

# THE AGE INCIDENCE OF TUBERCULOSIS AND ITS SIGNIFICANCE FOR THE ADMINISTRATOR<sup>1</sup>

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THE high incidence of active cases of tuberculosis among young adults calls for a new emphasis in tuberculosis administration. The preventive aspect of the tuberculosis program has been directed mainly toward case-finding among children and adolescents and close supervision of individuals at those ages in tuberculous families. Data are accumulating which indicate that a more direct attack against the disease should be made through case-finding and supervision among adults.

Through special studies of tuberculosis in Cattaraugus County, considerable original data have been collected over a period of years for the purpose of shaping the administrative program toward greater effectiveness in the control of the disease. Information was secured through investigation of tuberculous families which makes it possible to present for the first time the actual age incidence of manifest disease among family contacts with a comparison of the age incidence for the community as a whole. Some of the evidence indicating the relatively great importance of supervision among specific sex-age groups of the population is reviewed in this paper.

## AGE INCIDENCE AMONG FAMILY CONTACTS

It is important for the tuberculosis administrator to know the ages at which the breakdown from tuberculosis occurs most frequently so that these ages may be emphasized both in case-finding and supervision. It is recognized that precise data on tuberculosis according to age at onset of the disease are difficult to ascertain

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for any area because the disease may evidence itself as an acute illness with a sudden onset or a chronic illness with an insidious onset extending over a considerable period of time before it becomes characteristic of tuberculosis. Delayed diagnosis and faulty reporting are also factors which tend to conceal actual age incidence. However, it is generally conceded that tuberculosis is a disease which spreads among family contacts and it is believed that most cases in the community are the result of family or household contact with an infectious case. Consequently a group of tuberculous families in which the initial case is one of adult pulmonary tuberculosis may be used as a sample population in which to observe the frequency and age of occurrence of secondary cases with clinical symptoms.

Special investigation and study of tuberculous families in Cattaugus County make it possible to observe the occurrence of secondary cases in a sample of eighty-five families. The initial or first case in each family was adult pulmonary tuberculosis. The initial case was known to have had a positive sputum in 70 per cent of the families; in 17 per cent no record of a sputum test was available but it was believed that sputum had been positive; in 9 per cent the sputum tested was negative and in 4 per cent the initial case reported no sputum available for a test. In 65 per cent of the families the initial case was the husband or wife, in 20 per cent the first case was a daughter, in 13 per cent, a son, and 2 per cent some other relative in the home.

The age and sex incidence of secondary cases with clinical symptoms in these eighty-five families is shown in Figure 1 and Table 1. The method of determining the age at onset of the disease and of arriving at age incidence of tuberculosis, or case rate per year of observation, in a population composed of families is described in detail in the footnote below.<sup>2</sup> The incidence of sec-

<sup>2</sup>The eighty-five families were selected at random from the active cases of tuberculosis reported during the period 1923-1930. The only requisite of selection was

(Continued on page 154)

ondary cases of tuberculosis at ages 0-4 is 5.0 per 100 person years for males, the highest found in any age group; for females it is 2.5 or slightly lower than at certain adult ages. At ages 5-9 the

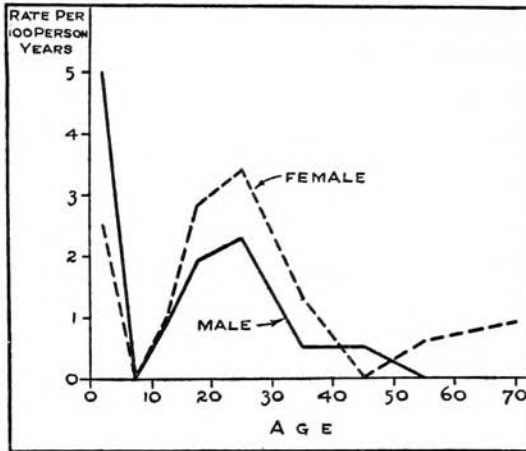


Fig. 1. Age incidence of secondary cases of tuberculosis (all forms) with clinical symptoms among male and female contacts in eighty-five tuberculous families in Cattaraugus County.

rate is zero for both sexes, then rises to .9 for males and 1.0 for females at 10-14 years of age. The frequency of cases in the next age period, 15-19, increases very rapidly and reaches a second peak at 20-29 for both sexes but the incidence is much higher for females than males. After age 30 the rates show a very rapid decline and con-

that there must have been an active case within each family sometime during the period 1923-1930 with an unquestionable diagnosis of active tuberculosis. The active case which formed the basis of selection in each family was not necessarily the initial case in the family. Detailed information as to the onset of first symptoms was secured for all cases in each family through visits to the home and interviews with patients in the sanatorium by an investigator, especially trained for this type of work. Symptoms which were asked about are as follows: fatigue or worn-out feeling, unusual loss of weight, pleurisy, chest cold of unusual duration, and blood spitting. Date and duration of time was secured for each symptom if it had been present. For pleurisy, information was sought as to the number of attacks, approximate date of each attack, whether or not there was effusion, whether or not the attack of pleurisy was disabling, length of time in bed and whether or not a doctor was in attendance. A chest cold of unusual duration was one which lasted four weeks or longer. The symptom history was considered in its entirety in determining the time of actual onset of disease for each patient, that is, neither the first symptom to appear nor no one symptom alone such as loss of weight was taken as absolutely indicative of onset.

