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Relation of Economic Status to Tuberculosis Mortality by Age and Sex

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THE close relationship of economic status and tuberculosis mortality has been documented by numerous studies. In most of these, economic status has been defined in terms of broad occupational classes. For example, the tuberculosis mortality rates of adult males in England and Wales in 1921-1923 were found to be as shown in Table 1.¹

TABLE 1

Adjusted Mortality Rates, Respiratory Tuberculosis, Male Adults in Five Social Classes, England and Wales, 1921-1923

Occupational Class	Mortality Rate per 100,000
I —Upper and middle	73.2
II —Intermediate	126.3
III—Skilled Labor	146.2
IV—Intermediate	150.2
V —Unskilled labor	209.5

In the United States, Britten² analyzed tuberculosis mortality rates by occupational class in 10 states in 1930 as shown in Table 2.

Other studies defined economic status in terms of family income. For example, in Hamburg, Germany, in 1896-1900, the following data (Table 3) were obtained.³

TABLE 2

Adjusted Mortality Rates, Respiratory Tuberculosis, Males, 15-64 Years of Age, in 10 States, 1930, by Occupational Class

Occupational Class	Mortality Rate per 100,000, Respiratory Tuberculosis
Professional men	26.2
Proprietors, managers and officials	43.2
Clerks and kindred workers	65.8
Skilled workers and foremen	72.1
Semiskilled workers	102.1
Unskilled workers	184.9
All gainfully occupied	87.5
Agricultural workers	46.5

TABLE 3

Mean Annual Mortality Rates from Tuberculosis per 100,000 Persons Classified According to Family Income, Hamburg, Germany, 1896-1900

Family Income in Marks	Tuberculosis Mortality Rate per 100,000
900-1,200	657
1,200-2,000	559
2,000-3,500	363
3,500-5,000	228
5,000-10,000	183
10,000-25,000	172
25,000-50,000	221

In the United States, Chapin found that in Providence, R. I., in 1865, the adjusted mortality rate from pulmonary tuberculosis among the 10,515 income

taxpayers was 139.7, as compared with a rate of 431.0 among the 44,080 non-taxpayers.⁴

Green determined tuberculosis mortality rates in the census tracts of the Cleveland Five-City Area in 1928-1931, using equivalent monthly rentals as the measure of economic status, with results shown in Table 4.⁵

TABLE 4

Adjusted Tuberculosis Mortality Rates, White Population, Cleveland Five-City Area, 1928-1931, by Economic Area

Economic Area	Tuberculosis Mortality Rate per 100,000 (White)
1 } Lowest	127
2 }	
3	78
4	74
5	55
6	48
7	45
8	34
9	29
10	26
11	27
12	22
13 } Highest	19
14 }	

One of the findings of the National Health Survey made in 1935-1936 was a well defined relationship between economic status and disability from tuberculosis (Table 5).⁶

As a result of these and similar studies it has become an accepted fact that occupational class and economic status bear a definite relationship to tuberculosis mortality as well as disability. Unfortunately there has been little disposition to probe further to determine which factor or factors in economic

TABLE 5

Days of Disability per Person per Year from Tuberculosis, for Persons of All Ages, According to Economic Status

Annual Family Income or Relief Status	Days of Disability from Tuberculosis per Person per Year
Relief	0.70
Non-relief	
Under \$1,000	0.31
\$1,000-\$1,500	0.20
\$1,500-\$2,000	0.14
\$2,000-\$3,000	0.11
\$3,000 and over	0.08

status or occupational class are responsible for the relationship.

It is clear that several causes may be involved — overcrowding, bad housing, poor nutrition, overwork, increased exposure to infection, etc. It is extremely difficult to separate these factors, since the groups which have a low economic status generally tend to be unskilled laborers who have strenuous jobs and suffer from overcrowding, poor housing, and malnutrition. How then can a more refined analysis be obtained?

