

TUBERCULOSIS IN A RURAL POPULATION  
THE PREVALENCE OF CHEST PATHOLOGY AS REVEALED BY  
X-RAY OF A RANDOM SAMPLE IN CATTARAUGUS COUNTY

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THIS article summarizes the chest X-ray findings in a series of health examinations conducted on 846 individuals from the farms and villages in the central part of Cattaraugus County, New York. The chest X-ray examinations were made primarily as a part of an epidemiological investigation of tuberculosis in a rural area, which is being carried on through the cooperation of the Milbank Memorial Fund, the United States Public Health Service, and the County Department of Health. Inasmuch as Sydenstricker and Downes<sup>2</sup> in a recent issue of the *Quarterly Bulletin* have described the geographical area included in the survey, the character of the population sample examined as well as the circumstances which brought them in for the examination, these points need not be detailed here. It is sufficient to say that the group examined represents rather well a random sample of the population of the geographical area under consideration and that the group constitutes about 17 per cent of this population.

It was not thought at the beginning of the investigation that the X-raying of such individuals would uncover much new tuberculosis. This supposition was based upon extensive tuberculin testing by the Bureau of Tuberculosis and examinations in diagnostic clinics over a period of ten years. Consequently the small number of significant lesions which this

<sup>1</sup>From the Cattaraugus County Department of Health and the Division of Public Health Activities of the Milbank Memorial Fund.

<sup>2</sup>Sydenstricker, Edgar and Downes, Jean: The Prevalence of Tuberculous Infection in a Rural Community in New York State. The Milbank Memorial Fund *Quarterly Bulletin*, July 1933, xi, pp. 221-232.

paper has to report, as resulting from the X-raying of chests, is not surprising or disappointing. It is only corroborative and gratifying. At the same time the fact should not be lost sight of that the Milbank Memorial Fund has been willing to finance the examinations in order to make a certainty out of what had been merely a probability.

As to technique, stereoscopic postero-anterior films were taken of practically all but infants and extremely small children. For these latter single films were made. The exposures were done uniformly at 48 inches for 1/10 second, with a Coolidge universal 100 milliamper tube, and the kilovoltage was varied with the chest depth, calipers being used to measure the chest. Only those films that were of satisfactory quality were included in this study. The films were read by Dr. Korn. Many of them were reviewed independently by Dr. Ralph Wheeler, and doubtful ones were sent to Dr. F. M. McPhedran who very kindly gave an opinion.

Table 1 shows the distribution of those X-rayed by sex and by age groups. A fairly satisfactory number were X-rayed in

Table 1. Age and sex distribution of the 846 individuals X-rayed.

AGE GROUPS	NUMBER			PER CENT		
	Both Sexes	Male	Female	Both Sexes	Male	Female
ALL AGES	846	372	474	100.0	100.0	100.0
0-9	191	91	100	22.6	24.5	21.1
10-19	185	86	99	21.9	23.2	20.9
20-29	93	34	59	11.0	9.2	12.4
30-39	97	36	61	11.5	9.7	12.9
40-49	114	45	69	13.5	12.1	14.6
50-59	84	36	48	9.9	9.7	10.1
60-69	52	24	28	6.2	6.5	5.9
70-79	23	16	7	2.7	4.3	1.5
80 Plus	6	3	3	.7	.8	.6
Age Unknown	1	1	0			

TYPE OF LESION	AGE GROUPS									Age Un- known
	All Ages	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70+	
TOTAL LESIONS	59	1	6	8	6	18	11	5	5	0
Adult Type: (Pulmonary)										
Minimal	7	0	0	0	0	3	3	0	1	0
Moderately advanced	1	0	0	0	0	0	1	0	0	0
Advanced	1	0	1	0	0	0	0	0	0	0
Childhood Type:										
Calcified nodules in the lung	15	0	1	2	2	4	3	3	0	0
Tuberculosis of the tracheo- bronchial lymph nodes— calcified	11	1	1	1	0	4	2	1	1	0
Both calcified nodules in the lung and calcified tracheo- bronchial lymph nodes	24	0	3	5 <sup>1</sup>	4	7 <sup>1</sup>	2	1	2	0
TOTAL INDIVIDUALS X-RAYED	846	191	185	93	97	114	84	52	29	1

<sup>1</sup>In one case the films indicated only partial calcification at the hilum.

