SALIENT POINTS OF ATTACK AGAINST TUBERCULOSIS[1]

JEAN DOWNES[2]

PUBLIC health procedures in the control of tuberculosis are today based upon our knowledge of the etiology and the epidemiology of the disease. Koch's discovery of the tubercle bacillus with his subsequent evidence of the infectious nature of the disease provided a foundation for further study and research. Knowledge of the disease has increased tremendously; however, there is as yet no simple cure for tuberculosis and no definite means of effective immunization against the disease. Briefly, the program for the control of tuberculosis is now based upon the prevention of the acquisition of infection and upon curative treatment for those with manifest disease.

During the past few years, epidemiological research in tuberculosis has extended our knowledge along two lines, both of which are exceedingly important if the program of control is to become more direct and specific. These are: (1) the ages at which the risk of disease and the risk of death is greatest; and (2) identification of the population group which has the greatest hazard from exposure to tuberculous infection. The purpose of this paper is to review some of this newer knowledge gained through special studies and to emphasize again the salient points of attack in the control of tuberculosis.

THE AGE CURVE OF DISEASE AND DEATH

Discovering the case of active pulmonary tuberculosis is funda-

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[2] From the Milbank Memorial Fund.

Acknowledgment is made to Dr. Kenneth F. Maxcy of The Johns Hopkins School of Hygiene who gave helpful suggestions and criticisms concerning the presentation of the data in this paper.

Age Groups	Rate Per 10,000 Population		Number of Cases of Active Tuberculosis		Population	
	Male	Female	Male	Female	Male	Female
All Ages	8.0	9.1	322	349	36,338	35,004
0–4	2.1	0.8	8	3	3,431	3,274
5–9	1.5	2.1	6	8	3,539	3,414
10–14	1.6	2.1	6	8	3,420	3,441
15–19	8.0	14.5	27	49	3,061	3,066
20–29	13.5	19.1	79	108	5,325	5,136
30–39	10.8	12.2	62	68	5,232	5,070
40–49	11.5	9.6	57	45	4,493	4,274
50–59	9.1	8.2	36	30	3,594	3,342
60–69	8.7	8.3	25	22	2,605	2,420
70+	8.9	4.6	16	8	1,638	1,567

Table 1. Average annual incidence of active cases of tuberculosis (all forms) by age groups and sex, Cattaraugus County, 1923-1933.

mental in the program of control. Our efforts in case-finding were in the past directed largely toward the easiest population group to reach, namely, the children. However, during recent years the search for tuberculosis has been definitely shifted from the grade school age child and is now centered mainly upon adolescents and and young adults. This change in emphasis has been brought about by recognition of the fact that the incidence of active clinical disease is lower among individuals of grade school age than at any other age period.

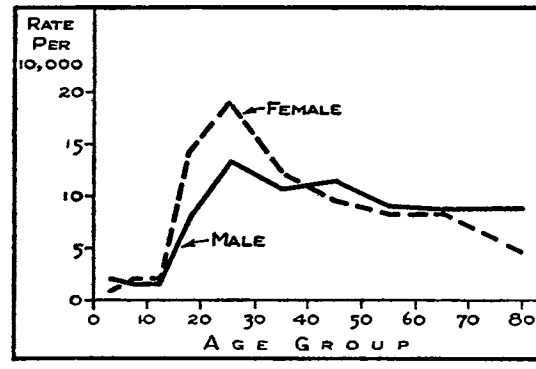

Fig. 1. Average annual incidence of active cases of tuberculosis (all forms) at specific ages for each sex, Cattaraugus County, 1923-1933.

Age Incidence of Active Tuberculosis. A study of the age incidence of tuberculosis in Cattaraugus County, New York, during the eleven-year period 1923-1933, indicated that for both males and females in the com-

munity as a whole, active tuberculosis occurred most frequently in early adult life.[3] These data are shown in Table 1 and Figure 1. The incidence of cases of active disease was relatively low for males and females under 15 years of age, where the rates for each sex were approximately 2 per 10,000 population. The age curve for each sex showed a rapid increase after age 15 and the peak of incidence was reached in early adult life; namely, at ages 20-29, where the rate for males was slightly less than 15 per 10,000 and that for females reached 20 per 10,000 population. The significant fact brought out by Figure 1 is that the risk of developing active tuberculosis is greatly increased during early adult life.