One method is to compare urban and rural populations which have a similar status in terms of family income. The author is not familiar with any such study. However, the fact that Britten found the tuberculosis mortality rate to be only 46.5 among agricultural workers as compared with 87.5 among all gainfully occupied persons (Table 2) would tend to indicate that economic status *per se* is not the only determinant and that other factors related to urban living probably play a significant role.

Another method which may be used

TABLE 6

Tuberculosis Mortality Rates by Age and Sex per 1,000 Persons in Copenhagen, Denmark, According to Broad Occupational Classes, 1865-1874

Occupational Class	All Ages						65 and over
	20 & over Adjusted	20-24	25-34	35-44	45-54	55-64	
<i>Males</i>							
Professional, Salaried and Merchant Class	3.4	3.4	3.3	3.1	3.4	4.4	2.9
Working Class	6.9	4.3	4.5	6.0	8.8	13.3	10.6
<i>Females</i>							
Professional, Salaried and Merchant Class	2.4	2.6	2.7	2.4	2.2	2.2	1.3
Working Class	3.4	1.9	2.6	4.0	4.4	4.5	4.5

is to compare the tuberculosis mortality of males and females in various economic classes. Data in Table 6 were obtained for Copenhagen, Denmark, for the years 1865-1874.⁷

It will be noted that among adult males, the tuberculosis mortality rate is twice as high in the working class as in the professional, salaried, and merchant class. Among adult females, however, the difference is not as marked; the rate in the working class is only 1½ times as high as in the other classes.

Green⁸ studied the age- and sex-specific tuberculosis mortality rates in Cleveland in 1928-1931 for two contrasting economic areas—the Low Area, which consisted of a population of approximately 100,000 living in census tracts having the lowest equivalent monthly rentals, and the High Area, consisting of a population of about 100,000 living in census tracts having the highest rentals. He found that in the Low Area the male rate was quite similar to the female rate up to age 25, after which the male rate was very markedly greater. In the High Area, on the other hand, the male and female rates were found to be quite similar throughout, both being much lower at all ages than was found to be the case in the Low Area.

Sydenstricker⁹ compared age-specific tuberculosis mortality rates among males and females in urban and rural areas in nine states in 1908-1912 and among insured members of wage earners' families in 1911-1916. He found that although there were some differences in the rates for adult females in the rural, urban, and insured wage earners' families (highest in the wage earners' families), these differences were fairly small. Among adult males, however, there were very striking differences, with the rural rates considerably below the urban and these in turn considerably lower than the rates among insured wage earners. He concluded that: "The rate for adult

wage earning males, especially in middle age after they have been at work a number of years, is in excess of that for any other group. The possibility that 'race' or, to put it more exactly, country of birth—*per se* was an important factor may be dismissed since females were largely of the same nationality as their husbands at the time covered by the statistics used. Yet wives, living in the same economic, social, and home environment, did not die from the disease to nearly the extent that their wage earning husbands did. . . . It is not 'conditions of life' only, but also the particular conditions constituting occupational environment, which are responsible for the greater mortality rate among male wage earners in the prime of life in cities than among women in general or among men in other pursuits."

The present study of tuberculosis mortality in the city of Buffalo gives striking confirmation of Sydenstricker's findings. Buffalo is an important industrial center, with large steel, auto, railroad, grain, aircraft and electrical industries. Its population in 1940 was 575,901, of which 81 per cent were native white, 16 per cent foreign-born white, and 3 per cent non-white, mainly Negroes.

The 1940 Census data on population and socio-economic characteristics of the 72 census tracts in Buffalo were used. The relative economic status of the population in each census tract was determined by combining four indices: median monthly rent, proportion of homes with central heating, proportion of homes with mechanical refrigeration, and median years of school completed. Statistical analyses made by the Buffalo Foundation have demonstrated that these factors are closely correlated, and that consideration of all four factors yields a more reliable measurement of average income and economic conditions than the use of a single factor.