Table 2. Type of tuberculous lesions discovered by X-raying 846 individuals, according to age.

each age group up to 70. The fact that the females predominate among the adults examined was almost unavoidable in a community chiefly agricultural.

Inasmuch as the films were taken primarily to determine the prevalence of discoverable tuberculosis in the chest, the data on this point are presented first. Table 2 gives this information by age groups.<sup>3</sup> The first three horizontal divis-

<sup>3</sup>Since it was desired to determine the amount of tuberculosis in a random sample of the resident population in a rural area, one individual who reported for the health examination and was diagnosed as moderately advanced pulmonary tuberculosis has been excluded. This individual, a man 28 years of age, had recently come from Buffalo into the area under consideration and remained there less than 6 months. He asked especially to have the health examination because he knew he had definite symptoms of tuberculosis. He should have been directed to the regular diagnostic clinic in the district instead of being examined in a clinic where the bases of selection of families were the general interest in health and the willingness to have an examination which included the tuberculin test. Consequently, it seems quite proper to exclude this case

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ions in the table show lesions of the adult type as classified by the National Tuberculosis Association. The last three illustrate primary lesions of the so-called childhood type, classified according to suggestions made to the writer by Dr. E. L. Opie.

Fifty-nine individuals showed some X-ray evidence of tuberculosis infection, but in 50 of these there were only calcified pulmonary nodules or tracheo-bronchial lymph nodes or both. In none of the 50 had any illness been attributed to tuberculosis and no history of illnesses suggestive of this disease was obtained. It was evident that these 50 had taken care of their lesions without any invalidism, and without the development of the adult type of lesion. Nine showed X-ray evidence of the adult type of tuberculosis, but in seven of these no history could be elicited that indicated clinical evidence of tuberculosis. In all of these seven the lesions were classed by X-ray as minimal and they appeared to be healed. The one moderately advanced case was apparently cured. The one advanced case was active and this patient had been under some medical observation before this examination.

In the entire group of 846, therefore, only one active case of pulmonary tuberculosis was found by X-ray, although a total of 59 showed by this method evidence of past tuberculosis infection.

Of the nine diagnosed as being of the adult type, eight, or 89 per cent, were males, although only 44 per cent of those X-rayed were males. It is interesting to note that only seven of the 59 diagnosed, or 11.9 per cent, were under 20 years of age although 44 per cent of those X-rayed were under 20. This confirms previous observations of the writer to the effect that in this county recognizable lesions usually develop after

since he was not an actual resident of the population being studied and sought the examination because of definite symptoms of tuberculosis.

adolescence. At the same time it should be kept in mind that the single advanced lesion found was in a boy only 17 years old.

Besides this there were five sets of films showing either a doubtful pulmonary nodule or a doubtful calcified area in the region of the tracheo-bronchial lymph nodes.

No attempt was made to record the results of the tuberculin tests for the series as a whole since they do not lie within the scope of this paper but one very interesting finding was that out of the fifty diagnosed by X-ray as showing calcified nodules or tracheo-bronchial lymph nodes, ten showed no reaction to 1.0 mg. of Old Tuberculin given intradermally. Eight of these non-reactors were over 40 years of age. This corresponds with our previous experience in this county, where casual tuberculosis infection seems light, in that we have found in several instances in middle age or later incontrovertible X-ray evidence of calcification, in the presence of a negative reaction to 1.0 mg. of standardized Old Tuberculin intradermally. Only about one-third of those diagnosed reacted to 0.01 mg. of Old Tuberculin, a larger dosage being required in the remainder.