Table 2. Age incidence of secondary cases of active tuberculosis in eighty-three tuberculous families in Cattaraugus County.

Age Groups	Rate per 100 Years of Life	Number of Secondary Cases of Active Tuberculosis	Number of Years of Life Observed At Each Age
0- 4	3.6	5	137
5- 9	0	0	304
10-14	1.3	4	309
15-19	2.0	6	301
20-29	2.7	12	441
30-39	0.4	1	279
40-49	0	0	279
50-59	0	0	234
60+	0	0	189

The age incidence of secondary cases among contacts in tuberculous families in Cattaraugus County is shown in Table 2 and Figure 2.[4] At ages 0-4 the incidence was 3.6 per 100 persons per year, the highest noted in any age group. At ages 5-9 the rate was zero, at ages 10-14 the incidence of cases was 1.3 per 100 persons per year. The frequency of cases in the next age period increased rapidly and reached a second peak at ages 20-29, where the rate was 2.7 per 100 persons per year. Tuberculosis mortality and morbidity in the general population indicate a definite age selection. Of special interest is the fact that the age selectivity of the disease is striking, even

[3] Downes, Jean: The Age Incidence of Tuberculosis and Its Significance for the Administrator. The Milbank Memorial Fund *Quarterly*, April, 1935, xiii, No. 2, pp. 152-161.

[4] Downes, Jean: A Study of the Risk of Attack Among Contacts in Tuberculous Families in a Rural Area. *The American Journal of Hygiene*, November, 1935, xxii, No. 3, pp. 731-742.

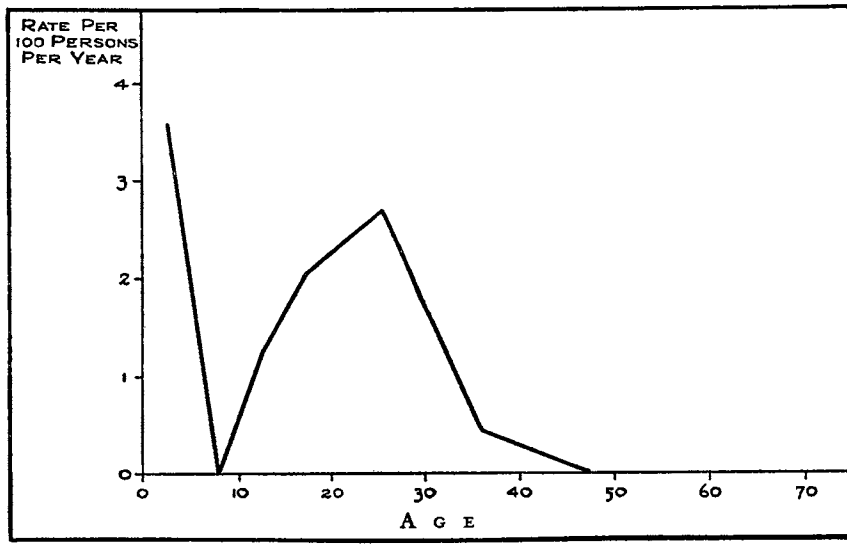

Fig. 2. Age incidence of secondary cases of active tuberculosis among family contacts in eighty-three tuberculous families in Cattaraugus County.

when the factor of exposure is held relatively constant, as in the experience of the tuberculous families.

Age Curve of Mortality. In the Original Registration Area of the United States the mortality from tuberculosis has declined 68 per cent since 1910. It is most gratifying to know that the death rate today is less than one-third the rate of thirty years ago. Individuals throughout the span of life have participated in this decline. This is plainly evident from the data in Table 3 and Figure 3, which portray the tuberculosis mortality at specific ages in the Original Registration States for the period 1908-1912 contrasted with the mortality in the same area in the years 1934-1936. Excluding the differences in level, the two mortality curves are generally similar in shape except that in the more recent period 1934-1936 the mortality reached its peak in the older ages, 55 and over; and in the earlier period the highest mortality was recorded at ages 30-49.