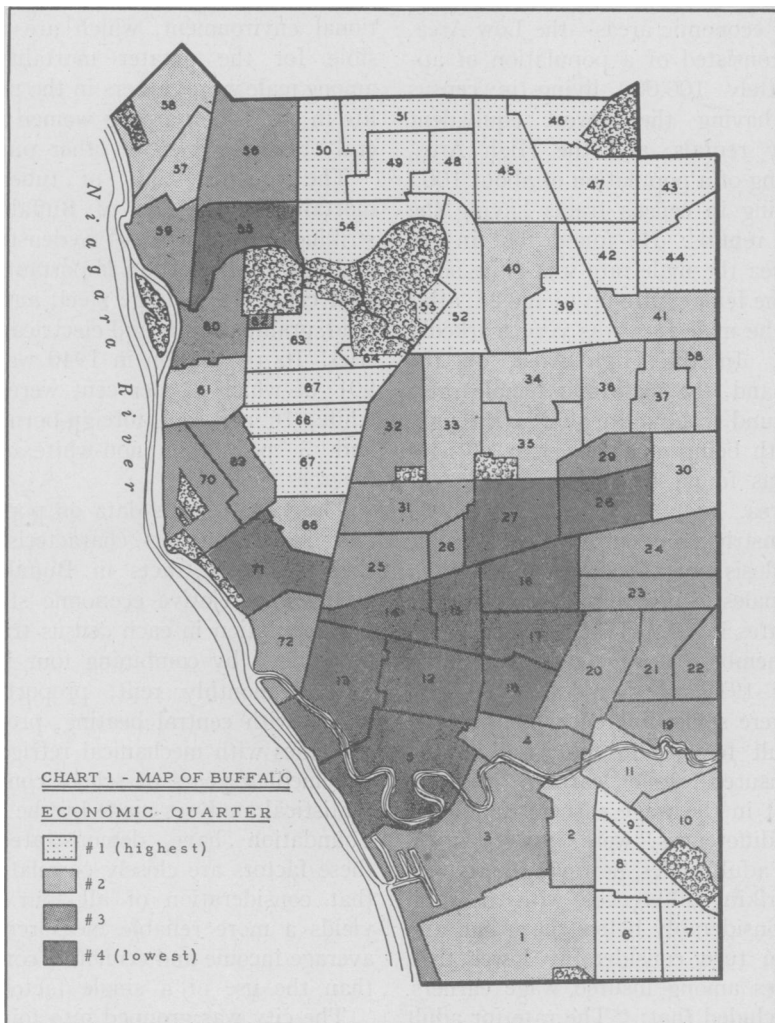
The city was grouped into four quar-

ters of approximately 145,000 population each on the basis of economic status. The classification of census tracts into the four economic quarters is shown on the map, Chart 1. Resident tuberculosis deaths occurring during the three year period 1939-1941 were used to determine annual tuberculosis death rates by age, sex, and color for each of the four quarters as well as the city as a whole.

Tuberculosis mortality by age, sex, and color for the City of Buffalo is shown in Table 7 and Chart 2. It will

be noted that there is a significantly higher male death rate after the third decade for both the white and non-white populations (the non-white population in Buffalo is almost entirely Negro). This finding is essentially consistent with the data obtained for all cities of over 100,000 population in the United States.¹⁰

Tuberculosis mortality rates by age and sex were calculated for the white population in each of the economic quarters. Similar comparisons for the non-white population could not be made