Some attention was devoted to abnormalities in the films that might be ascribed to causes other than tuberculosis. These abnormalities are grouped roughly in Table 3.

The abnormalities tabulated will be commented upon in the above order.

*Increased lung markings.* This term was applied to exaggerations of normal markings whether local or general and was not used to cover homogeneous densities. It was thought that in adults obesity might be a factor in causing thin films and so the appearance of increased markings. It was found that very few under age 20 were more than 10 per cent overweight, as reckoned by standard tables. Of the 469 over age 20 who were X-rayed the overweight group numbered eighty-

AGE GROUPS	TOTAL X-RAYED	IN-CREASED LUNG MARKINGS	EN-LARGED HEART OR AORTA	OTHER CAUSES OF WIDE MEDIA-STINAL SHADOW	THICK-ENED PLEURA	BRON-CHIEC-TASIS	CONVA-LESCENT PNEU-MONIA	CALCI-FIED PLAQUE IN AORTA	PUL-MO-NARY IN-FARCT	RIB ANOM-ALIES
ALL AGES	846	96	37	8	7	2	2	5	1	5
0-20	376	14	3	3	1	0	0	0	0	3
20-39	190	46	3	3	1	1	0	0	0	0
40+	279	36	31	2	5	1	2	5	1	2
Age unknown	1	0	0	0	0	0	0	0	0	0

Table 3. Evidence of pathology, other than tuberculosis in 850 chests X-rayed.

nine or 19 per cent. Of the eighty-two over age 20 who showed increased lung markings twenty or 24 per cent were in the overweight group. This difference of 5 per cent is slight and may not be significant. If the films are read objectively the interpreter might occasionally suspect pathology in or around the bronchioles in some of the obese patients, but when due allowance is made for the increased chest thickness such films can usually be properly evaluated.

It was thought too that a history of previous chest trouble might be elicited more frequently from those who showed increased markings than from those not showing this feature, but such was not the case. In fifteen, or 15 per cent, of ninety-six showing such markings there was a history of previous chest trouble. In five of these there had been pneumonia, and in two chronic heart disease. In the entire group of 846 X-rayed 167, or 19 per cent, gave a history of previous chest trouble, subdivided as follows: pneumonia 81, influenza 45, repeated colds with cough and sputum 11, repeated bronchitis 10, pleurisy 10, sinusitis 4, asthma 3, chronic heart trouble 2. In this connection it should be stated that no relationship between tuberculosis and previous chest trouble was noted.

One further fruitless effort was made to account for increased lung markings. The pathology of the nose, mouth, and pharynx was recorded and it was found in the group of ninety-six with increased markings that twenty-nine, or 30 per cent, showed carious teeth, ten, or 10 per cent, deviated septum, twenty-three, or 24 per cent, enlarged tonsils, and five, or 5 per cent, enlarged turbinates. In the entire group of 846, 329, or 38 per cent, showed carious teeth, 88, or 10 per cent, deviated septum, 258, or 30 per cent, enlarged tonsils, and 46, or 5 per cent, enlarged turbinates. Ninety had no natural teeth and 75 had had tonsillectomy. And it is fair to assume that these had shown pathology in previous years. They were so distributed as not to change the ratio appreciably.

It would seem in this series then, that there is little if any evidence pointing to obesity as a cause of increased lung markings and that previous chest trouble or present pathology in the oral and nasal passages are negligible factors in the production of such markings. Table 3 shows clearly the importance of age as a factor. Of 376 X-rayed under age 20 only fourteen, or less than 4 per cent, showed increased markings, while of 469 X-rayed over age 20, eighty-two, or 17 per cent, showed such markings.