These changes in the shape of the age curve of mortality may be more clearly demonstrated by eliminating the effect of the differences in the level of the two curves. This may be done by plotting

Age Groups	Mean Rate Per 100,000 Population		Ratio of the Rate at Each Age to the Rate for All Ages	
	1908–1912[1]	1934–1936[2]	1908–1912	1934–1936
All Ages	160.2	51.2	1.00	1.00
0– 4	128.9	19.5	.80	.38
5– 9	30.5	5.7	.19	.11
10–19	77.6	17.6	.48	.34
20–29	203.1	62.2	1.27	1.21
30–39	232.4	66.0	1.45	1.29
40–49	210.7	69.7	1.32	1.36
50–59	189.0	75.6	1.18	1.48
60–69	189.7	80.3	1.18	1.57
70+	180.3	80.9	1.13	1.58

[1] Data obtained from Mortality Statistics, Bureau of the Census. Rates are based upon the population of 1910.
[2] Data obtained from Mortality Statistics, Bureau of the Census. Population of 1935 was obtained by applying the percentage distribution by age, estimated for each state by the Scripps Foundation, to the total estimated population of 1935 for the ten Original Registration States.

Table 3. Mortality by age from tuberculosis (all forms) and ratio of rates at specific ages to the total rate in the Original Registration Area in 1908-1912 and in 1934-1936.

for each time period the age specific rates as ratios to the average rate for all ages. Figure 4 and Table 3 which show the relative mortality from tuberculosis at specific ages, indicate that in the more recent period the mortality from tuberculosis among persons over fifty years of age has increased compared with the mortality among persons at those ages some twenty-five years ago. In old age the rate is now 58 per cent above the average for all ages contrasted with an excess of 10 to 18 per cent at the older ages in the earlier period. For persons under thirty years

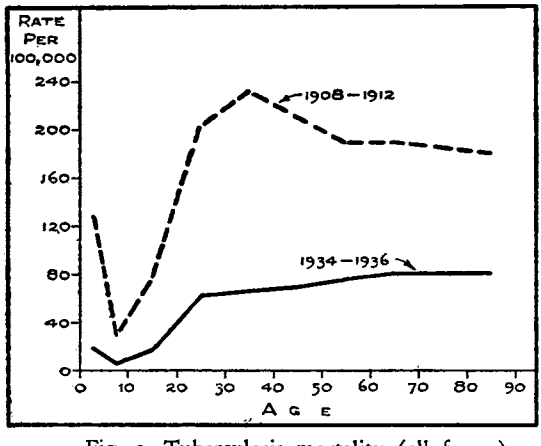

Fig. 3. Tuberculosis mortality (all forms) by age in the Original Registration States in 1908-1912, compared with 1934-1936.

of age, the age curve has undergone no such marked change in shape.

Figure 5 illustrates the fact that this increase in the relative mortality in the old-age period is common to both sexes, males and females. The rates upon which the ratios are based are shown in Table 4. Even though these data are based on an eastern section of the United States, the same phenomenon is occurring in other areas. For example, Figure 6 shows the relative mortality by age from tuberculosis for the City of Minneapolis during the five-year period 1900-1904 contrasted with the more recent period 1929-1931. Here again, the death rate among old people shows in more recent times a marked excess over the average rate for all ages when contrasted with a period some thirty years earlier.

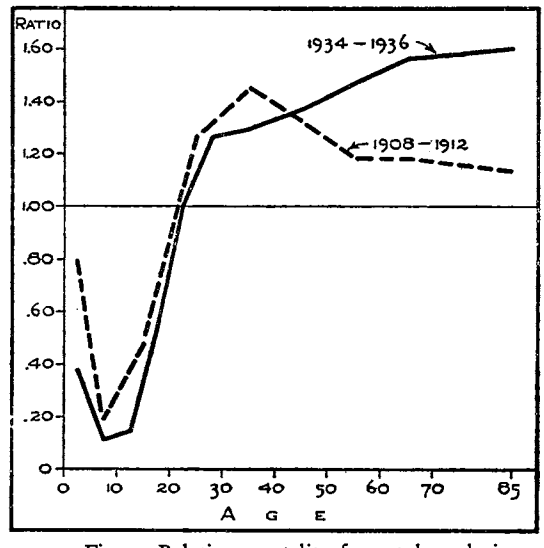

Fig. 4. Relative mortality from tuberculosis (all forms) by age in the Original Registration States in 1908-1912, compared with 1934-1936.

