

THE EFFECT OF TUBERCULOSIS ON THE SIZE OF FAMILY¹

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VARIOUS studies have shown that there is a greater risk of disease and death among persons in intimate familial contact with infectious tuberculosis than is true of persons in the general population.² However, the full effect of tuberculosis upon the growth of the family as a simple biological unit has not been described in precise terms. Excluding collateral or subsidiary relationships, the family as a simple biological unit may be considered as composed of the husband, the wife, and their offspring. The size of the simple family unit at any given moment of time after marriage is determined by the operation over a period of years of two factors: namely, the number of births which determines the increment of the family, and the number of deaths which occur among both offspring and parents. It is of considerable interest to observe the effect of the operation of these two factors upon families where one or both parents had tuberculosis contrasted with the experience of families drawn from the general population.

¹ From the Milbank Memorial Fund.

² Weinberg, W.: *Die Kinder der Tuberkulösen*. Leipzig, Verlag von S. Hirzel, 1913.

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

To observe the effect of the birth rates and the death rates upon the size of the natural family unit, it is necessary that families be followed over a considerable period of years. Births may occur over a period of twenty-five to thirty years of married life, and disease and death may occur at any time during the life of the family. Through special investigation and study of family histories in Cattaraugus County, New York, it is possible to show the growth of the natural family as a unit, as evidenced by (1) a group of tuberculous families in which marriage occurred and the children were born during the latter half of the nineteenth century, and (2) a group of families in a general population drawn from the same area and period of time. It is possible, also, to study similar groups of families in the present century and to contrast their experience for a limited period of time after establishment of the family with those of the past century.

DATA AND METHOD OF STUDY

In connection with a study of morbidity conducted in a rural area of Cattaraugus County by the United States Public Health Service in cooperation with the Milbank Memorial Fund, an effort was made to secure a history of the parents and sibs of both the husband and wife in each of the 1,400 families in the morbidity survey. The data included in the history which are pertinent to this particular study are: (1) the date of marriage and (2) the date of birth, (3) the age and date of death for each member of the family and (4) the cause of death for all who were deceased at the time the survey was made.⁸ Every effort was made to secure as complete and accurate family history records as possible. In many instances the family Bible was used as a source of information, or at least as a check of the accuracy of the data obtained from the informant. When there was uncertainty as to the date of death or age at death for a deceased member of the family and the place of burial was known, the ceme-

⁸ The family histories were secured during the period 1931-1933. The family, as considered in this study, is the simple family unit consisting of a husband and wife and their offspring.

tery was visited and this information was taken from the gravestone. If the grave could not be located, the records of the sexton of the burying ground were consulted for the needed information.⁴ Occasionally, a part of the family history record was obtained through questionnaires sent to surviving members of the family or relatives living in various parts of the United States. In fact, all available channels were used in an effort to secure a complete record for each family.

In a rural community, such as the one from which these records were obtained, the ages of the husbands and wives in the present families will vary from those in their early twenties or younger to the very old, that is, those who have survived to past eighty years of age. Consequently, such records will include some families in which the offspring were born previous to 1850 as well as some in which the offspring were born since 1900. The data for this particular study consist of records for 892 families in which all the children were born previous to 1901.⁵ The majority of these families had lived in Cattaraugus County or were from near-by rural areas. For the purposes of this study they may be considered as a sample of rural families in which the offspring were born in the latter half of the nineteenth century.

In calculating the fertility experience of the 892 married pairs, the exposure to risk is controlled by taking the length of marriage for each pair into account. When the death of either the husband or the wife occurred, the couple was dropped from the population.

⁴ Records of all burials in a given cemetery are kept by the sexton. In many instances these records go as far back as the middle of the eighteenth century. The record for each deceased person includes the name of the father and the mother of the deceased, the date of death and the cause of death of the deceased. The investigators were always permitted to examine the sexton's records.

⁵ When data concerning date of marriage were lacking, or date of birth or age at death or cause of death were lacking for some members of the family, the entire record was discarded; also records for foreign-born families were excluded. In all, 10 per cent of the total family histories were considered unsuitable for use because the date of birth or the age at death of the wife or husband and the date of marriage were lacking. Also, 16 per cent of the family histories had to be discarded because data in regard to the offspring were lacking or the families were foreign-born.

