

A Reappraisal of Tuberculosis in Florida

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IN RECENT YEARS the tuberculosis mortality rate in Florida has diminished rapidly, declining from 17.9 per 100,000 population in 1951 to 16.9 in 1952 and to a low of 9.7 in 1953. The 1953 rate is substantially below the national rate of 12.5 as estimated from the 10-percent sample of death certificates filed with the National Office of Vital Statistics, Public Health Service (1). Only 303 deaths from tuberculosis among Florida residents were recorded during 1953, and for the first time in the history of death statistics in Florida, tuberculosis was not among the 10 leading causes of death.

It is unfortunate that mortality statistics provide the most frequently used measure of disease problems. They indicate poorly the trend of the incidence and prevalence of infectious chronic diseases such as tuberculosis because of the time lag between infection and death. Mortality statistics alone, as an indication of the magnitude and trend of the tuberculosis problem, are especially unsatisfactory, since improved therapeutic techniques have decreased the proportion of tuberculosis cases terminating in death. However, the rapid decline in mortality and the impending reduction in funds

available for tuberculosis control indicated a reappraisal of the tuberculosis problem and the present methods of X-ray case finding in Florida.

For this reappraisal, statistics collected from the 1953 X-ray screening in Florida were analyzed to develop an estimate of the prevalence of undetected cases in the general population.

An estimate of the number of undetected cases, when used with statistics on known cases derived from the tuberculosis case register, offers a much more satisfactory basis for planning a tuberculosis control program than does the use of mortality statistics alone. Estimates of prevalence made on an annual basis over a period of years will also indicate the trend of the tuberculosis problem more satisfactorily than will mortality figures.

These statistics of known cases and estimated undetected cases offer a good basis for the appropriation of tuberculosis control funds by State and local governments for use in planning hospital facilities and nursing services, for the operation of X-ray case-finding programs, and for the activities of the tuberculosis association.

During 1953, State and local health units in Florida made 70-mm. X-ray films of 382,304 persons. Of these films, 8,882 were interpreted as showing some type of pathology. A total of 4,448 were interpreted as indicative of tuberculosis (table 1).

Followup films were made on 2,762 patients showing signs of definite or suspected tuberculosis. A definite diagnosis of tuberculosis

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not previously known to the State board of health was established in 497 cases, yielding a new case rate of 130 per 100,000 persons screened on the original 70-mm. X-rays. Since the followup of the original screenings was only 62 percent complete, the actual rate is probably much higher. Hospitalization was recommended for 191 patients.

State X-ray Screening Survey

Included in the 70-mm. X-rays were 148,240 exposures made for "mass screenings," principally by mobile units of the State board of health. As more complete information concerning both the persons X-rayed and the results of followup was available for this group, a detailed analysis was made from these data. The age, race, and sex distribution of this group was compared to the general population and found to differ significantly. However, on the basis of available information, adjustments were made for these factors and statistical inferences were drawn regarding the prevalence of undetected tuberculosis in Florida. The methodology and results of this analysis are presented in this paper.

The 29 Florida counties surveyed (map) are not randomly distributed throughout the State, but are concentrated in western and south-

Table 1. Results of 70-mm. X-ray screenings and 14'' x 17'' followup films, Florida, 1953

Diagnosis	Number
Total 70-mm. films ¹	382, 304
Definite or suspected tuberculosis.....	4, 448
Cardiovascular pathology.....	1, 560
Tumor.....	170
Other pathology.....	2, 704
Negative.....	373, 422
Total 14'' x 17'' followup films ²	2, 762
New cases.....	497
Old cases.....	434
Suspected tuberculosis.....	206
Calcification.....	106
Other pathology.....	437
Diagnosis reserved.....	224
Negative.....	858

¹ Excludes unsatisfactory films.

² Followup of 70-mm. films with impressions of definite and suspected tuberculosis.

western Florida. Three universities located in counties not shaded on the map were also included in the survey. Since the survey was not intended primarily as a statistical study, no attempt was made to insure a random sample. The survey was made to find and bring to treatment cases of tuberculosis, and the statistics available represent a byproduct.