A most significant contribution to our knowledge of the epidemiology of tuberculosis was made by the late Dr. Wade H. Frost in a paper dealing with the age selection of mortality from tuberculosis in successive decades which has just been published in *The American Journal of Hygiene*.[5] Dr. Frost said:

> As we pass along the age scale from infancy through childhood, to early adult life, and on to old age, the curve of mortality from tubercu-

[5] Frost, Wade Hampton: The Age Selection of Mortality from Tuberculosis in Successive Decades. *The American Journal of Hygiene*, November, 1939, 30, No. 3, Sec. A., pp. 91-96. Reprinted in the Milbank Memorial Fund *Quarterly*, January, 1940, xviii, No. 1, pp. 61-66.

losis shows a continuous movement either upward or downward. This is such a familiar fact that we are apt to take it for granted; to dismiss it as characteristic of the disease, and to pass on. But there is perhaps no single statistical fact which is potentially of more significance. For every change in the rate of mortality as we pass from one age to another represents a shift in the balance established between the destructive forces of the invading tubercle bacillus, and the sum total of host-resistance.

Dr. Frost pointed out that this shift in the risk of mortality to the older ages is more apparent than real. He has shown that in successive cohorts since 1870 the age selection has been uniform. Figure 7, which is a reproduction of a chart from Dr. Frost's paper, shows the age specific mortality from tuberculosis throughout the life of male cohorts of the decades 1880, 1890, 1900, and 1910 in the State of Massachusetts. A cohort includes the life experience of individuals born within a given period of time. For example, male persons born during the period 1871-1880 form the cohort of 1880, and in that year they were 0-9 years of age; in 1890 this cohort had reached ages 10-19. Members of this cohort who survived to 1930 were at that time 50 to 59 years of age. The figure shows the tuberculosis mortality at successive ages up to the year 1930 for each group of male cohorts. Dr. Frost, in discussing this

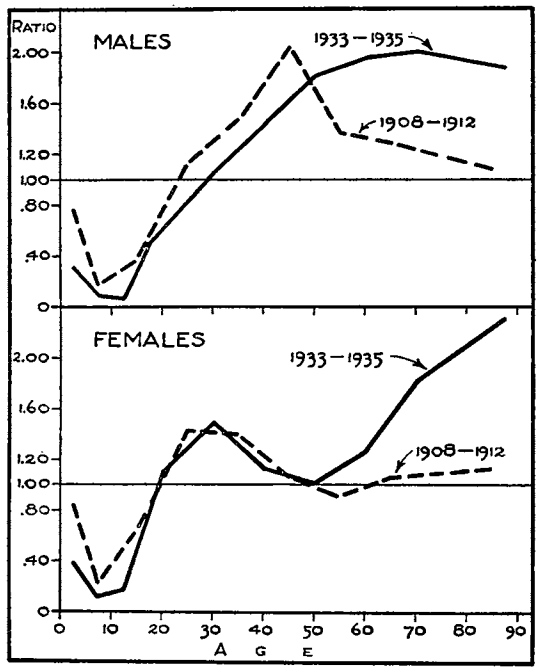

Fig. 5. Relative mortality from tuberculosis (all forms) by age for males and females in the Original Registration States in 1908-1912, compared with 1933-1935.

Age Groups	Mean Rate Per 100,000 Population		Ratio of the Rate at Each Age to the Rate at All Ages	
	Males	Females	Males	Females
	ORIGINAL REGISTRATION AREA—1908–1912			
All Ages	179.2	140.8	1.00	1.00
0– 4	138.0	119.5	.77	.84
5– 9	29.4	31.6	.16	.22
10–19	65.7	89.4	.37	.63
20–29	204.6	201.6	1.14	1.43
30–39	266.4	196.5	1.49	1.40
40–49	367.5	150.3	2.05	1.07
50–59	245.9	129.0	1.37	.92
60–69	231.2	149.2	1.29	1.06
70 and Over	198.5	164.2	1.11	1.17
	1920 REGISTRATION AREA—1933–1935			
All Ages	52.9	38.7	1.00	1.00
0– 4	16.9	15.4	.32	.40
5– 9	5.1	4.4	.10	.11
10–14	4.1	6.4	.08	.17
15–24	26.1	42.8	.49	1.10
25–34	55.9	58.2	1.06	1.50
35–44	77.2	43.8	1.46	1.13
45–54	96.9	39.4	1.83	1.02
55–64	104.3	48.9	1.97	1.26
65–74	106.9	70.6	2.02	1.82
75 and Over	100.4	89.8	1.90	2.32