*Other abnormalities* found need not be commented upon at length. Thirty-two showed decided enlargement of the heart shadow or widening of the aortic shadow or both. Several of these gave histories and corroborating findings of organic heart disease. Eight showed wide upper mediastinal shadows due to persistent thymus in three, substernal thyroids in four and to a malignant mediastinal tumor in one. Seven showed thick pleura. Bronchiectasis was found in two, localized densities due to convalescent pneumonia in two, calcified plaques in the aorta in five, pulmonary infarct in one, cervical ribs in four, and fusion of the anterior ends of two ribs in one case.

## DISCUSSION

The above data would seem to have distinct value in that they reveal a very small amount of active or clinically important tuberculosis of the lungs in the community under consideration. Only one active case was found among the 846 who had chest X-ray examinations. These data also furnish a basis for estimating the actual prevalence of active tuberculosis in the rural part of Cattaraugus County. In addition to the one case discovered there should be added the proportionate number of active cases known within the 5,000 population from which the 846 were drawn, or one case, making a total prevalence of two.<sup>4</sup> If this prevalence be applied to the rest of the County's rural and village population, numbering approximately 40,000 (exclusive of reservation Indians), there should be ninety-four active cases. The Bureau had actually sixty-nine active cases on the roster, or 73 per cent of the estimated prevalence. If this estimated prevalence be accepted as a reasonably accurate approximation to the actual prevalence of active tuberculosis, the fact that 73 per cent of the cases were known indicates a high degree of attainment in case finding and reporting in Cattaraugus County.

The annual death rate from all forms of tuberculosis in this rural and village district of 40,000 people averaged 33 per 100,000 for the past five years, but it is gratifying to note that the number of deaths has markedly decreased during this period. In 1928 there were 19; in 1929, 21; 1930, 12; in 1931, 8, and in 1932, 6. So the finding of so little active tuberculosis in a sample of the population under discussion is quite

<sup>4</sup>As stated in the study reported upon by Sydenstricker and Downes (*op. cit.* 2) none of the four families with known active tuberculosis was asked to have the special health examination. If we assume these cases to be evenly distributed among the 5,000 population, in any sample of 846 drawn at random we should expect to have one known case of tuberculosis.



consistent with a rapidly decreasing death rate from the disease in this area.

Also interesting and significant is the fact, brought out in Sydenstricker's and Downes' paper referred to above, that tuberculosis infection takes place mostly after adolescence in the area under consideration. The X-ray findings in the sample group here reported are consistent with the above report on tuberculin tests in that they show six times the number of lesions in those over age 20 as compared with those under 20. In spite of the large increase in discoverable lesions over age 20 there is no evidence that post-adolescent primary infection is not borne as well as childhood primary infection. The calcified areas in the lungs and tracheo-bronchial lymph nodes appear to remain calcified and no new lesions appear to develop. The weak response to tuberculin in adults mentioned in this paper, by a number of those showing calcification, would indicate probably a light primary infection and a healing of the lesion.

#### SUMMARY

In summary the chests of 846 individuals, representing a cross-section of a rural and village community, were X-rayed. The amount and type of tuberculosis found is recorded, and other pathological findings in the films are noted.

A total of fifty-nine persons showed some X-ray evidence of tuberculosis infection, fifty of these illustrating the primary or childhood type, which apparently was of no clinical significance. The remaining nine showed secondary or adult types of lesions, but of these nine only two had had symptoms referable to their pulmonary trouble, and only one was considered active. Only one of these nine was under 20 years of age. Those over 20 showed six times as many tuberculosis lesions of all types as did those under 20. The adult type of

lesion was found prevailingly in males. A relatively large number of those over 40, showing X-ray evidence of calcification, failed to respond to diagnostic doses of Old Tuberculin.

No correlation of significance was noted between heavy lung markings seen in the film on the one hand, and obesity, previous chest trouble, or present pathology of the oral and nasal passages on the other. These markings increased definitely with age.

The net result of importance, therefore, of the chest X-ray examinations, was to prove that serious tuberculosis is rare in the population group studied. This confirms impressions derived from negative symptomatology and physical findings in the group examined and also from previous intensive search for tuberculosis in the same geographical area.