

# PROJECTIONS OF MORTALITY IN THE UNITED STATES TO 1970

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THE two major objectives of this paper are: *First*, to ascertain the projected age-sex specific mortality rates of United States white and nonwhite populations for the years 1960, 1965, and 1970; and *second*, to establish the future life expectancy at selected ages for these four race-sex population groups based upon hypothetical life tables derived from projected death rates.

Numerous mortality projections, employing a variety of techniques, have been prepared and experience has proved many of these forecasts to be unduly conservative.<sup>2</sup> Also, data for recent years indicate that Dorn's projections are rather conservative.<sup>3</sup> For example, mortality rates from 1948 to 1955 decrease to such an extent that the expectation of life in 1955, especially for the white population, had nearly attained his projected values for 1960.

Mortality projections serve four major purposes: *First*, projected survival rates are essential for developing population projections;<sup>4</sup> *second*, mortality forecasts serve as a basis for estimating premiums, annuities, and reserves by life insurance companies; *third*, they are necessary for preparing future cost estimates for the Old-Age, Survivors and Disability Insurance program; and *fourth*, they provide estimates of mortality

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<sup>2</sup> Wolfenden, Hugh H.: *POPULATION STATISTICS AND THEIR COMPILATION*. Chicago, The University of Chicago Press, 1954, Chapter X; Spiegelman, Mortimer: *INTRODUCTION TO DEMOGRAPHY*. Chicago, The Society of Actuaries, 1955, Chapter 6; and Dublin, Louis I.; Lotka, A. J.; and Spiegelman, Mortimer: *LENGTH OF LIFE*. New York, The Ronald Press Co., 1949, Chapter 9.

<sup>3</sup> Dorn, Harold F.: Prospects of Further Decline in Mortality Rates. *Human Biology*, December, 1952, 24, No. 4, pp. 235-61.

<sup>4</sup> These United States death rate projections were developed primarily for use in preparing Oklahoma population projections, with the projected state mortality levels being tied in with corresponding national computations.

rates, assuming the application and acceptance of existing medical knowledge.

#### MORTALITY PROJECTION PROCEDURE

In computing 1960, 1965, and 1970 projected United States race-sex mortality rates, it was assumed that age-specific death rates will decline asymptotically throughout 1955–1970. These rates were projected, using conventional punch card tabulation machinery and an IBM 650 computer, by the following procedure:

*First*, the annual United States age-specific death rates for the 25-year period 1930–1954 were extrapolated to 1970. Straight line and parabolic fits were obtained for the natural logarithms of age-specific mortality rates versus years coded with 1930 as zero. Exponential curves were computed by the least squares method using the following two formulas:

$$\text{Straight line: } \log y = a + bx \quad (1)$$

$$\text{Parabolic: } \log y = a + bx + cx^2 \quad (2)$$

*Second*, the resulting two sets of 1960, 1965, and 1970 age-race-sex extrapolations obtained by fitting exponential curves were then compared and one was chosen. Table 1 shows the coefficients for the selected mathematical fits to the 1930–1954 mortality data.

*Third*, erratic and unrealistic projections were obtained for white males 55–59 and 85 years of age and over, nonwhite males 75 years of age and over, and for nonwhite females 70 years of age and over. Adjustments were necessary in these cases, requiring the elimination of inconsistent projected death rates.

The recorded age-specific United States death rates for the four race-sex populations at every fifth year from 1930 through 1955 and the 1960, 1965, and 1970 projections are shown in Tables 2 and 3. The prospective changes during the 15-year period 1955–1970 reflect a continuation of past trends, one of steadily declining mortality rates.

Table 1. Table of coefficients for curves fitted to annual mortality rates 1930-1954.