Table 4. Mortality by age from tuberculosis (all forms) among males and females and ratio of rates at specific ages to the total rate in the Original Registration Area 1908-1912 and in the 1920 Registration Area—1933-1935.

chart, pointed out the highly significant fact that the "terminal" rates for these cohorts constitute the 1930 age curve of mortality. The cross-hatched section in the lower part of the chart indicates the mortality at specific ages in the year 1930.

The 1930 curve considered alone gives the impression that at the present time an individual encounters his greatest risk of death from tuberculosis between the ages of 50 and 59. But Dr. Frost pointed out that this is not really so; the people making up the 1930 age group 50-59 have, in earlier life, passed through greater

mortality risks—(note the mortality at ages 0-4 and 20-29 for the cohort of 1880). Dr. Frost directed special attention to the fact that in successive cohorts the age selection has been uniform, with the mortality highest in the first five years of life, and again from 20-29 years of age; thereafter the mortality declines. This study has thrown a new light upon the age curve of mortality from tuberculosis.

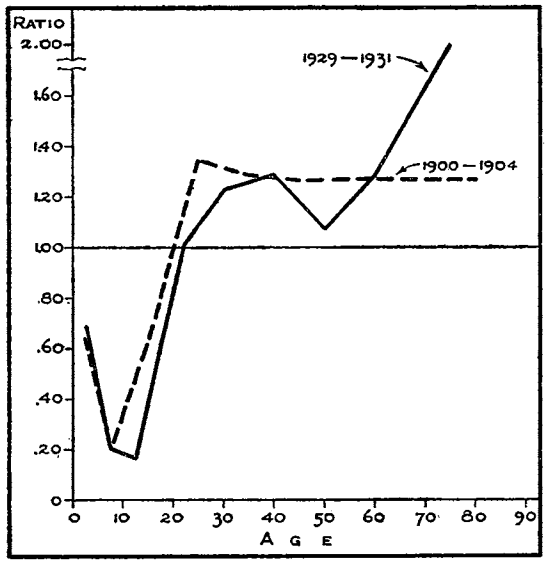

Fig. 6. Relative mortality from tuberculosis (all forms) by age in Minneapolis, Minnesota, in 1900-1904, compared with 1929-1931.

It seems suitable at this point to refer to a study based upon the experience of tuberculous families in Cattaraugus County, New York. Figure 8 and Table 5 show the mortality from all causes at specific ages among offspring of a tuberculous parent compared with the mortality in a sample population.[6] The population considered in this study included individuals born during the period 1850 to 1900 who survived to age one. Though these data are not strictly comparable with the cohort experience presented by Dr. Frost, in that they do not represent individuals born within a single decade, nevertheless they do represent the life experience of individuals born within a given period of time. Tuberculosis deaths constituted a high proportion of the deaths from all causes among the offspring of a tuberculous parent and it is quite evident from Figure 8 that the age curve of death among these individuals was strikingly

[6] Downes, Jean: The Risk of Mortality Among Offspring of Tuberculous Parents in a Rural Area in the Nineteenth Century. *The American Journal of Hygiene*, November, 1937, xxvi, No. 3, pp. 557-569.

similar *in shape* to that among the cohorts shown in the preceding figure (Figure 7). The mortality was highest among young adults aged 20-29.

These findings have the highest significance to those engaged in the work of combating tuberculosis, for they indicate the ages which should be emphasized. They furnish incontrovertible evidence that after the interval of infancy the period of maximum risk of mortality from the disease, both in the general population and in tuberculous families, has been, and still is, during early adult life. Furthermore, the period of greatest risk of developing clinical tuberculosis is similar to the age period where the risk of death from the disease is greatest. This fact was shown by the studies of age inci-