Counties were selected for screening on the basis of the time elapsed since a previous survey of that county. The mean elapsed time between the last survey of the counties in the study and the 1953 survey was 24.7 months, ranging from 11 months to 71 months. The length of elapsed time between surveys is undoubtedly a factor in the number of tuberculosis cases detected. A correlation between the time elapsed and the size of the new case rate in the counties surveyed showed a positive coefficient of $r=.41$. This correlation is significant statistically at the 5-percent level. Since the counties not included in the survey had been screened more recently than those included, some upward bias has been introduced into the prevalence estimate by this factor.

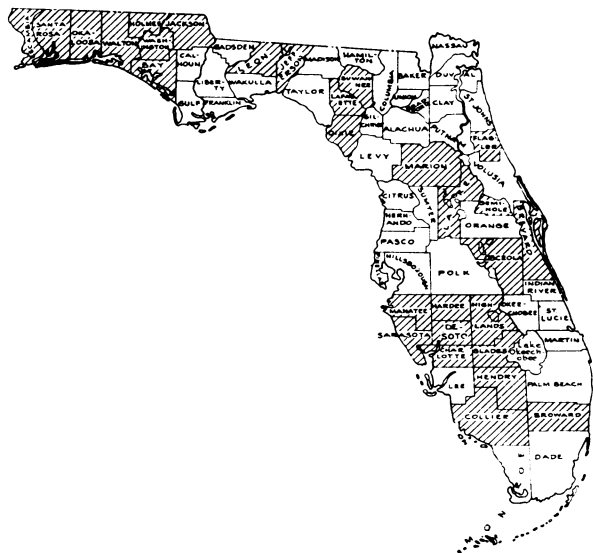
This bias has probably been more than offset by the fact that the counties surveyed are predominantly rural, and the counties containing Florida's largest cities are not in the area surveyed. Since tuberculosis case rates are generally higher in large cities, the geographic distribution of the counties included would tend to have a downward influence on the prevalence estimate (2).

Another factor exerting a downward bias upon the estimate of prevalence is the inherent assumption that nonrespondents to the survey would show a proportion of tuberculosis similar to that of the screened population. There is some indication that a higher proportion of the population which did not voluntarily respond to the survey would show signs of definite or suspected tuberculosis (3).

The methodology of the survey was typical of mass X-ray screenings of the general population. Advance publicity was given to the arrival of the survey unit. The X-ray team set up shop in a prominent location and photographed all persons 15 years of age or older volunteering.

These 70-mm. films were then read, chiefly

Shaded counties were included in tuberculosis survey and followups, excluding universities, Florida, 1953.



by the bureau of tuberculosis control of the Florida State Board of Health. When the impression indicated definite or suspected tuberculosis, an attempt was made to obtain a 14" x 17" followup film. Followup films were successfully obtained for 75.2 percent of the persons suspected of having tuberculosis.

As a result of these followup films, 187 new tuberculosis cases were definitely diagnosed, yielding an unadjusted case rate of 126.1 per 100,000 adults successfully X-rayed by the original 70-mm. films.

The Survey and General Populations

Since information regarding the age, race, and sex was collected at the time the survey X-rays were taken, it was felt that a good estimate of the number of undetected cases of tuberculosis could be made by use of these data.

A 10-percent sample of the 70-mm. X-rays diagnosed as negative was drawn for each county surveyed. Commencing with the fifth card in each county, every 10th card was selected. Cards were filed in the order in which the films had been taken. Information on race and sex, and on age was tabulated.

The race, sex, and age distributions of the 145,267 negative X-rays were estimated from this sample, and the distribution of the films with pathological findings was added to this to derive an estimate of the distribution of all of the 70-mm. films taken.

Since 1953 was fairly close to the census year of 1950, information concerning the race and sex distribution of the population of Florida in 1950 was used as a standard against which to

Table 2. Distribution of 1950 Florida adult population, 15 years of age and over, and of 1953 survey population by race, sex, and age