AGE	WHITE MALE			WHITE FEMALE			NONWHITE MALE			NONWHITE FEMALE		
	A	B	C	A	B	C	A	B	C	A	B	C
	Under 1	-2.68102	-.04011	.00020	-2.91778	-.04011	.00010	-2.23427	-.03152	.00006	-2.41696	-.03326
1-4	-5.12937	-.07014		-5.24469	-.07744	.00021	-4.61074	-.06619		-4.74263	-.06679	
5-9	-6.18139	-.05097		-6.36280	-.06251	.00005	-5.95519	-.04845		-6.03253	-.05563	
10-14	-6.35170	-.04379		-6.61230	-.05601		-5.86800	-.04950		-5.83963	-.06924	
15-19	-5.99950	-.02952		-6.17604	-.05715		-5.11347	-.04817		-4.88413	-.07320	
20-24	-5.70417	-.02530		-5.73287	-.06805		-4.59837	-.04650		-4.54916	-.06727	
25-29	-5.56427	-.03706		-5.57684	-.06589		-4.44995	-.04699		-4.48060	-.06096	
30-34	-5.38815	-.03818		-5.47427	-.05665		-4.24224	-.04593		-4.33541	-.05212	
35-39	-5.15684	-.03169		-5.32636	-.04501		-4.11813	-.03920		-4.27517	-.04044	
40-44	-4.84139	-.02488		-5.07474	-.03854		-3.86949	-.03375		-3.98752	-.03516	
45-49	-4.52049	-.01699		-4.79508	-.03083		-3.71357	-.02390		-3.85078	-.02612	
50-54	-4.19818	-.00943		-4.46193	-.02641		-3.50244	-.01186		-3.49771	-.02284	
55-59	-3.82814*	-.00616*		-4.07527	-.02447		-3.32160	-.00888		-3.26908	-.02395	
60-64	-3.45629	-.00555		-3.66649	-.02271		-3.13504	-.00673		-3.11142	-.01797	
65-69	-3.08546	-.00567		-3.25994	-.01996		-2.94537	-.00166		-3.03829	-.00810	
70-74	-2.66647	-.00779		-2.79186	-.01837		-2.61794	-.00896		-2.74184*	-.01475*	
75-79	-2.21407	-.00880		-2.32493	-.01580		-2.31394*	-.01001*		-2.53149*	-.01045*	
80-84	-1.79584	-.01004		-1.90447	-.01340		-1.95524*	-.02035*		-2.28277*	-.01480*	
85+	-1.37945*	-.00597*		-1.44059	-.00880		-1.49380*	-.02210*		-1.73672*	-.02056*	

\* Apparent inconsistencies and random irregularities were adjusted. Therefore, these coefficients were not employed in 1960, 1965, and 1970 mortality projections.

The 1970 projections, for example, indicate that death rates will be lower in every age-race-sex population group than in 1955. Infants and young adults have benefited most from

Table 2. Death rates by age for white males and females, United States 1930-1955, and projected rates for 1960, 1965, and 1970.