In calculating the size of family, each year of life or fractional year of life of each person in the family after the date of its establishment, that is, the date of marriage, is considered, and the total person-years derived in this manner constitute a total population in each given year of observation of the family. This total population in any given year of observation, divided by the total number of families considered, indicates the average size of the family unit.

Both the fertility and the mortality experience of a group of married pairs, derived from family history records secured in the manner described above, have an obvious bias. The childless family will not be represented, for the securing of the family history was dependent upon an offspring. The mortality experience of a population secured from family history records is also weighted because a survivor in the family was a requisite for obtaining the record in practically all instances.⁶ Families living in the vicinity in the same time-period but which have died out completely are necessarily not included. Furthermore, the probability of having a surviving offspring in the community is influenced by the original number of offspring in the family. However, it is believed that these limitations of the data in respect to fertility and to mortality do not preclude their use for purposes of internal comparison since the biases pointed out above are common to all the families. But it should be emphasized that the factor of survivorship as an essential in securing the family records operates most forcibly upon the tuberculous families, where due to excessively high mortality the chance of survival of offspring was considerably less than was true of those in the general population.

FERTILITY IN TUBERCULOUS FAMILIES IN THE PAST AND PRESENT CENTURIES

Included in the sample of 892 families, or married pairs, are thirty-eight in which it is recorded that either the husband or wife

⁶ In a few cases where the wife and all members of her family were dead, the wife's family history was secured from the husband, and vice versa.

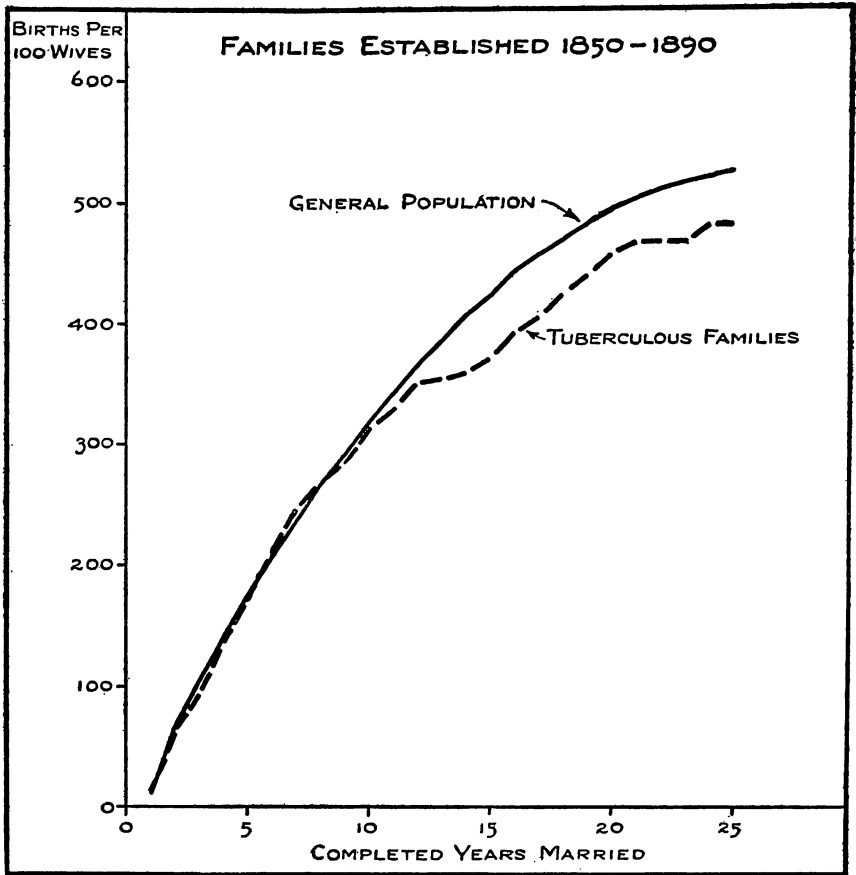


Fig. 1. Cumulated birth rates for successive years of married life among two groups of women in the nineteenth century.