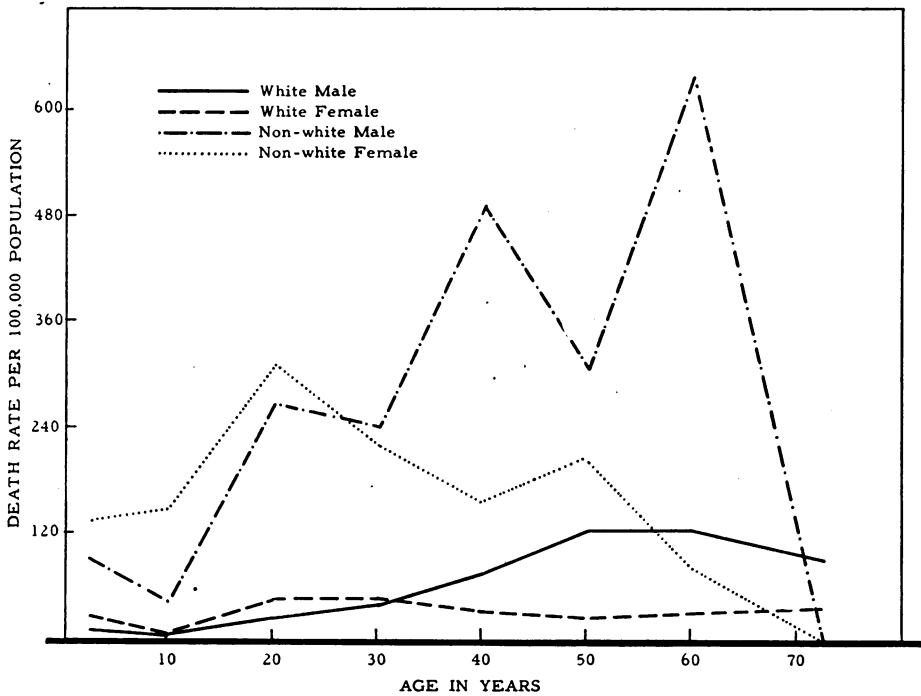


CHART 2 - Tuberculosis Mortality Rates by Age, Sex and Color - Buffalo, 1939-41

TABLE 7
Tuberculosis Mortality by Age, Sex, and Color, Buffalo, 1939-1941

Age	Male			Female		
	Population	Tbc deaths 1939-1941	Annual Tbc mortality rate per 100,000	Population	Tbc deaths 1939-1941	Annual Tbc mortality rate per 100,000
	<i>White</i>					
Under 5	18,152	5	9.2	17,711	13	24.5
5-14	41,538	4	3.2	41,388	5	4.0
15-24	48,520	35	24.0	51,520	69	44.6
25-34	44,547	51	38.2	47,088	65	46.0
35-44	41,192	94	76.1	42,545	43	33.7
45-54	39,855	150	125.5	37,968	28	24.6
55-64	24,189	92	126.8	24,314	24	32.9
65 and over	16,640	46	92.1	20,451	23	37.5
Total	274,633	477	57.9	282,985	270	31.8
	<i>Non-White</i>					
Under 5	719	2	92.7	754	3	132.4
5-14	1,541	2	43.3	1,590	7	146.8
15-24	1,245	10	267.7	1,501	14	310.9
25-34	1,501	11	244.3	1,803	12	221.9
35-44	2,151	32	495.9	1,907	9	157.3
45-54	1,295	12	308.9	959	6	208.6
55-64	466	9	643.8	385	1	86.6
65 and over	216	0	0	250	0	0
Total	9,134	78	284.6	9,149	52	189.4
	<i>Total</i>					
Under 5	18,871	7	12.4	18,465	16	28.9
5-14	43,079	6	4.6	42,978	12	9.3
15-24	49,765	45	30.1	53,021	83	52.2
25-34	46,048	62	44.9	48,891	77	52.5
35-44	43,343	126	96.9	44,452	52	39.0
45-54	41,150	162	131.2	38,927	34	29.1
55-64	24,655	101	136.6	24,699	25	33.7
65 and over	16,856	46	91.0	20,701	23	37.0
Total	283,767	555	65.2	292,134	322	36.7

because the non-white population in the two highest quarters is negligible. The results are shown in Tables 8 and 9 and Charts 3 and 4. It is seen that before the third decade there is some difference in tuberculosis mortality by eco-

nomical status for both sexes. After the third decade, however, there is a very large difference in mortality among the males of the various economic groups, while there is only a moderate difference in mortality among females.