Since it was desired to arrive at an incidence of secondary cases of disease in a population based on families into which the factor of exposure to an infectious disease had been introduced, it is necessary to use the total person years at each age as a population base after exposure to tuberculosis is known to have occurred. Thus it is possible to compute the rate of occurrence of tuberculosis with clinical symptoms at each age in a population with familial exposure to tuberculosis. This is an adaptation of the life table method with the distinction that it represents years of life after the factor of exposure to familial tuberculosis has been introduced. For example, the person years at ages 10-14 include individuals for whom exposure to tuberculosis started at ages 10-14 plus those individuals for whom exposure started at 0-4 or 5-9 who had reached ages 10-14. This same procedure applies to each age group. Person years were counted from the beginning of exposure to familial tuberculosis to July 1, 1934.

AGE GROUPS	RATE PER 100 PERSON YEARS		NUMBER OF SECONDARY CASES OF TUBERCULOSIS WITH CLINICAL SYMPTOMS		NUMBER OF PERSON YEARS OBSERVED AT EACH AGE	
	Male	Female	Male	Female	Male	Female
0-4	5.0	2.5	4	2	80	80
5-9	0	0	0	0	182	194
10-14	0.9	1.0	2	2	212	204
15-19	1.9	2.8	4	6	206	215
20-29	2.3	3.4	7	10	303	291
30-39	0.5	1.3	1	2	192	155
40-49	0.5	0	1	0	187	179
50-59	0	0.6	0	1	152	162
60+	0	0.9	0	1	151	106

<sup>1</sup>The initial or first case in each of the eighty-five families was one of adult pulmonary tuberculosis.

Table 1. Age incidence of secondary cases of tuberculosis with clinical symptoms by sex in eighty-five tuberculous families, Cattaraugus County.<sup>1</sup>

tinue below a rate of 1.0 per 100 person years after age 40. These data are shown for age at onset of disease determined by a history as to appearance of symptoms. When tabulated according to actual breakdown from tuberculosis, there is practically no change in the shape of the curve. The high incidence of tuberculosis among infants and children of preschool age in tuberculous families is a well-known fact. The tendency for children who have had intimate exposure to tuberculosis to develop the disease at the teen ages is also generally recognized. But since active tuberculosis with clinical symptoms occurs even more frequently in early adult life than in the teens, it would seem a wise procedure in tuberculosis administration to place considerably more emphasis than is customary at the present time upon case-finding among young adults and close supervision of family contacts between 20 and 30 years of age.

#### AGE INCIDENCE FOR CATTARAUGUS COUNTY

It is of interest to know whether or not the age incidence of cases of tuberculosis with clinical symptoms for the community as a whole is similar to the incidence in tuberculous families. The collection of data of cases in Cattaraugus County over a period

of eleven years (1923-1933) makes it possible to show the average annual incidence of active tuberculosis at different ages for that area.<sup>3</sup> These data are shown in Figure 2. The age incidence for

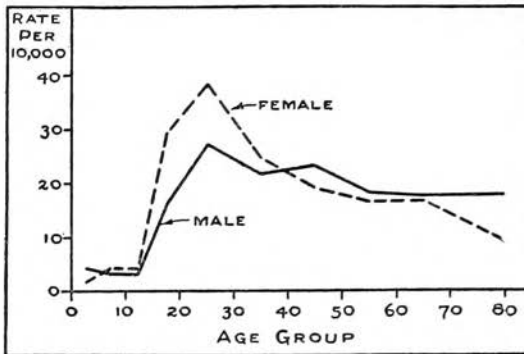


Fig. 2. Average annual incidence of active cases of tuberculosis (all forms) by age groups and sex, Cattaraugus County, 1923-1933. The rates shown in this chart are based upon all active cases reported or diagnosed in the eleven-year period, or a total of 671 cases. Cases among Indians and Buffalo residents at J. N. Adam Memorial Hospital, Perrysburg, are excluded.

the County as a whole and that for the tuberculous families when compared show certain important similarities. Excluding the occurrence of tuberculosis among children under 10 years of age, both curves indicate a rapid increase in tuberculosis at the teen ages and reach a high point at ages 20-29. The incidence for the total County falls much

less rapidly after age 30 than was found to be true in the tuberculous families. Since the age curve for these tuberculous families does not include the initial cases among which are those resulting from extra-familial contact, this difference would suggest that extra-familial contact plays a rather important part in the production of cases at older adult ages. The significant fact brought out by this chart again is the high frequency of occurrence of cases in the early adult ages which are not being particularly emphasized for case-finding or supervision. These ages must be considered as highly important in tuberculosis control if the present decline in mortality from the disease is to be greatly accelerated.