or both died of tuberculosis before reaching the age of fifty years.⁷ Figure 1 and Table 1 show the cumulated birth rates through twenty-five years of married life for the tuberculous pairs compared with the birth rates for the remaining 854 pairs. The cumulated birth rates are of especial interest, for they indicate the rapidity with which the "natural family" was built up among pairs where one or both parents had tuberculosis contrasted with the average "na-

⁷ The family history records do not include information concerning the probable date of onset of tuberculosis in either spouse. It was considered best to limit the group to cases where death from tuberculosis occurred prior to age fifty, which brings the occurrence of disease and death closer to the childbearing period.

YEARS MARRIED	TUBERCULOUS			GENERAL POPULATION			CUMULATIVE RATES	
	No. of Wives	No. of Births	Rate per 100 Wives	No. of Wives	No. of Births	Rate per 100 Wives	Tuber- culous	General Population
1	38	4	10.5	854	106	12.4	10.5	12.4
2	38	20	52.6	854	460	53.9	63.1	66.3
3	36	11	30.6	847	311	36.7	93.7	103.0
4	35	15	42.8	843	307	36.4	136.5	139.4
5	34	12	35.3	838	296	35.3	171.8	174.7
6	33	13	39.4	835	272	32.6	211.2	207.3
7	32	11	34.4	834	244	29.3	245.6	236.6
8	29	7	24.1	825	243	29.4	269.7	266.0
9	27	4	14.8	816	196	24.0	284.5	290.0
10	26	7	26.9	804	222	27.6	311.4	317.6
11	25	4	16.0	796	188	23.6	327.4	341.2
12	22	5	22.7	787	187	23.8	350.1	365.0
13	22	1	4.5	780	160	20.5	354.6	385.5
14	20	1	5.0	777	165	21.2	359.6	406.7
15	19	2	10.5	775	130	16.8	370.1	423.5
16	18	4	22.2	769	139	18.1	392.3	441.6
17	17	2	11.8	759	122	16.1	404.1	457.7
18	15	3	20.0	750	88	11.7	424.1	469.4
19	13	2	15.4	743	105	14.1	439.5	483.5
20	12	2	16.7	730	84	11.5	456.2	495.0
21	9	1	11.1	725	69	9.5	467.3	504.5
22	9	0	0	717	41	5.7	467.3	510.2
23	8	0	0	712	48	6.7	467.3	516.9
24	7	1	14.3	701	38	5.4	481.6	522.3
25	7	0	0	688	25	3.6	481.6	525.9

¹ Date of marriage 1850-1890.

Note: Every wife or couple is counted for each specific year of married life, that is, every wife who completed two years of married life is counted for that year, every wife who completed three years of married life for that year, etc., with the result that the number of wives for whom rates were computed change year by year.

Table 1. Birth rates in successive years of married life among two groups of women in the nineteenth century.¹

tural family.”⁸ During the first ten years of married life the birth

⁸ Since age of the wife at marriage is an important factor in considering birth rates over a period of married life, the two groups of pairs were tested for comparability in this respect. The percentage distribution according to age of wife at marriage was as follows:

Age of Wife at Marriage	Spouse Died of Tuberculosis	854 Pairs
All Ages	100.0	100.0
Under 20 Years	39.5	43.4
20-24 Years	39.4	38.5
25-29 Years	15.8	12.8
30+ Years	5.3	5.3

rates among the two groups of married pairs are strikingly similar. From that point on, births became less frequent in the tuberculous group, and throughout the remaining fifteen years of married life

