

FACTORS INFLUENCING SEX DIFFERENCES IN MORTALITY FROM RESPIRATORY TUBERCULOSIS IN ENGLAND AND WALES

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In Great Britain, men and women die from respiratory tuberculosis at very different rates. After due allowance is made for variations in age structure, the death rate for men is much higher than for women. Even more striking is the difference between the curves exhibiting age-specific death rates in the two sexes. The male curve is now characterized by a slow rise from early adult life to a peak at about 60 years and then a decline to old age. The female curve, in contrast, rises steeply to a high peak between 20 and 30 years and then falls away almost as rapidly.

The aim of this paper is to examine some of the many factors which may be responsible for these different mortality patterns.

Investigation has been confined to the examination of existing records, all of which have been taken from various volumes of the Registrar-General's Statistical Review of England and Wales, and from his Decennial Supplement for 1931. From these tables, numbers of deaths from respiratory tuberculosis by age, sex, social class, and occupation have been extracted for different years. The populations of each group were obtained from the same source. Age-specific death rates were calculated from these figures in various population groups. In a few instances the calculation had already been made by the Registrar-General.

The usefulness of this method of study is limited by the fact that mortality records are the only indices of respiratory tuberculosis used. Death is the terminal event in a disease which may have been going on for many years. A description of the circumstances which are associated at death may bear little or no relation to those which set the morbid process in motion. This is particularly true of circumstances leading to the primary infection with the tubercle bacillus. Tuberculin testing surveys have shown that no significant difference exists between the percentage of male and female reactors (McDougall, 1949a). This fact suggests that mortality differences may be attributed either to some inherent difference between the sexes, to unequal chances of reinfection, or to other environmental inequalities.

HISTORICAL TRENDS.—Tuberculosis mortality has been falling for at least a century, and consideration of Fig. 1 gives evidence of the very considerable improvement which has taken place during the past 50 years. The standardized mortality per million for the years 1851-60 was 2,694 for men and 2,854 for women. By 1939 these rates had dropped to 556 and 404 (Registrar General, 1947), a reduction to one-fifth of the male rate and to one-seventh of the female rate.

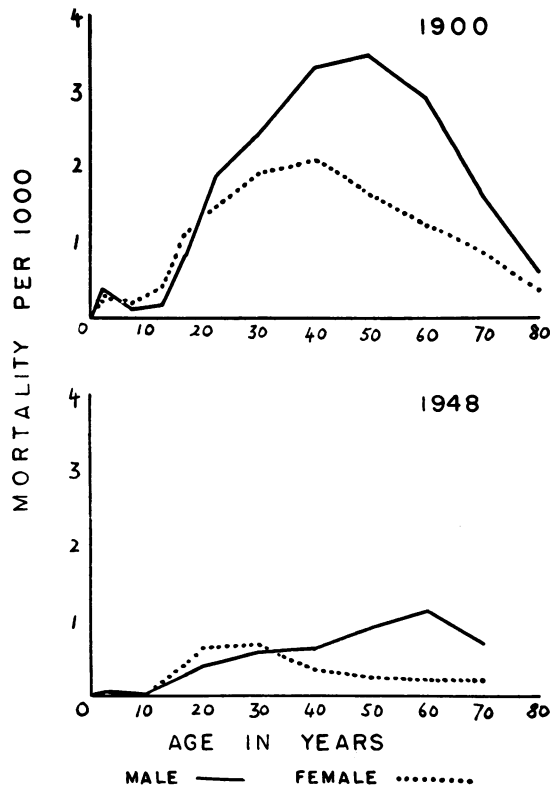


FIG. 1.—Phthisis mortality (1900) and respiratory tuberculosis mortality (1948).
(Sources: 63rd Annual Report of Registrar-General for 1900, Table 1, p. xxxi. Registrar-General's Statistical Review for 1948, Part I, Table 2, p. 2, and Table 24, p. 180).

These historical changes have been studied in detail by Hart and Wright (1939) who state:

The mortality for most age groups in England and Wales has declined steadily since 1870, except during the war period 1914-18.

For young adults the mortality declined satisfactorily until the beginning of the present century, but a retardation set in about 1900-4 for young women and about 1912-14 for young men. This retardation has been particularly severe amongst young women whose mortality in 1931-33 was scarcely lower than it had been in 1901-3.