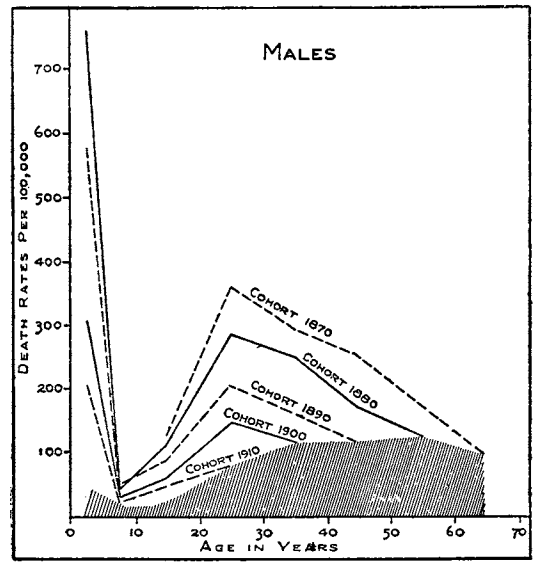

Fig. 7. Tuberculosis mortality (all forms) by age in successive ten-year cohorts (males) in Massachusetts, 1870-1910.

Data from Frost, Wade H.: The Age Selection of Mortality from Tuberculosis in Successive Decades. *The American Journal of Hygiene*, November, 1939. (The cross-hatched section, showing the 1930 age curve of mortality, has been added to the original chart.)

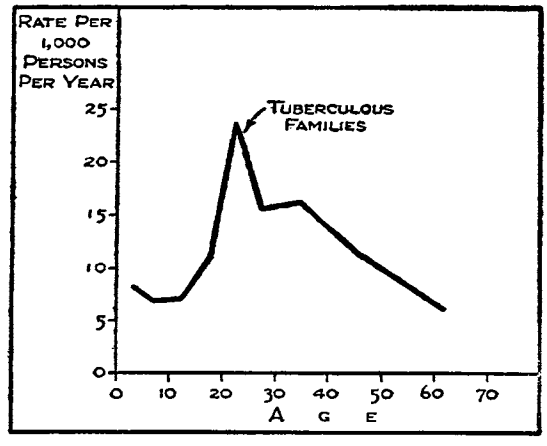

Fig. 8. Mortality from all causes by age among offspring in tuberculous families, Cattaraugus County, 1850-1900.

dence of the disease in the general community and among contacts in tuberculous families in Cattaraugus County, and referred to earlier.

Another implication of the data dealing with cohorts, pointed out by Dr. Frost, is that "if the frequency and extent of exposure to infection in early life has decreased progressively decade by decade, there is no indication that this has had the effect of exaggerating the risk of death in adult life due to lack of opportunity to acquire specific immunity in childhood." This conclusion of Dr. Frost's should give us greater confidence in the wisdom of advocating the protection of the public against the acquisition of even small amounts of tuberculous infection.

Table 5. Mortality from all causes in a population composed of persons born previous to 1901, Cattaraugus County.[1]

Age Groups	Mortality From All Causes (Rate per 1,000 Population)	Number of Deaths All Causes	Years of Life
All Ages	7.9	1,514	190,945
1– 4	13.0	207	15,970
5– 9	4.0	78	19,400
10–14	3.0	58	19,057
15–19	4.1	76	18,753
20–24	6.0	110	18,262
25–29	5.8	103	17,704
30–34	5.2	89	16,985
35–39	5.1	79	15,393
40–49	6.7	166	24,898
50+	22.3	548	24,523

[1] The population includes the 4,121 individuals who survived to age one in 1,062 families.

Dr. Frost concludes also that "constancy of age selection (relative mortality at successive ages) in successive cohorts suggests rather constant physiological changes in resistance (with age) as the controlling factor." This is a highly significant conclusion.

In a study of the risk of mortality among white and colored tuberculin-positive infants, Brailey has shown that even among children under two years of age, resistance to mortality is affected by the age at which tuberculous infection is discovered.[7] Children found to be infected before six months of age had a mortality of 33 per cent within the first year of observation, and the mortality

[7] Brailey, Miriam: Mortality in Tuberculin-Positive Infants. *Bulletin of the Johns Hopkins Hospital,* July, 1936, lix, No. 1, pp. 1-10.

was nearly 78 per cent within the five years following the discovery of infection. For children for whom tuberculous infection was demonstrated after six months and up to two years of age, the mortality was only 16 per cent in the five years subsequent to the discovery of infection. Brailey points out that these differences in mortality are significant.