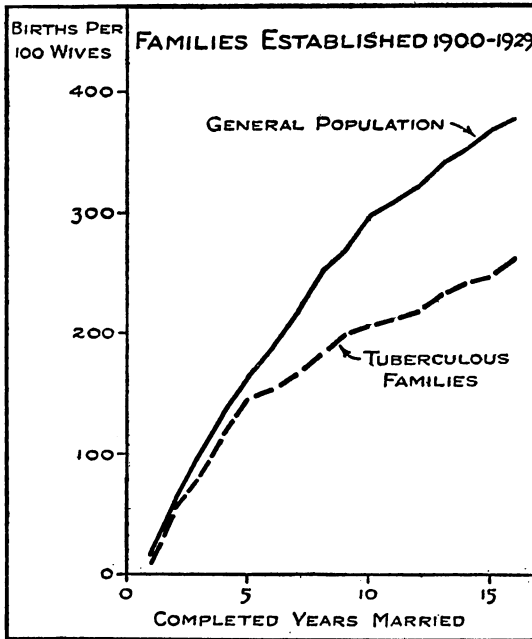


Fig. 2. Cumulated birth rates for successive years of married life among two groups of women in the twentieth century.

the cumulated rates are somewhat lower in this group than among the general population. At the end of twenty-five years of married life 100 women in tuberculous families had borne on an average 481 children compared with an average of 526 children per 100 women in the general group of families.

It is of considerable interest to examine the cumulative birth rates for a more recent period, 1900-1929, among some-
what similar groups of pairs drawn from the same area, Cattaraugus County. Figure 2 and Table 2 show the cumulated birth rates during the first sixteen years of married life for fifty-eight⁹ pairs where one or the other spouse had tuberculosis, compared with the birth rates for a selected sample of 100 pairs drawn from the same rural area.¹⁰ During the first five years of married life the birth rates

⁹ Detailed records were collected and reported upon for eighty-three families in which the index case was one of pulmonary tuberculosis. In forty-eight of the eighty-three families, a parent had pulmonary tuberculosis. The families were selected on the basis of the presence of an active case in some member of the family during the period 1923-1930. An additional ten families in which a parent had pulmonary tuberculosis were obtained from records secured for all new active cases reported in Cattaraugus County during the period January, 1932 to July 1, 1935.

¹⁰ The sample consisting of 100 married pairs was drawn from a group of some 1,400
(Continued on page 281)

YEARS MARRIED	TUBERCULOUS			GENERAL POPULATION			CUMULATIVE RATES	
	No. of Wives	No. of Births	Rate per 100 Wives	No. of Wives	No. of Births	Rate per 100 Wives	Tuber- culous	General Population
1	58	5	8.6	100	14	14.0	8.6	14.0
2	58	27	46.6	100	48	48.0	55.2	62.0
3	57	15	26.3	100	37	37.0	81.5	99.0
4	57	21	36.8	99	34	34.3	118.3	133.0
5	52	14	26.9	96	30	31.2	145.2	164.5
6	48	4	8.3	95	22	23.2	153.5	187.7
7	47	6	12.8	87	26	29.9	166.3	217.6
8	44	7	15.9	81	27	33.3	182.2	250.9
9	41	7	17.1	79	13	16.4	199.3	267.3
10	40	3	7.5	72	22	30.6	206.8	297.9
11	34	2	5.9	71	8	11.3	212.7	309.2
12	33	2	6.1	64	8	12.5	218.8	321.7
13	30	4	13.3	62	12	19.4	232.1	341.1
14	24	2	8.3	60	6	10.0	240.4	351.1
15	19	1	5.3	57	9	15.8	245.7	366.9
16	19	3	15.8	55	5	9.1	261.5	376.0

¹ Date of marriage 1900-1929.

Note: Every wife or couple is counted for each specific year of married life, that is, every wife who completed two years of married life is counted for that year, every wife who completed three years of married life for that year, etc., with the result that the number of wives for whom rates were computed change year by year.