The retarded decline in mortality from respiratory tuberculosis amongst young adults has been most serious in the large urban areas of the country, i.e. the metropolitan and county boroughs.

It is against a background of falling death rates at all ages and in both sexes that the present patterns of mortality must be considered. Even the young female peak figures are no exception to this downward trend though they exhibit it least. The shape of the male curve would seem well explained by the "cohort" hypothesis of Frost (1939), and though it is less apparent the female curve must be influenced by the same mechanism. McDougall (1949b) notes that there exists

a very constant correlation in successive generations between infant mortality from tuberculosis and the rates for the remainder of life in the same generation.

Childhood mortality reflects closely the weight of infection to which that generation of children is subjected. The bulk of this infection must originate from infected adults in the child's environment.

It appears probable that once a downward trend is established, as at present, the mortality from tuberculosis will continue to fall until for some reason a given number of infected cases manage to infect a higher number of children of the next generation. Assuming no change in the nature of the tubercle bacillus or in the innate susceptibility of the human host, environmental conditions would seem to be the factors which determine an upward or downward trend.

The problem which remains is to explain why, in spite of the universal downward trend, young women fare less favourably than young men, and older women much more favourably than older men.

Springett (1950) has helped to answer this question by showing that for purely mathematical reasons the peak rate of mortality shifts to an older age group only when the curve is rounded or plateau in type and not when steeply rising and sharply peaked. Young adult females experience an earlier and more sharply rising mortality from tuberculosis than do young adult males. It has been suggested that this is due to fundamental physiological sex differences. If there is

indeed a difference of this kind in the basic curve for the two sexes it would explain, at least in part, why older men fare less well than older women. It seems reasonable to think that other factors may also play a part and the possible influence of certain of these will now be examined.

INFLUENCE OF URBANIZATION.—The mortality patterns of men and women living in London, large cities, small towns, and rural districts are shown in Fig. 2. In both 1911 and 1938, rural districts are seen to have the lowest rates. In 1911, London had the highest tuberculosis mortality and the county boroughs next; in 1938, these positions were reversed.

The curve for females has much the same shape in both years, and the degree of urbanization appears to influence its shape and level very little. In contrast, the male curve is quite different in rural and urban areas. In both years the male and female patterns are most alike under rural conditions. They are least alike in London and the county boroughs, and the difference is greatest in the 50-65 year age group, that is, in the latter half of the working life.

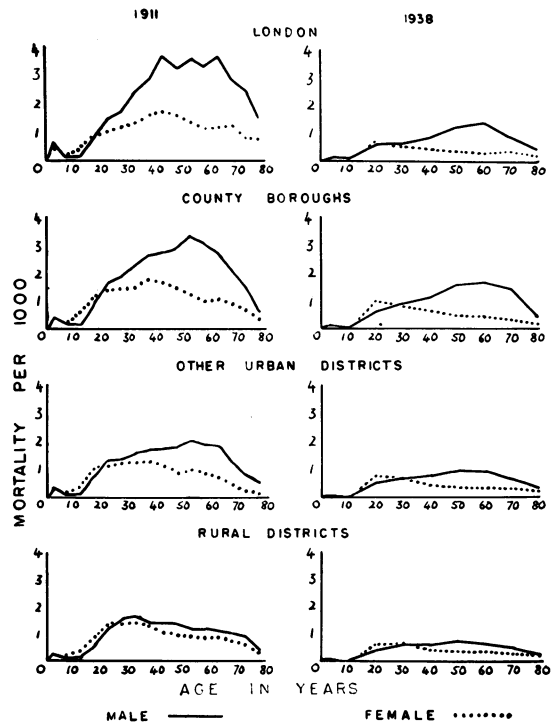


FIG. 2.—Phthisis mortality (1911), respiratory tuberculosis mortality (1938), and urbanization. Sources: 74th Annual Report of Registrar-General for 1911, Table LIV, p. lxxi. Registrar-General's Statistical Review for 1938 and 1939, Text, Table XLVII, p. 72.

