretariat Survey, the prevalence rate of bacillary disease would come up to 6.9 per 1000 instead of the actual 4.0 per 1000 and total active disease (both bacillary and abacillary) 28.6 per 1000 instead of 6.2 per 1000. Another population of 30,000 in the city of Delhi was surveyed in 1962 i.e. about the same time as the second Secretariat Survey (Pamra, 1966). If the age and sex specific rates of this community survey are applied to the second Secretariat Survey, the rate of bacillary disease would have been 6.7 per 1000 instead of 4.4 per 1000 and total active disease 20.3 per 1000 against 10.9 per 1000. The advantage in favour of the Central Secretariat staff as compared to the general population of Delhi is obvious and needs no comments. Similarly, whereas the breakdown rate of inactives in the general population is 26 per 1000 per year (nearly half of which are bacillary), the breakdown rate of inactives in the Central Secretariat Survey (Table 8) was only 7 per 1000 per year, half of them being bacillary at the time of breakdown. The breakdown rate of inactives has been compared with the corresponding rate in Delhi Police, which group, too, has been under surveillance for over 1,0 years (Sikand et al, 1959). The breakdown rate of inactives in Delhi Police is nearly 80 per 1000 per year. This too brings out the enormous advantage that Central Secretariat staff has over general population and Delhi Police. Probably the difference is mostly due to the disparity between the economic composition and working conditions of the various groups which is further discussed in some detail, later.

Another significant difference which has been noted between the general population and the Secretariat is that whereas the incidence of total disease (both actives and inactives) is roughly the same in the Central Secretariat and the general population, the incidence of active disease is much less in the former ; showing thereby that the fresh inactives are more frequent in the Central Secretariat. This is probably because persons in the Central Secretariat have better health consciousness and have better facilities for diagnosis and treatment. Therefore as soon as the disease starts, action is taken and before the following survey, disease which to begin with was necessarily active, became inactive before the repeat survey. Acceptability of treatment in the general population, on the other hand, is poor (Pamra, 1966) especially in patients detected in a survey. This explanation is plausible. Furthermore, reference to Table 28 would show that the percentage of known cases amongst the bacillary cases in the Central Secretariat is less than in the active abacillary cases. This is contrary to the usual finding in almost all surveys, including the two community surveys in Delhi referred to already. No doubt this difference may also be due to the Secretariat staff taking early action in the event of symptoms and the bacillary cases quickly becoming abacillary or being diagnosed at a much earlier and therefore abacillary state. All these differences would tend to highlight the fact that if adequate facilities are available and the population is comparatively better off and more health conscious, impact on the epidemiology of disease is considerable.

One of the salient findings of this survey has been the close relationship of economic status to prevalence and incidence. The Central Secretariat is a composite group in more senses