Recently interest has been centered upon efforts to learn the cause of the definite increase in mortality from tuberculosis at certain ages, especially among females of the teen ages. Finding no definite factor to which the increase in mortality with age could be assigned, it has been generally assumed that the increase is due to biological factors. Certainly the data taken from Dr. Frost's paper offer the most convincing evidence, even though he ventures to call it only suggestive, presented so far, that physiological changes in resistance (with age) is the controlling factor in relative mortality from tuberculosis at different ages. No one has attempted to explain exactly what these physiological changes in resistance may be, which upset the balance maintained by the host against the tubercle bacillus, or how they operate. Even though the physiological factors themselves and their operation causing changes in human resistance are not known, nevertheless, attention should now be centered upon the study of ways and means of increasing general or nonspecific resistance to tuberculosis at the particular ages where it seems to be lowest, as evidenced by the greatest occurrence of morbidity and mortality from the disease.

It should be added that the results of efforts to increase specific resistance to tuberculosis by vaccination with an attenuated form of the bovine type of tubercle or with the heat-killed human bacillus are not sufficiently well established, both as to the harmlessness of vaccination and as to its protective value, to justify its general use as a public health measure for the control of tuberculosis. Consequently, our efforts should be directed upon experimentation and study of how to increase nonspecific resistance to the disease.

THE POPULATION GROUP AT GREATEST RISK OF TUBERCULOSIS

One of the significant contributions of epidemiological research in tuberculosis has been to define in precise terms the importance of the family or household contact in the spread of the disease. Studies of the risk of attack for family contacts have been made in various areas of the United States, both urban and rural; namely, Cattaraugus County, New York; Williamson County, Tennessee; Philadelphia; the Mulberry area of New York City, and to these may be added the experience of the Lymanhurst Health Center in Minneapolis.[4, 8, 9, 10] These studies are all based upon relatively small samples of tuberculous families but there is such a high measure of agreement in the results of all of them that it is now possible to define with some assurance the extent of the hazard for persons in close familial contact with tuberculosis. The annual tuberculosis attack rates among family contacts are shown for each of the five areas in Table 6. The data drawn from the Lymanhurst experience in Minneapolis differ somewhat from the data from the other areas in that they include only individuals under twenty years of age at the beginning of the period of observation and the period of observation is considerably longer; however, they do include individuals exposed to infectious tuberculosis, and the period of observation (from 0-17 years) is sufficiently long to carry most of them well into early adult life. Consequently, it seems entirely proper to include these data.

The Philadelphia study includes the incidence of manifest tuberculosis among family contacts during the ten years following

[8] Stewart, H. C.; Gass, R. S.; Gauld, R. L.; and Puffer, Ruth R.: Tuberculosis Studies in Tennessee—Infection, Morbidity and Mortality in the Families of the Tuberculous. *The American Journal of Hygiene,* November, 1937, xxvi, No. 3.

[9] Opie, E. L.; McPhedran, F. M.; and Putnam, P.: The Fate of Persons in Contact with Tuberculosis: The Exogenous Infection of Children and Adults. *The American Journal of Hygiene,* November, 1935, xxii, No. 3.

[10] Chiu, P. T. Y.; Myers, J. A.; and Stewart, C. A.: The Fate of Children with Primary Tuberculosis. *The Journal of the American Medical Association,* April 8, 1939, 112, No. 14, pp. 1306-1307.

Areas	Rate Per 100 Years of Life	Number of Cases	Years of Life
Philadelphia 0–10 Years Observation	1.08	99	9,155
Cattaraugus County 0–10 Years Observation	1.19	27	2,264
Williamson County, Tennessee 0–10 Years Observation	1.03	20	1,934
Mulberry Area, New York City 0–9 Years Observation	1.20	23	1,859
Lymanhurst Health Center, Minneapolis 0–17 Years Observation	1.33	67	5,024

Table 6. Annual tuberculosis attack rates among family contacts in five different areas of the United States.

onset of the first sputum positive case known to have occurred in the family. In the Cattaraugus County, Williamson County, and Mulberry area studies the experience of the family contacts was confined to the period following onset of the index case, which was the case which brought the family into the special study. The Lymanhurst study includes the experience of contact children after they came under the supervision of the Lymanhurst Health Center. Even though there are some differences in the technique of these studies, nevertheless they can be compared with respect to the general results.