TABLE 8

Tuberculosis Mortality, White Male Population, by Economic Status and Age, Buffalo, 1939-1941

<i>Economic Quarter No. 1 (Highest)</i>				<i>Economic Quarter No. 2</i>			
<i>Age</i>	<i>Population</i>	<i>Tbc deaths 1939-1941</i>	<i>Annual Tbc mortality rate per 100,000</i>	<i>Age</i>	<i>Population</i>	<i>Tbc deaths 1939-1941</i>	<i>Annual Tbc mortality rate per 100,000</i>
Under 5	3,749	2	17.8	Under 5	4,334	0	0
5-14	8,879	0	0	5-14	9,949	0	0
15-24	9,643	6	20.7	15-24	11,166	4	11.9
25-34	10,156	9	29.5	25-34	11,024	15	45.4
35-44	11,179	14	41.7	35-44	10,853	14	43.0
45-54	10,305	17	55.0	45-54	9,762	25	85.4
55-64	6,201	9	48.4	55-64	5,914	21	118.4
65 and over	4,621	5	36.7	65 and over	4,134	14	112.9
Total	64,733	62	31.9	Total	67,136	93	46.2

<i>Economic Quarter No. 3</i>				<i>Economic Quarter No. 4 (Lowest)</i>			
<i>Age</i>	<i>Population</i>	<i>Tbc deaths 1939-1941</i>	<i>Annual Tbc mortality rate per 100,000</i>	<i>Age</i>	<i>Population</i>	<i>Tbc deaths 1939-1941</i>	<i>Annual Tbc mortality rate per 100,000</i>
Under 5	5,176	1	6.4	Under 5	4,893	2	13.6
5-14	11,761	0	0	5-14	10,949	4	12.2
15-24	13,791	9	21.8	15-24	13,920	16	38.3
25-34	12,310	11	29.8	25-34	11,057	16	48.2
35-44	10,526	31	98.2	35-44	8,634	35	135.1
45-54	10,184	45	147.3	45-54	9,605	63	218.6
55-64	6,443	29	150.0	55-64	5,630	33	195.4
65 and over	4,583	15	109.1	65 and over	3,302	12	121.1
Total	74,774	141	62.8	Total	67,990	181	88.7

TABLE 9

Tuberculosis Mortality, White Female Population, by Economic Status and Age, Buffalo, 1939-1941

<i>Economic Quarter No. 1 (Highest)</i>				<i>Economic Quarter No. 2</i>			
<i>Age</i>	<i>Population</i>	<i>Tbc deaths 1939-1941</i>	<i>Annual Tbc mortality rate per 100,000</i>	<i>Age</i>	<i>Population</i>	<i>Tbc deaths 1939-1941</i>	<i>Annual Tbc mortality rate per 100,000</i>
Under 5	3,734	2	17.8	Under 5	4,233	2	15.7
5-14	8,760	0	0	5-14	9,940	1	3.4
15-24	11,844	10	28.1	15-24	11,651	19	54.4
25-34	12,446	16	42.8	25-34	11,666	14	40.0
35-44	13,126	5	12.7	35-44	10,918	9	27.5
45-54	11,311	3	8.8	45-54	9,621	6	20.8
55-64	7,724	11	47.5	55-64	6,197	6	32.3
65 and over	6,829	6	29.3	65 and over	5,111	3	19.6
Total	75,774	53	23.3	Total	69,337	60	28.8

<i>Economic Quarter No. 3</i>				<i>Economic Quarter No. 4 (Lowest)</i>			
<i>Age</i>	<i>Population</i>	<i>Tbc deaths 1939-1941</i>	<i>Annual Tbc mortality rate per 100,000</i>	<i>Age</i>	<i>Population</i>	<i>Tbc deaths 1939-1941</i>	<i>Annual Tbc mortality rate per 100,000</i>
Under 5	5,083	3	19.7	Under 5	4,671	6	42.8
5-14	11,758	0	0	5-14	10,930	4	12.2
15-24	13,968	14	33.4	15-24	14,057	26	61.7
25-34	12,556	16	42.5	25-34	10,420	19	60.8
35-44	10,617	16	50.2	35-44	7,883	13	55.0
45-54	9,637	14	48.4	45-54	7,397	5	22.5
55-64	6,492	3	15.4	55-64	3,903	4	34.2
65 and over	5,613	7	41.6	65 and over	2,888	7	80.8
Total	75,724	73	32.1	Total	62,149	84	45.1