AGE	YEAR								
	1930	1935	1940	1945	1950	1955	1960	1965	1970
<b>WHITE MALES</b>									
Under 1	66.6	58.1	48.3	39.9	30.2	29.8	24.6	21.5	19.0
1 - 4	5.5	4.4	2.8	2.0	1.4	1.1	.7	.5	.4
5 - 9	2.0	1.7	1.2	1.1	.7	.6	.5	.4	.3
10-14	1.6	1.5	1.1	1.0	.7	.6	.5	.4	.3
15-19	2.5	2.2	1.7	1.8	1.3	1.3	1.0	.9	.8
20-24	3.4	3.0	2.3	3.5	1.7	1.8	1.6	1.4	1.2
25-29	3.8	3.3	2.5	2.9	1.7	1.6	1.3	1.1	.9
30-34	4.4	3.9	3.1	3.1	2.0	1.8	1.5	1.2	1.0
35-39	5.5	5.0	4.1	4.1	2.9	2.6	2.2	1.9	1.6
40-44	7.6	7.2	6.1	5.6	4.8	4.2	3.7	3.3	2.9
45-49	10.3	10.3	9.2	8.4	7.7	7.1	6.5	6.1	5.6
50-54	14.6	14.3	13.9	13.3	12.1	11.4	11.3	10.8	10.3
55-59	21.0	21.2	20.9	20.6	18.8	17.5	17.5*	17.3*	16.7*
60-64	31.1	30.6	30.6	28.9	28.1	27.0	26.7	26.0	25.3
65-69	45.8	45.3	44.6	40.6	40.7	41.1	38.6	37.5	36.4
70-74	68.4	65.4	57.8	61.2	60.4	58.1	55.0	52.9	50.9
75-79	103.1	107.4	104.0	94.7	90.1	88.2	83.9	80.3	76.8
80-84	154.7	156.3	158.1	139.7	135.2	133.9	122.8	116.8	111.1
85 and Over	237.6	239.3	251.4	225.5	221.2	200.6	200.6*	200.6*	198.2*
<b>WHITE FEMALES</b>									
Under 1	53.2	45.2	37.8	31.1	23.1	22.4	17.9	15.1	12.8
1 - 4	4.8	3.8	2.4	1.7	1.1	.9	.6	.5	.3
5 - 9	1.6	1.4	.9	.7	.5	.4	.3	.2	.2
10-14	1.2	1.1	.8	.6	.4	.3	.3	.2	.2
15-19	2.1	1.6	1.2	.9	.6	.5	.4	.3	.2
20-24	3.0	2.4	1.6	1.3	.8	.6	.4	.3	.2
25-29	3.4	2.9	1.9	1.5	1.0	.7	.5	.4	.3
30-34	3.8	3.3	2.4	1.9	1.3	1.0	.8	.6	.4
35-39	4.6	4.0	3.1	2.7	1.9	1.6	1.3	1.0	.8
40-44	5.9	5.3	4.3	3.5	2.9	2.4	2.0	1.6	1.3
45-49	7.8	7.3	6.1	5.3	4.4	3.7	3.3	2.8	2.4
50-54	10.9	10.2	9.0	8.0	6.6	5.6	5.2	4.6	4.0
55-59	16.2	15.1	13.5	12.2	10.2	8.6	8.2	7.2	6.4
60-64	24.5	22.9	20.8	18.1	16.2	14.1	12.9	11.6	10.3
65-69	37.3	35.3	32.9	28.2	25.2	24.2	21.1	19.1	17.3
70-74	58.3	54.8	54.0	47.0	42.6	37.1	35.3	32.2	29.4
75-79	90.9	91.9	87.1	77.1	69.9	64.3	60.9	56.3	52.0
80-84	140.7	136.3	138.1	119.8	112.5	110.1	99.6	93.2	87.1
85 and Over	225.1	223.4	235.0	208.5	196.8	191.6	181.9	174.0	166.5

\* Apparent inconsistencies and irregularities were adjusted.

recent health progress and probably will experience the greatest relative reductions in mortality by 1970. Comparatively small declines will occur among the aged.

Table 3. Death rates by age for nonwhite males and females, United States 1930-55, and projected rates for 1960, 1965, and 1970.