TABLE I
RESPIRATORY TUBERCULOSIS MORTALITY AND SOCIAL CLASS, 1930-2
(Rates calculated for 100,000 living for the 3-yr period 1930-2)

Age		16-	20-	25-	35-	45-	55-	65-	70-	75	
Males	Total	199	319	325	383	454	377	269	177	87	
	Social Class I	196	165	188	261	242	264	211	142	142	
	" " II	148	212	231	283	312	258	211	165	80	
	" " III	182	313	330	375	386	273	272	179	80	
	" " IV	166	312	323	416	497	377	249	176	105	
	" " V	228	359	363	488	605	518	398	270	138	
	Unoccupied	337	582	686	690	359	178	102	—	31	
Females	Married	Total	306	315	262	199	145	125	103	82	64
		Social Class I	—	—	124	91	84	85	—	—	—
		" " II	—	199	173	131	99	94	84	132	68
		" " III	295	309	257	196	145	127	110	62	67
		" " IV	260	320	273	207	163	126	97	81	78
		" " V	396	379	342	271	197	160	138	95	—
		Unoccupied	—	—	105	70	26	17	—	—	—
	Single	Total	308	379	371	250	170	132	125	94	68
		Social Class I	—	—	199	454	—	—	—	—	—
		" " II	188	202	204	124	91	71	115	—	—
		" " III	223	321	347	245	176	168	152	106	129
" " IV		329	453	445	286	193	130	—	—	—	
" " V		319	444	346	299	273	210	—	—	—	
	Unoccupied	549	596	493	302	188	114	109	84	43	

Rates not calculated for any age group in which there were less than ten deaths.
Source: Registrar-General's Decennial Supplement for 1931, Part IIA Occupational Mortality, Tables 4A, 4B, 4C, pp. 215-325.

The figures available throw no light on the effect of urbanization on the mortality experience of young adults. In studying the difference between the sexes, one is liable to overlook the great similarity of the steep rise in mortality which takes place between 15 and 25 years of age.

Urbanization seems closely associated with the general level and pattern of male mortality but has very little influence on either the level or pattern of female mortality. Since urbanization itself would seem to be an environmental factor of equal importance to both men and women the cause of the difference cannot be urbanization but something associated with it. Dahlberg (1949) has recently suggested that urban employment is the responsible factor, and it is interesting to note that John Snow (1855) reached the same conclusion.

INFLUENCE OF SOCIAL CLASS.—Fig. 3, based on Table I, confirms the generally accepted view that tuberculosis mortality is closely associated with socio-economic conditions. The male and female curves are similar in shape in the five social classes, but the level at which they are set rises as we descend the social scale.

Single women have consistently higher rates than married women, particularly in the younger age groups. The curves for single and married women are nevertheless very similar. Selection can be held responsible for the higher rate for single women, who, if tuberculous, are less likely to marry. The great similarity

between the mortality experience of married and single women does suggest that maternity is not the main cause of the high female mortality in young adult life.

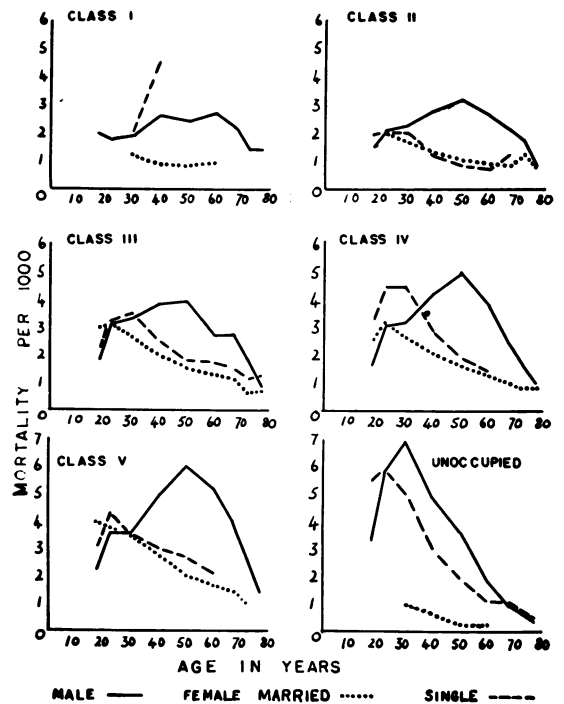


FIG. 3—Respiratory tuberculosis mortality and social class (1930-32)—based on Table I.