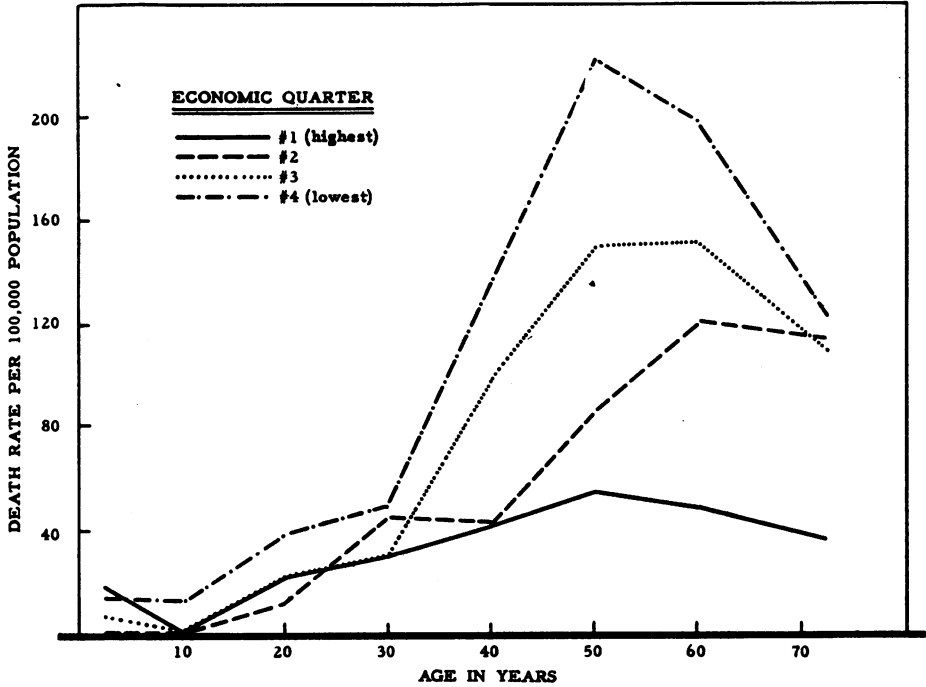


CHART 3 - Tuberculosis Mortality Rates, White Males, by Economic Quarter - Buffalo, 1939-41