Race, sex, and age	Florida	Survey population	Percentage distribution ¹	
			Florida	Survey population
Total.....	2, 045, 502	148, 240	100. 0	100. 0
Race and sex:				
White male.....	795, 238	54, 820	38. 9	37. 2
White female.....	827, 465	59, 876	40. 4	40. 8
Nonwhite male.....	203, 713	16, 971	10. 0	11. 6
Nonwhite female.....	219, 086	15, 208	10. 7	10. 4
Unknown.....		1, 365		
Age:				
15-24.....	595, 027	46, 418	19. 3	32. 0
25-34.....	440, 625	28, 530	21. 5	19. 7
35-44.....	412, 153	27, 297	20. 2	18. 8
45-54.....	324, 207	20, 324	15. 9	14. 0
55-64.....	236, 016	13, 185	11. 5	9. 1
65 and over.....	237, 474	9, 408	11. 6	6. 4
Unknown.....		3, 078		

¹ Unknowns excluded.

judge the representativeness of the surveyed population. The adult population of Florida was distributed on a percentage basis by age, race, and sex, and these percentages were used as a theoretical set of frequencies for comparison with the survey group (table 2).

The persons of known age, race, and sex in the survey group were redistributed according to the theoretical frequencies, and a chi square test made. The survey group was found to fit the theoretical distributions poorly, chiefly as a result of the large number of university stu-

Table 3. Film impressions of 70-mm. mass X-ray screenings, by race, sex, and age, Florida, 1953

Race, sex, and age	Total films ¹	Percent of population ²	Film impression				
			Definite or suspected tuberculosis	Cardio-vascular	Tumor	Other pathology	Negative
Total.....	148, 240	28. 0	1, 344	597	66	966	145, 267
Race and sex:							
White male.....	54, 820	27. 0	623	141	23	456	53, 577
White female.....	59, 876	29. 4	427	170	23	313	58, 943
Nonwhite male.....	16, 971	32. 0	187	138	13	114	16, 519
Nonwhite female.....	15, 208	26. 6	96	139	5	74	14, 894
Unknown.....	1, 365	-----	11	9	2	9	1, 334
Age:							
15-24.....	46, 418	39. 6	157	51	1	103	46, 106
25-34.....	28, 530	26. 3	130	28	6	83	28, 283
35-44.....	27, 297	27. 5	193	49	5	161	26, 889
45-54.....	20, 324	26. 6	263	112	16	175	19, 758
55-64.....	13, 185	23. 3	251	104	18	185	12, 627
65 and over.....	9, 408	15. 9	314	245	19	235	8, 595
Unknown.....	3, 078	-----	36	8	1	24	3, 009

¹ Excludes unsatisfactory films.

² Based on 1953 estimated corresponding population group in counties surveyed.

Table 4. Findings on followup by 14'' x 17'' X-ray of definite or suspected tuberculosis, mass X-ray screenings, Florida, 1953

Race, sex, and age	Follow-up films	Percent follow-up	Findings						
			New cases	Old cases	Sus-pected tubereu-losis	Calcifi-cation	Other pathol-ogy	Diagno-sis re-served	Nega-tive
Total.....	1, 011	75. 2	187	142	82	19	191	79	311
Race and sex:									
White male.....	478	76. 7	80	83	35	8	104	50	118
White female.....	333	78. 0	60	44	26	9	60	22	112
Nonwhite male.....	132	70. 6	35	10	12	1	14	6	54
Nonwhite female.....	63	65. 3	11	4	8	1	13	1	25
Unknown.....	5	-----	1	1	1	-----	-----	-----	2
Age:									
15-24.....	119	75. 8	12	5	8	1	19	2	72
25-34.....	102	78. 5	23	22	3	1	8	10	35
35-44.....	141	73. 1	37	26	9	1	26	6	36
45-54.....	200	76. 0	45	27	24	5	31	15	53
55-64.....	194	77. 3	33	26	22	7	36	22	48
65 and over.....	238	75. 8	34	33	16	4	70	24	57
Unknown.....	17	-----	3	3	-----	-----	1	-----	10

dents included, and was judged not to be representative of the total Florida population.

To compensate for the poor correspondence of the survey population to the general population, age-specific rates were computed and used to derive an estimate of the number of undetected cases in Florida.

Rates were developed for specific population groups based on a cross tabulation by age, race, and sex of the 187 new cases, and the corresponding number of persons in each age, race, and sex group of the surveyed population. The estimated adult population of Florida as of July 1, 1953, was prorated according to the age, race, and sex distribution of the 1950 census. The age-specific rates were then applied to each population group to derive an estimate of undetected cases in 1953.