TABLE II
RESPIRATORY TUBERCULOSIS MORTALITY AND OCCUPATION, 1930-2
(Rates calculated for 100,000 living for the 3-yr period (1930-2))

Occupational Group	Marital Status	Age Group									Social Class
		16-	20-	25-	35-	45-	55-	65-	70-	75	
Farmers and their relatives	M	69	90	140	148	133	134	101	110	—	II
	W	—	160	172	117	105	76	89	179	—	II
Agricultural and garden labourers .. .	M	72	173	186	208	197	183	135	118	104	IV, V
	W	—	214	212	162	135	114	87	—	—	IV, V
Coal hewers and getters	M	233	272	264	261	422	384	291	153	—	III
	W	706	531	396	238	147	159	129	—	—	III
Iron and steel foundry furnacemen .. .	M	310	582	397	454	763	430	—	—	—	IV
	W	—	—	391	293	—	—	—	—	—	IV
Employers and managers	M	—	306	257	294	349	385	354	280	234	II
	W	—	—	—	—	not available	—	—	—	—	II
Boot and shoe factory operatives .. .	M	400	746	697	692	724	570	643	—	—	III
	W	—	—	400	378	168	190	—	—	—	III
Carpenters	M	153	209	231	306	346	334	276	153	—	III
	W	—	255	234	202	118	118	159	—	—	III
Water transport—dock labourers .. .	M	638	914	416	722	959	813	696	613	—	V
	W	—	371	361	304	168	136	—	—	—	V
Retail proprietors: Grocery	M	—	—	246	316	255	231	141	—	—	II
	W	—	—	190	137	114	—	—	—	—	II
Dairy, meat, fish, greens	M	—	349	366	422	281	281	—	—	—	II
	W	—	310	220	183	109	88	—	—	—	II
Commercial travellers	M	—	162	294	373	449	363	214	—	—	II
	W	—	—	181	125	90	—	—	—	—	II
Bank and insurance officials, clergy, physi- cians, engineers	M	—	—	142	203	188	166	212	162	113	I
	W	—	—	90	77	86	88	—	—	—	I
Typists and other clerks (not Civil Service)	M	181	364	400	482	550	425	336	213	—	III
	W	—	—	—	—	not available	—	—	—	—	—
General labourers	M	278	619	414	538	656	549	449	307	165	V
	W	496	440	381	318	222	180	138	83	—	V
Textile workers: Cardroom, etc. .. .	S	313	291	244	—	—	—	—	—	—	III, IV
Spinners, etc.	S	470	685	548	636	—	—	—	—	—	III
Weavers	S	327	299	280	226	107	—	—	—	—	III
Dressmakers, glovemakers	S	256	492	457	298	158	217	—	—	—	III
Milliners, hatformers, sewers, etc. .. .	S	318	542	488	420	606	912	—	—	—	IV
Midwives, sick nurses, etc.	S	172	233	378	214	124	102	—	—	—	III
Teachers (not music)	S	—	127	198	130	86	65	—	—	—	II
Indoor domestic servants	S	171	277	316	243	178	159	146	125	130	III
Charwomen, office cleaners	S	—	306	176	190	237	270	—	—	—	V

Rates not calculated for any age group in which there were less than ten deaths.

M = men W = wives S = single women

Source: Registrar-General's Decennial Supplement for 1931, Part IIA Occupational Mortality, Tables 4A, 4B, 4C, pp. 215-325.

It is assumed, of course, that the frequency of pregnancy is lower among single than married women and that the risk of tuberculosis accompanying pregnancy is the same for both.

Individuals are assigned to their social class by virtue of the nature of their occupation, or, in married women, by the occupation of their husbands. Thus there remains a sixth group; the unoccupied. One might expect that as tuberculosis is a disabling disease, the unoccupied would have a high mortality rate, and Fig. 3 shows that this is indeed so.

Social class and all that goes with it appear to have a great influence upon the general level of mortality from tuberculosis in both men and women, but cannot be held responsible for the differences between the sexes. Broadly speaking, men and their wives are subject to the same socio-economic environment, but the male and female curves are widely different in all five social groups.