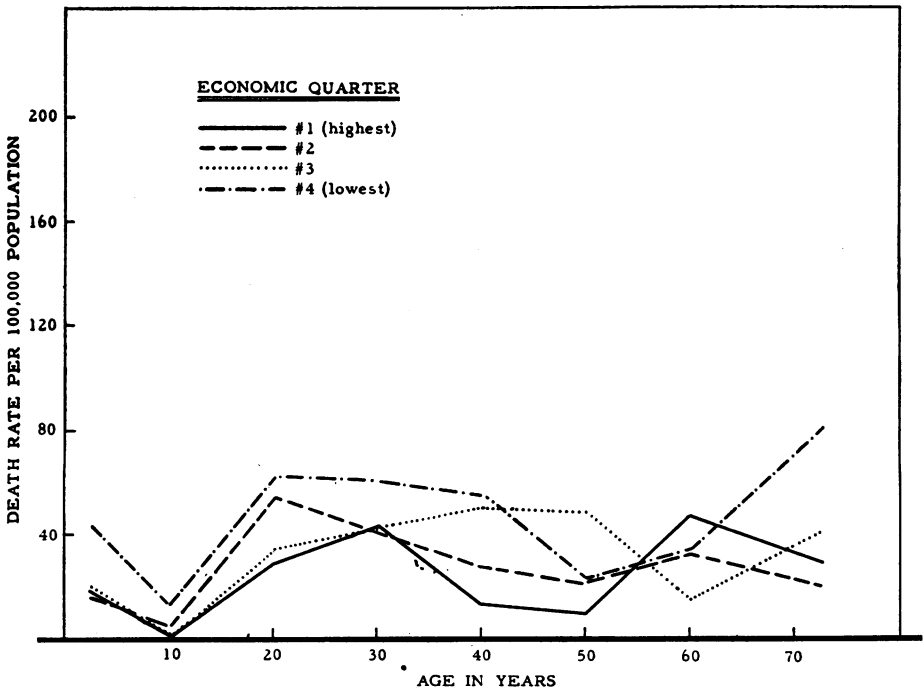


CHART 4 - Tuberculosis Mortality Rates, White Females, by Economic Quarter - Buffalo, 1939-41

TABLE 10
*Adjusted Tuberculosis Mortality Rates of White Population by Sex, Major Age Groups,
 and Economic Status, Buffalo, 1939-1941*

Sex and Economic Status	Adjusted Tuberculosis Mortality Rates		
	Under 35 years	35 years and over	Total
Males			
Economic Quarter 1 (highest)	17.3	46.7	30.3
2	17.0	80.9	45.4
3	16.3	125.9	64.9
4 (lowest)	31.1	172.4	93.8
Females			
Economic Quarter 1 (highest)	23.9	20.8	22.6
2	32.3	25.2	29.2
3	25.8	41.5	32.7
4 (lowest)	46.2	45.3	45.8

The magnitude of these differences is indicated in Table 10, which gives the tuberculosis death rates below and above age 35, adjusted to the entire population of Buffalo as the standard population. It will be noted that below age 35, the tuberculosis mortality for both males and females in the lowest economic quarter is about double that in the highest quarter. Likewise, in females age 35 and over, the mortality in the lowest economic quarter is a little more than double that in the highest quarter. But for males age 35 and over, the mortality in the lowest economic quarter is almost four times as great as in the highest quarter.

The difference in tuberculosis mortality between the highest and lowest economic quarters is statistically significant* for all groups, i.e., for males 35 years and over, females 35 and over, males below 35, and females below 35. However, only in males 35 years and over are all the differences in mortality between each economic quarter and the next highest economic quarter statistically significant. It is fair to conclude, therefore, that the differences in mortality for males 35 years and over among the different economic groups are significantly greater than for females in the same age classification.

These data indicate that the high male mortality after age 35 is not merely a matter of economic status *per se*. If it were, the females in the lower economic groups should show a similar rise in mortality after age 35. It is reasonable to assume, therefore, that other factors associated with economic status, but more or less limited to males, are responsible for the differences found in the four economic groups of males after age 35.

The most striking difference in the mode of life of adult men and women relates to occupational status. In Buffalo in 1940, 62 per cent of the 226,704 males age 14 years and over were employed, while of the 235,587 females age 14 and over, only 23 per cent were employed and 55 per cent were engaged in housework in their own homes. Also, Table 11 shows that in 1940, 57 per cent of the employed males in the highest economic quarter in Buffalo were professional workers; semi-professional workers; proprietors, managers, and officials; and clerical, sales and kindred workers. Only 18 per cent of the employed males in the lowest quarter were in these categories. On the other hand, 50 per cent of the employed males in the lowest economic quarter were classified in the 1940 census as operatives and laborers, as compared with only 17 per cent in the highest quarter.

There are several factors associated

* A difference of two or more standard deviations was considered statistically significant.

TABLE 11

*Occupational Status of Employed Males in Each of the Four Economic Quarters, Buffalo 1940 (U. S. Census) **

<i>Economic Quarter</i>	<i>Per cent of Total</i>	
	<i>Professional; Semi-Professional; Proprietors, Managers, and Officials; Clerical, Sales and Kindred Workers</i>	<i>Operatives and Laborers</i>
1 (highest)	57.3	16.9
2	32.4	31.7
3	26.3	38.6
4 (lowest)	18.4	49.5

* Includes both whites and non-whites. Data not available for whites only.

with occupation which might be considered to contribute to the differences found. It might be postulated, for example, that the higher tuberculosis mortality among adult men in the low income groups is due to their position as family breadwinners who are therefore more likely to postpone needed hospitalization than are women in the same strata. While this explanation appears reasonable, some doubt is cast on its validity by the fact that Sydenstricker discovered the phenomenon of disproportionately high tuberculosis mortality among adult wage earning males in 1911-1916, when the sanatorium movement was in its infancy and hospitalization for tuberculosis could not therefore be expected to play a significant role in reducing mortality.