<sup>3</sup>A program of intensive case-finding and of education of the public to seek early diagnosis has been carried on in Cattaraugus County throughout the period 1923-1933. It is believed that most individuals in the County who are ill with tuberculosis are known to the Department of Health. Through a special study of the prevalence of tuberculosis in a rural section of the County, it was concluded that 73 per cent of the active cases among the rural population are known and this is considered as an indication of a high degree of attainment in case-finding and reporting in the County as a whole.

The sex differences in the incidence of active tuberculosis in the County during this period as shown in Figure 2 also follow closely those noted for members of tuberculous families. From ages 5-29 the case rate is higher among females than among males, the excess being greatest at ages 15-19 where it is 81 per cent. At ages 40-49 the rate among females falls to 83 per cent of the male rate and continues to be slightly lower at the older ages.

In view of the fact that the mortality data do not show a comparable excess among females except at ages 15-19,<sup>4</sup> the question may be asked whether active tuberculosis actually occurs more frequently among females than among males at young adult ages as Figure 2 indicates, or has case-finding and reporting operated more effectively among females than among males.

In the first place we may refer to the evidence obtained from the secondary case rates in the tuberculous families. Among this group of carefully observed individuals the female incidence at ages 20-29 exceeded the male in the same amount as noted for the total County incidence; at ages 15-19 the excess in the tuberculous families was about 50 per cent compared with 80 in the County. Secondly, the proportion of family contacts examined has not differed for the two sexes. Since the stage of the disease at diagnosis is an indication of successful case-finding, sex differences by stage may be considered. Classification of adult pulmonary cases shows that at ages 15-29 approximately 6 per cent more females than males was diagnosed as minimal. However, if the minimal cases are excluded from the rates for both sexes, we have at ages 15-19 a rate of 11.3 among females compared with 6.8 among males; at ages 20-29, a rate of 14.5 compared with 10.8 per 10,000 males. The difference between these rates among males and females, namely, at ages 15-19,  $4.5 \pm 1.562$ , and at 20-29,  $3.7 \pm 1.416$ , when tested statistically may be considered as

<sup>4</sup>The average annual mortality from tuberculosis by age and sex is discussed on page 158.

significant.<sup>5</sup> No significant differences were found at any other age. It seems reasonable to conclude that tuberculosis does occur more frequently among females than among males at those ages.

#### MORTALITY AT SPECIFIC AGES

As already suggested, the specific sex-age differences in mortality from which most of our information concerning incidence of tuberculosis has been drawn do not agree closely with the case

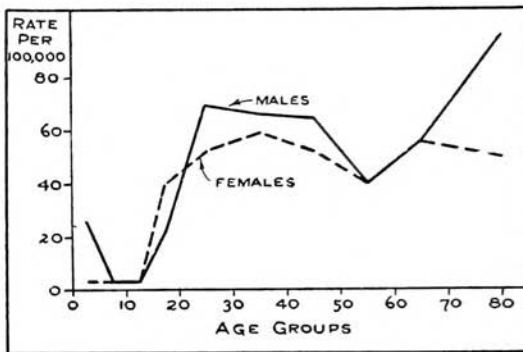


Fig. 3. Average annual mortality from tuberculosis in Cattaraugus County by age groups and sex, 1925-1933. (Excluding Indians and nonresidents dying at the J. N. Adam Memorial Hospital, Perrysburg.)

incidence as it has been observed in Cattaraugus County. The average annual mortality for the period 1925-1933 is shown according to age and sex in Figure 3. The sex differences in the mortality and case incidence can be seen very clearly in Figure 4 in which the ratio of the female rate to the male rate is plotted. In early childhood, 0-4 years, both case incidence and mortality are much lower for females than males; from ages 5-14 mortality for the two sexes is nearly equal but case incidence is 30 to 40 per cent higher among females. During the adolescent years, ages 15-19, the female rates for both mortality and case incidence exceed the male rates by about 80 per cent. At ages 20-40 a striking reversal occurs and the mortality rates for females are lower

<sup>5</sup>The difference in the average annual rates for males and females at ages 15-19 is three times its probable error, as shown in the table. The difference in the rates at ages 20-29 is almost three times its probable error. Consequently the differences at these ages may be considered as probably

Age Group	Average Annual Rate Per 10,000		
	Male	Female	Differences
15-19	6.8 ± .95	11.3 ± 1.2	4.5 ± 1.6
20-29	10.8 ± .92	14.5 ± 1.1	3.7 ± 1.4

significant and not due entirely to chance variations.

than for males although the incidence continues to be higher. Above 40 years of age the sex ratio for mortality and incidence is similar with the female rates slightly below the male rates.