Table 2. Birth rates in successive years of married life among two groups of women in the twentieth century.¹

families in five rural townships in Cattaraugus County. These families formed the population included in a special study of morbidity conducted during the period 1929-1932 by the United States Public Health Service in cooperation with the Milbank Memorial Fund. The sample of 100 was selected in the following manner: the 1,400 families were arranged according to an alphabetical file; those falling under each of the following letters—A,E,F,G, J,L,N,P,T and U—were sorted according to the date of marriage; only those with one marriage, and that occurring during the period 1900-1929, were used. These records, still in alphabetical groups, were then arranged according to age of the wife at marriage. The sample was then selected so as to be comparable with the distribution according to the age of wife at marriage among the fifty-eight pairs where either the husband or wife, or both, had tuberculosis. The percentage distribution for both groups is shown in the following table:

Age of Wife at Marriage	Tuberculous Spouse	Sample—100 Pairs
All Ages	100.0	100.0
Under 20 Years	43.1	43.0
20-24 Years	31.0	31.0
25-29 Years	15.6	16.0
30+ Years	10.3	10.0

No effort was made to have the two groups of families comparable with respect to the frequency of no-child families. In fact, the proportion of childless marriages was similar in both groups; 14 per cent of the 100 married pairs had no offspring, and 13.8 per cent of the fifty-eight tuberculous pairs had no offspring.

for the two groups of married pairs were similar. However, from the sixth to the sixteenth year of married life the fifty-eight pairs (tuberculous) had a markedly lower birth rate than was noted among the 100 pairs during the same period of married life. For example, after sixteen years of married life 100 women in the tuberculous families had borne on the average 261 children compared with an average of 375 children for the 100 women drawn from a general population.

These groups of married pairs drawn from the modern period are not strictly comparable with the groups for the previous century (Figure 1) in that those in the modern period contain childless families, and the groups in the other period of necessity do not.¹¹ Therefore, it is not suitable to compare the level of the birth rates in the two periods of time. However, considerable significance may be attached to the fact that the differential fertility rates in the two groups persist in the same direction both in the nineteenth century and in the twentieth century. These data suggest that when tuberculosis is present in a parent the natural family is built up with less rapidity and is on the whole smaller in size than is ordinarily true of families in the rest of the community.

SIZE OF FAMILY IN THE PAST AND PRESENT CENTURIES

The excess mortality among offspring of tuberculous parents over the average mortality in the community has been presented in a previous publication.¹² However, it is of interest to see the full effect of the operation of the two factors—the differential fertility and the differential mortality—upon the growth of the family. This may be most strikingly presented by showing the average size of the natural family, including parents and their offspring, over a period of years for the two groups of families, the tuberculous group and

¹¹ Fourteen per cent of the 100 married pairs had no offspring, and 13.8 per cent of the fifty-eight tuberculous pairs had no offspring.

¹² 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.

Table 3. Size of family in successive years after establishment among the tuberculous, and in a general population in the nineteenth century.¹

YEARS FAMILY OBSERVED	AVERAGE SIZE OF FAMILY		NUMBER OF YEARS OF LIFE IN FAMILIES		NUMBER OF FAMILIES	
	General Population	Tuberculous Families	General Population	Tuberculous Families	General Population	Tuberculous Families
1	2.0	2.0	1,746	76	854	38
2	2.6	2.5	2,188	96	854	38
3	2.9	2.8	2,484	106	854	38
4	3.2	3.1	2,760	117	854	38
5	3.5	3.3	3,024	126	854	38
6	3.8	3.6	3,283	138	854	38
7	4.1	3.8	3,502	143	854	38
8	4.4	3.8	3,716	146	854	38
9	4.6	4.0	3,886	151	854	38
10	4.8	4.1	4,073	154	854	38
11	5.0	4.1	4,237	155	854	38
12	5.1	4.2	4,383	158	854	38
13	5.3	4.2	4,511	159	854	38
14	5.4	4.2	4,632	159	854	38
15	5.6	4.2	4,758	159	854	38
16	5.7	4.2	4,870	161	854	38
17	5.8	4.3	4,955	162	854	38
18	5.9	4.3	5,029	163	854	38
19	6.0	4.2	5,099	161	854	38
20	6.0	4.3	5,152	162	854	38
21	6.1	4.2	5,208	158	854	38
22	6.1	4.1	5,224	157	854	38
23	6.1	4.2	5,242	154	854	37
24	6.2	4.1	5,255	150	854	37
25	6.1	4.0	5,249	149	854	37
26	6.1	4.0	5,239	147	854	37
27	6.1	3.9	5,232	143	854	37
28	6.1	3.8	5,215	139	854	37
29	6.1	3.6	5,198	135	854	37
30	6.0	3.6	5,153	134	854	37
31	6.0	3.5	5,146	131	854	37
32	6.0	3.5	5,109	128	854	37
33	5.9	3.4	5,079	126	854	37
34	5.9	3.4	5,047	125	854	37
35	5.9	3.4	5,016	124	854	37
36	5.8	3.3	4,978	123	852	37
37	5.8	3.2	4,938	120	851	37
38	5.8	3.2	4,895	116	847	36
39	5.8	3.2	4,830	113	840	35
40	5.7	3.2	4,772	108	839	34
41	5.7	3.2	4,750	104	833	33
42	5.7	3.2	4,735	98	826	31
43	5.6	3.1	4,569	95	816	31
44	5.6	3.1	4,471	95	803	31
45	5.5	3.1	4,356	93	787	30