This procedure introduces many possibilities for error. The number of cases in each age bracket is small, and the rates correspondingly irregular. The age distribution of the population has undoubtedly changed since 1950, and the projected population also must vary from the actual to some degree. However, it is believed that the method is reasonably accurate and is considerably better than an estimate based on the unadjusted case rate.

One additional adjustment was believed necessary to derive a prevalence of undetected cases in 1953: an adjustment for incomplete followup of the definite and suspected cases detected on the 70-mm. films.

The film impression results, percent followup by race, sex, and age, and new cases found appear in tables 3-5. No significant difference in percent followed (at the 5-percent level) could be found for the two most divergent age groups, or by race (table 4). It was therefore decided that the overall followup percentage (75.2) could be used as an adjusting factor if it were assumed that a similar proportion of the cases lost to followup would have been definite tuberculosis cases. The adjusted figure for undetected cases in 1953 is 4,856, and the rate 211.1 per 100,000 adult population.

To this figure may be added the 11,608 known cases of active, questionably active, and inactive pulmonary tuberculosis under supervision by local health departments in 1953, yielding a prevalence estimate of 16,464 known and undetected cases.

In contrast to the small number of deaths, 303, these figures indicate that tuberculosis remains a major health problem in Florida.

Table 5. Activity and stage of new cases found, by race, sex, and age, mass X-ray screenings, Florida, 1953

Race, sex, and age	Total	Stage				Activity			New case rate ¹
		Minimal	Moderately advanced	Far advanced	Unknown	Active	Inactive	Undetermined	
Total.....	187	76	87	12	12	49	59	79	126.1
Race and sex:									
White male.....	80	38	32	5	5	22	27	31	145.9
White female.....	60	25	27	1	7	10	27	23	100.2
Nonwhite male.....	35	7	22	6		14	2	19	206.2
Nonwhite female.....	11	5	6			3	2	6	72.3
Unknown.....	1	1					1		
Age:									
15-24.....	12	3	8		1	8	2	2	25.9
25-34.....	23	5	14	3	1	12	5	6	80.6
35-44.....	37	16	14	4	3	11	6	20	135.5
45-54.....	45	17	24	2	2	10	14	21	221.4
55-64.....	33	13	15	1	4	4	17	12	250.3
65 and over.....	34	20	12	1	1	2	14	18	361.4
Unknown.....	3	2		1		2	1		

¹ Rate per 100,000 satisfactory 70-mm. films.

Administrative Uses

Administratively, several important facts became apparent as a result of the detailed analysis. While the case rate increased considerably with age (table 5), the proportion of the population surveyed became progressively smaller with age (table 3). Case rates were higher for males than for females (table 5), but a relatively constant proportion of each sex group was surveyed. Evidently, case-finding efforts will yield greater returns if a greater proportion of older persons and males can be screened.

The largest proportion of cases found (87.2 percent) were in the minimal or moderately advanced stages, indicating that the mass screening technique is successful in finding cases at a stage when treatment of active cases or supervision of questionably active cases can be most successfully undertaken.

The distribution of new cases by activity is based chiefly on the reading of the 14" x 17" followup films and only in part on clinical study. The proportion of active cases decreased progressively with age, and the proportion of cases with activity undetermined tended to increase. This has probably resulted from the difficulty of making a diagnosis from 14" x 17" chest X-ray films in older persons who are more likely to have calcification, fibrosis, and caseation, whereas the younger patients are more apt to have exudative lesions and present less difficulty in determining activity.

Future Plans

The productivity of X-ray screening will, of course, diminish as the prevalence of tuberculosis is reduced, and the cost per case found will increase correspondingly. It is difficult to assess at what point the yield of the X-ray technique does not justify the expenditure.

In Florida, the 1953 X-ray screenings yielded 497 new cases. There are no figures available showing how many additional cases resulted from the followup of contacts of these infected persons, but this number is believed to be substantial. It would seem that this method of case finding is still sufficiently productive in Florida to warrant its continuance.

As the prevalence of tuberculosis is further reduced, the X-ray screening program will be directed toward those areas and age, race, and sex groups which will yield the greatest number of cases as indicated by the present general surveys.

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