INFLUENCE OF OCCUPATION.—In studying the occupational mortality figures in Table II, one is struck

by the very great variety of patterns which they describe. With one or two exceptions, however, their essential character is constant, the male rate rising and the female rate falling with advancing age up to the end of the working life. After this point, the male mortality in most of the occupational groups improves.

The exceptions, which are of particular interest, are farmers and their relatives, and agricultural and garden labourers (Fig. 4, opposite). Only in these groups does any great similarity in pattern exist between the sexes. There is considerable difference in the economic level of these two groups, but they both work in the country and, with the possible exception of coal hewers and getters, are the only groups of rural workers examined.

Coal miners are interesting for two reasons; the first, that their wives have such high death rates under the age of 35; and the second, that the male rate shows every sign of falling until it rises suddenly in the 40-45 age group. One wonders whether, but for the specific hazard of pneumoconiosis in this trade, the



FIG. 4.—Respiratory tuberculosis mortality and occupation (1930-32)—based on Table II. *Top*: farmers and their relatives; *below*: agricultural and garden labourers.

male rates might not have been similar to those of the other rural occupations.

A mixed group of occupations in Social Class I, shows a striking difference between the general level of the male and female mortality. The upward gradient during the working life of the male is very slight. Several occupations in Social Class II are shown and, with the possible exception of grocers, their favourable socio-economic position does not result in the male and female patterns being any more alike.

The high level of tuberculosis mortality of boot and shoe workers has been investigated by Stewart and Hughes (1949), who considered that the factors probably responsible were selective recruitment and working conditions. They observed that tuberculosis rates were not related to environmental working conditions judged by the usual criteria but did appear to be related to the number of workers per room, large groups faring worse than small groups.

The wives of general labourers share with the wives of miners a high mortality rate in the 16-20 age group. No evidence is available to account for this, although one may guess that the woman who is married before the age of 20 is subject to considerable stress, particularly if her husband has a more than average liability to tuberculosis, and if her economic position is poor.

Selection, small numbers, and the lack of variety of occupations make it dangerous to deduce anything from the rates for single women. In most groups the pattern is of the typical female type, but milliners, hat formers, sewers and trimmers, and charwomen

and office cleaners exhibit some similarities to the male type.

In what way does urban employment differ from rural employment and so increase the mortality rate of men in comparison with their wives? Socio-economic qualities such as income, nutrition, and education, may be dismissed because they are not points of difference between rural and urban employment. Population density is greater and available sunshine less in the cities, but these hazards are shared by men and women. Terris (1948) suggested that physical overstrain might be an important factor, but there seems no reason to think that physical strain is greater in urban than in rural occupations. Mental stress, on the other hand, may be greater in urban conditions of work, but there is no obvious connection between this factor and tuberculosis.

We are left with conditions inherent in industrial employment to which men are exposed more than their wives. Industrial air pollution might in some way lower resistance to infection or increase the liability of the breakdown of a quiescent lesion, but existing evidence does not support this explanation. Working conditions in our cities and towns have improved in many ways, but the risk of respiratory infection is still great. Large groups of working people come together day after day in the confined space of the workshop and canteen; there is often crowding and the amount of sunlight and ventilation may be far from ideal. In any large group there may be a case of open pulmonary tuberculosis to whom the same people are exposed over long periods. There is the opportunity for infection and superinfection, the risk increasing with duration of exposure. Men are subjected to these conditions throughout their working lives, and women, for the most part, only until they are married.

CONCLUSIONS

(1) The pattern of female mortality remains fairly constant under varied conditions of socio-economic environment and urbanization. Employment of a few types appears to modify this pattern. Socio-economic factors appear to determine the general level.

(2) The pattern of male mortality is influenced by the degree of urbanization and the nature of occupation, but not by social class. The general level of the curve is influenced by all three factors.

(3) It is suggested that the increasingly unfavourable mortality experience of occupied males with advancing years, in comparison with their wives, is due in part to certain qualities of urban employment. Frequent close contact with many people over long periods seems to be the most likely factor and presumably acts by increasing the risk of exposure to infection and reinfection.

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