It is conceivable that silicosis may play some part in the differences found. While industry in Buffalo is for the most part apparently not of the character associated with silicosis, there is no definite information at this time concerning the extent of the hazard and the actual incidence of silicosis in the area.

It is also possible that there are larger differences in extra-familial exposure to tuberculosis among males in the four economic groups than among females. This factor may play a definite role but is somewhat difficult to evaluate.

A major consideration which may help explain the findings relates to the adverse effects of overexertion on patients with tuberculosis. Physical overstrain

is characteristic of the tasks of the unskilled laborers who make up 50 per cent of the employed males in the lowest economic quarter of Buffalo and only 17 per cent of employed males in the highest quarter. The importance of overexertion in the prognosis of tuberculosis has long been recognized; it forms the basis for our therapeutic approach to the disease; and in recent years has influenced greatly our thinking with respect to rehabilitation. It has become very clear that a recovered tuberculosis patient cannot be returned to an occupation requiring strenuous physical exertion without running serious risks of early breakdown and recurrence. The result has been an emphasis on retraining patients for occupations requiring less physical exertion and on the development of sheltered workshops. It would appear logical therefore to suggest that physical overstrain plays an important role in the disproportionately high tuberculosis mortality among adult males in the lower income groups.

It must be recognized however that this brief discussion of possible explanations for the high tuberculosis mortality of low-income adult males is on a speculative level. The conditions of the study did not permit isolation of the individual factors in order to determine their relative influence.

SUMMARY AND CONCLUSIONS

1. Numerous studies have shown the

close correlation of occupational class and economic status with tuberculosis mortality and disability.

2. Analysis of tuberculosis mortality by age, sex, and economic status in Buffalo, 1939-1941, indicates that the inverse correlation of economic status with tuberculosis mortality is greater for adult males than for adult females.

3. It is concluded therefore that economic status *per se* is not the only factor involved, but that conditions of occupation probably have an important effect. Various aspects of occupational environment are discussed, and it is suggested that the factor of physical overstrain plays a significant role.

4. It is recommended that similar studies be conducted in other cities to test the general validity of the findings, and that further studies be instituted to isolate the various factors, if possible,

in order to determine their relative influence on tuberculosis mortality.

REFERENCES

1. Sydenstricker, E. *Health and Environment*. New York: McGraw-Hill, 1933, p. 96.
2. Britten, R. H. Mortality Rates by Occupational Class in the United States. *Pub. Health Rep.* 49, Sept. 21, 1934, p. 1101, ff.
3. Collins, S. D. Economic Status and Health. *Pub. Health Bull.* 165, U. S. Public Health Service, Washington, 1926, p. 40.
4. *Papers of Charles V. Chapin, M.D.* New York: The Commonwealth Fund, 1934, p. 222.
5. Green, H. W. *Tuberculosis and Economic Strata, Cleveland's Five-City Area, 1928-1931*, Anti-Tuberculosis League of Cleveland, 1932.
6. Disability from Specific Causes in Relation to Economic Status. National Health Survey, Preliminary Reports, Sickness and Medical Care Series, *Bull.* 9, U. S. Public Health Service, Washington, 1938, p. 7.
7. Collins, *op. cit.*, p. 36.
8. Green, *op. cit.*, p. 9 ff.
9. Sydenstricker, *op. cit.*, p. 145.
10. Yerushalmy, J., and Silverman, C. Tuberculosis Mortality in Communities of Different Size. *Am. Rev. Tuberc.* 51:413 (May), 1945.

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