The annual attack rates shown in Table 6 are fairly similar in all five areas; clinical tuberculosis occurred at the rate of slightly more than one case per one hundred years of life per year among those at special risk. In a broad sense these studies have the quality of laboratory experiments. The data are drawn from various parts of the country, and one experiment tends to confirm the other. When there is such a high degree of consistency in the results, it is a justifiable conclusion that an important fact concerning the epidemiology of tuberculosis has been established.

Though the risk of developing manifest tuberculosis is similar for family contacts in various parts of the country, this special risk compared with the general hazard in the given community will depend upon the relative amount of tuberculosis in the community. The studies in which it has been possible to compare the risk of attack in the general community with that among family contacts have shown that in tuberculous families the hazard is from ten to fifteen times as great as for persons in the general population. Without question the tuberculous family is the most important group for case-finding. It must be remembered, however, that the search for cases in tuberculous families should be carried on over a period of years, for tuberculosis, unlike the acute communicable diseases, is a disease which may have a relatively long incubation period before it manifests itself in illness. Furthermore, the data presented in the first part of this paper indicate that the risk of disease and of death from tuberculosis changes with age. It may be concluded that individuals who have been exposed to infectious tuberculosis in the family should have the benefit of public health supervision during infancy, during late adolescence, and through early adult life.

In the preceding discussion attention was called to the fact that various studies have shown that the risk of tuberculosis among family contacts is from ten to fifteen times greater than is the risk for the general population. The difference in the level of tuberculosis mortality today, contrasted with the level of mortality thirty years ago, is unquestionable evidence that the risk of death, and probably also of tuberculous disease, is considerably less in the general community today than it was formerly. But there is no convincing evidence available that there has been over a period of time any marked change in the hazard of tuberculosis among family contacts. In fact, what evidence there is indicates that there has been no change.[6, 11] Too often the damage has been done; that is, tuberculous infection has been spread in the family before medical su-

[11] Weinberg, W.: DIE KINDER DER TUBERKULÖSEN. Leipzig, Verlag von S. Hirzel, 1913.

pervision or public health nursing supervision has been made available to the family. As the risk of disease and mortality from tuberculosis in the general community declines, the problem of tuberculosis is more and more concentrated in the immediate environment of the positive sputum case. Therefore a way must now be found to make public health work in tuberculous families more effective so that the hazard from tuberculosis in this population group will be greatly reduced.

THE PROGRAM FOR CONTROL OF TUBERCULOSIS

These recent advances in knowledge of the epidemiology of tuberculosis point the way to a more direct and specific program for the control of the disease. The principal kinds of activity to be included in an effective program have been most ably outlined by Dr. Frost.[12] They are as follows:

1. The isolation in sanatoria of all known open cases of pulmonary tuberculosis, continuing isolation so long as the cases remain open.
2. Adequate medical care, preferably in institutions, for the known cases of tuberculosis which are active but not in an open stage, since these cases constitute the group most likely in the immediate future to become infectious.
3. More vigorous effort to find cases of tuberculosis earlier and to bring them more promptly under medical care and under isolation if they are discharging bacilli.
4. Special protection, including medical observation and advice, and financial aid as needed, for those groups who, though not at the time suffering from tuberculosis, are most imminently endangered.

It is important to note the emphasis which Frost laid particularly upon *isolation* of the infectious case and prompt and adequate medical care for those in need of it. This measure (isolation) forms a part of three of the four activities he advocated. And it alone, if it

[12] Frost, W. H.: How Much Control of Tuberculosis? *The American Journal of Public Health,* August, 1937, 27, No. 8, p. 759.

were possible to be put into effect universally, would certainly accelerate the eradication of tuberculosis.

In the meantime, the program of tuberculosis control ought to include social measures. If the relatively high incidence of disease and death at certain ages is due to physiological changes in resistance (with age), a serious attempt should now be made to find out what definite measures will enable those most endangered to maintain the highest possible state of bodily health. This may mean that the standard of living of the tuberculous family must be given special consideration. Study and experimentation, in order to ascertain what specific measures and what sort of teaching are necessary to raise the level of resistance to this particular disease, are of immediate importance.