¹ Families established 1850-1890.

the general group, both in the nineteenth century and during the early part of the present century. These data are presented in Tables 3 and 4 and in Figures 3 and 4. Figure 3 shows the average size of family for each year during a period of forty-five years after establishment of the family for each of the two groups of families (tuberculous and general groups) in the nineteenth century. In the general group (854 families), the size of the family increased rapidly until the fifteenth year after its establishment; at the end of that period there were on an average 5.6 persons per family. From the fifteenth to the nineteenth year the increment to the family was considerably slower; in the twentieth year the average size of family was six persons, and this level was maintained for some ten years. After thirty years of observation, as might be expected, the size of the family declined slowly and at the end of forty-five years of observation reached an average of 5.5 persons per family.

Table 4. Size of family in successive years after establishment among the tuberculous and in a general population in the twentieth century.¹

YEARS FAMILY OBSERVED	AVERAGE SIZE OF FAMILY		YEARS OF LIFE IN FAMILIES		NUMBER OF FAMILIES	
	General Population	Tuberculous Families	General Population	Tuberculous Families	General Population	Tuberculous Families
1	2.1	2.0	205.75	117.25	100	58
2	2.5	2.4	250.00	142.00	100	58
3	2.9	2.7	286.50	156.00	100	58
4	3.1	3.0	312.25	176.00	100	58
5	3.4	3.2	340.25	184.00	99	58
6	3.7	3.2	354.50	179.75	96	56
7	3.9	3.3	357.75	180.50	91	55
8	4.3	3.3	361.50	180.50	84	55
9	4.6	3.4	364.25	175.50	80	51
10	4.6	3.5	348.25	176.00	76	51
11	4.9	3.6	349.75	163.00	72	45
12	4.8	3.6	337.50	159.50	70	44
13	5.0	3.6	325.00	151.25	65	42
14	5.1	3.7	324.50	143.50	64	39
15	5.2	3.6	328.75	121.50	63	34
16	5.3	3.8	315.50	118.00	60	31

¹ Families established 1900-1929.