Obviously the higher mortality for males at ages 20-39, although the incidence of active cases is higher for females, must mean that more of the diagnosed cases among males were fatal. One factor influencing the higher fatality is the relatively unfavorable stage at which the male cases were diagnosed. Thus Table 2 shows that a higher proportion of minimal cases were diag-

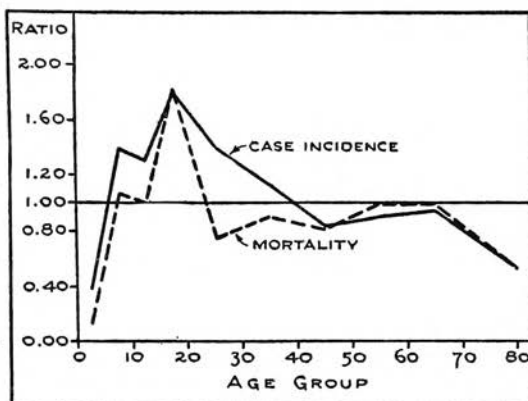


Fig. 4. Ratio of the tuberculosis death rate and the active case incidence among females to males at different ages. When the ratio is 1.0 to 1.0 the male and female rates are equal; if less than 1.0 the female rate is lower than the male; if more than 1.0 the female rate is higher than the male. Based on Figures 2 and 3.

nosed among females than males at ages 15-29; at ages 30-49 almost 50 per cent of the male cases were classed as advanced compared with 30 per cent among females. Practically no differences as to stage were noted for either sex after age 50. When the fatality by sex for cases diagnosed in the same stage is compared, a very interesting result is shown. Those diagnosed as moderately advanced at ages 15-19 had an average annual fatality of 12.6 per 100 years of observation among females and 6.0 among males; at ages 20-29 the fatality was strikingly different with a rate of 15.3 among males and 7.6 for females; very little difference was noted in the average annual fatality among males (7.7) and females (8.8) diagnosed at ages 30-39. These differences in fatality are suggestive but are found not to be significant when judged by their probable errors. This means that they are no greater than



STAGE	AGE GROUPS					
	15-29		30-49		50+	
	Male	Female	Male	Female	Male	Female
	PER CENT					
TOTAL	100.0	100.0	100.1	100.0	100.0	100.1
Minimal	21.3	26.8	19.4	30.2	9.4	12.8
Moderately advanced	44.7	42.8	32.7	39.6	37.5	36.2
Advanced	34.0	30.4	48.0	30.2	53.1	51.1
	NUMBER					
TOTAL	94	138	98	96	64	47
Minimal	20	37	19	29	6	6
Moderately advanced	42	59	32	38	24	17
Advanced	32	42	47	29	34	24

Table 2. Active cases of pulmonary tuberculosis according to stage of disease and age when diagnosed, Cattaraugus County, 1923-1933.

might have occurred as chance variations due to the small numbers involved.<sup>6</sup> Therefore no general significance can be attached to this difference in fatality found in Cattaraugus County until more data have been accumulated.

#### SUMMARY

The findings of this study of tuberculosis cases in Cattaraugus County may be summarized briefly. Among contacts in tuberculous families active cases of tuberculosis with clinical symptoms, both male and female, occurred even more frequently in early adult life, ages 20-29, than at the teen ages. The incidence of

<sup>6</sup>The average annual fatality among active cases diagnosed as minimal and those diagnosed as advanced showed no sex differences. The differences noted among cases diagnosed as moderately advanced are shown in the table:

AGE GROUP	AVERAGE ANNUAL FATALITY PER 100 YEARS OF OBSERVATION		
	Male	Female	Difference
15-19	6.0±2.8	12.6±2.6	6.6±3.8
20-29	15.3±3.8	7.6±2.2	7.7±4.4
30-39	7.7	8.8	1.1

active cases for the total County was highest also at ages 20-29 for both sexes. This is evidence that more emphasis should be placed upon the supervision of contacts between the ages of 20 and 30 in tuberculous families and case-finding among young adults should be stressed. There is evidence also that active tuberculosis occurs more frequently among females than males in early adult life. However the higher mortality among males at those ages and the relatively unfavorable stage at which the male cases were diagnosed indicates that a special effort should be made to secure earlier diagnosis among males.

The isolation of positive sputum cases, the supervision of child contacts in tuberculous families, the protection against infection through tuberculin testing of cattle and pasteurization of milk, all have, no doubt, contributed to the declining death rate from tuberculosis. But if the decline in the death rate is to be greatly accelerated, due consideration must be given to the points cited above.