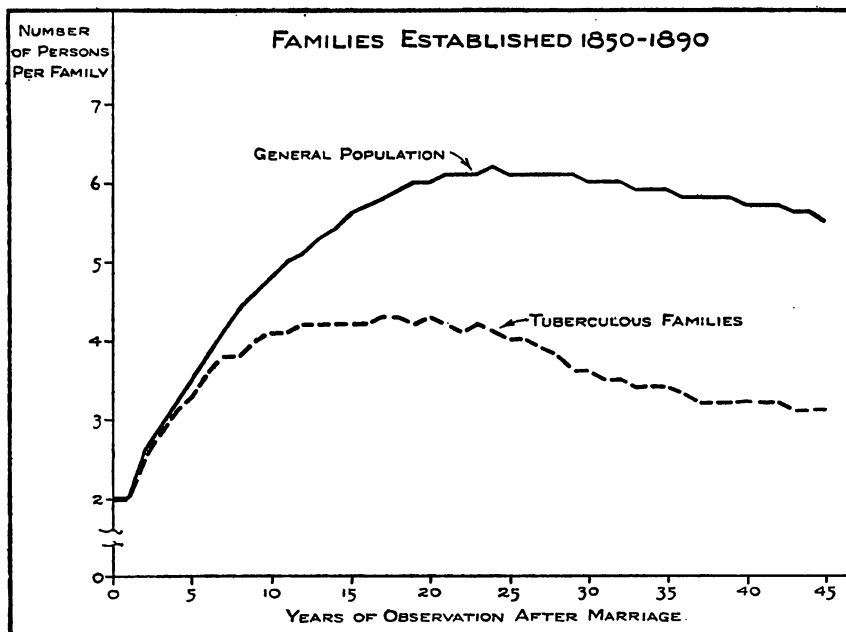


Fig. 3. Average size of family in successive years after establishment in the nineteenth century.

The curve describing the growth of the family where tuberculosis occurred in a parent differs markedly from that for the general group of families. After the tenth year of observation the tuberculous family was on the average significantly smaller in size than was true for the general group of families in the same time-period; for example, in the fifteenth year after marriage the average size of the tuberculous family was approximately four persons per family contrasted with 5.6 persons per family in the general group. Furthermore, in the tuberculous families the decline in the size of family started twenty years earlier and was much more precipitate than was noted for the families in the general group. Without doubt the natural family unit in the tuberculous group tended to be eliminated much more rapidly than was true of family units in the general population.²⁸

²⁸ It should be pointed out that in this study persons are withdrawn from the family unit
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The two groups of families, tuberculous and general groups, drawn from the twentieth century, presented in Table 4 and Figure 4, show that the growth of the family unit during the first sixteen

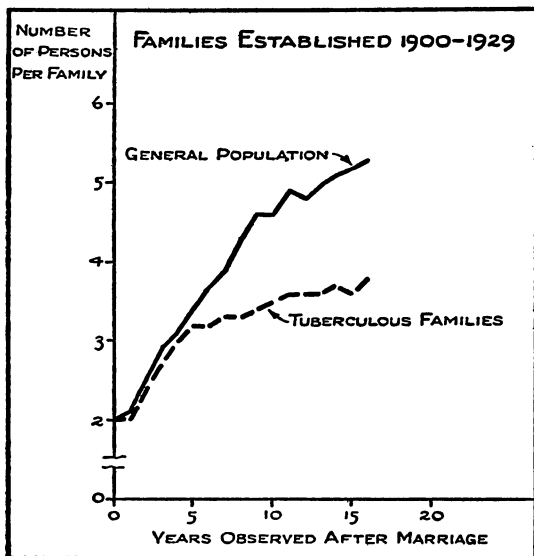


Fig. 4. Average size of family in successive years after establishment in the twentieth century.

average in each period an excess of 1.4 persons per family in families drawn from the general population contrasted with the tuberculous families. These differences in average size of family in both time-periods (nineteenth century and twentieth century) may certainly be considered as significant. Furthermore, these data suggest that in this rural area family units in the present generation are following somewhat the same general pattern of growth as experienced by those in the past generation.

Even though the data in this study are based upon small samples drawn from a rural area it seems suitable to call attention to their wider meaning. The tendency of the tuberculous family unit to be eliminated more rapidly through a somewhat lower fertility operat-

only because of death. This applies both to parents and to offspring. Also, offspring are counted as a part of the biological unit throughout their lives up to the date the family record was secured, even though they may have left the household.

years after marriage was similar to the growth experienced during the same period after marriage by families drawn from the latter part of the previous century. The differential in the size of family in the two groups was similar both in the nineteenth century and in the twentieth century. For example, fifteen years after establishment of the family there was on the

ing in conjunction with an excessively high mortality among offspring has probably been a factor contributing to the decline in the tuberculosis death rate which has been occurring over a long period of years. Limitation of births among the tuberculous is now being encouraged as a therapeutic measure, and if in the future there is no marked change in the hazard of disease and death to the offspring of the tuberculous, we may expect the size of the family unit among the tuberculous to play an increasingly important part in the continued decline in mortality from the disease.