Age	YEAR								
	1930	1935	1940	1945	1950	1955	1960	1965	1970
NONWHITE MALES									
Under 1	108.7	91.6	82.2	63.2	48.9	57.0	41.6	35.5	30.4
1-4	10.0	7.1	5.3	3.5	2.7	2.1	1.4	1.1	.8
5-9	2.7	2.1	1.6	1.3	1.0	.7	.6	.5	.4
10-14	2.6	2.3	1.7	1.3	1.0	.8	.6	.5	.4
15-19	6.0	4.6	3.7	3.1	2.2	1.6	1.4	1.1	.9
20-24	9.7	7.8	6.5	6.1	3.7	3.0	2.5	2.0	1.6
25-29	11.0	9.6	7.7	6.4	4.3	3.7	2.9	2.3	1.8
30-34	13.5	11.3	9.4	8.1	5.7	4.3	3.6	2.9	2.3
35-39	14.9	14.5	11.2	9.1	7.0	6.3	5.0	4.1	3.4
40-44	19.7	17.9	15.4	12.7	10.4	8.8	7.6	6.4	5.4
45-49	23.4	21.5	20.5	17.4	14.6	12.6	11.9	10.6	9.4
50-54	29.8	28.0	29.4	25.0	23.4	19.3	21.1	19.9	18.7
55-59	36.7	33.6	34.3	30.2	31.4	27.3	27.7	26.5	25.3
60-64	45.3	43.8	40.8	34.9	39.2	38.3	35.6	34.4	33.2
65-69	59.3	49.3	58.0	45.8	54.1	56.7	50.0	49.6	49.2
70-74	80.2	67.2	70.2	59.4	63.7	66.6	55.8	53.3	51.0
75-79	101.7	92.2	98.5	79.8	82.9	71.7	71.7*	69.7*	66.3*
80-84	147.8	129.3	130.8	88.9	106.0	99.3	91.1*	86.6*	82.4*
85 and Over	228.5	192.8	199.7	165.1	160.2	103.3	103.3*	98.0*	92.8*
NONWHITE FEMALES									
Under 1	90.9	74.6	65.2	50.8	39.9	45.6	32.9	27.9	23.6
1-4	8.7	6.3	4.4	3.0	2.3	1.8	1.2	.9	.7
5-9	2.4	1.8	1.3	1.1	.8	.6	.5	.4	.3
10-14	2.7	2.1	1.5	1.1	.7	.5	.4	.3	.2
15-19	7.1	4.8	4.3	2.7	1.8	.9	.8	.6	.4
20-24	9.3	7.2	5.8	4.4	2.5	1.7	1.4	1.0	.7
25-29	10.4	8.3	6.7	4.7	3.3	2.3	1.8	1.3	1.0
30-34	11.9	9.9	8.2	6.4	4.6	3.3	2.7	2.1	1.6
35-39	13.4	11.3	9.8	7.8	6.1	5.0	4.1	3.4	2.8
40-44	17.7	15.1	14.2	11.5	9.2	6.7	6.5	5.4	4.5
45-49	21.4	18.0	17.6	14.4	12.5	10.1	9.7	8.5	7.5
50-54	30.2	26.4	25.6	20.8	19.4	15.6	15.3	13.6	12.1
55-59	38.5	33.6	30.7	26.0	24.0	21.0	18.5	16.5	14.6
60-64	45.1	41.2	36.4	30.8	32.4	28.5	26.0	23.8	21.7
65-69	54.4	43.1	48.0	38.3	42.4	44.1	37.6	36.1	34.7
70-74	68.4	58.3	58.7	47.0	51.6	50.4	46.9*	44.9*	42.8*
75-79	81.7	74.2	76.8	63.1	64.8	56.0	52.1*	49.9*	47.6*
80-84	107.3	90.3	98.2	72.9	81.7	79.9	74.4*	71.1*	67.9*
85 and Over	187.2	160.4	159.7	124.1	133.7	90.8	84.5*	80.8*	77.1*

\* Apparent erratic fluctuations were adjusted.

Also, females have profited to a greater extent than males from mortality reduction in the advanced ages. These sex differences will widen even more by 1970, as in both races aged females will experience proportionately greater reductions in death rates than will males.

In general, the proportionate declines in the death rates of young persons of both races and sexes will be approximately equal. However, in the productive and advanced ages, the death rates of nonwhite males are likely to fall relatively more than those for white males. In contrast, mortality rates will decline more rapidly for white than for nonwhite females in these age groups.

PROJECTED CHANGES IN LIFE EXPECTANCY

Hypothetical abridged life tables were prepared by sex and race for the United States population, using 1960, 1965, and 1970 projected age-specific death rates in each case. The separation factors (f) for the population under 1 year of age were computed by the following formulas:<sup>5</sup>

$$L_0 = fl_0 + (1 - f)l_1, \text{ where} \tag{3}$$

$$f = \frac{L_0 - l_1}{l_0 - l_1} \tag{4}$$

Greville's method of abridged life table construction was employed.<sup>6</sup>

<sup>5</sup> The separation factors (f) for United States race-sex groups age 0-1 were projected to 1970, by the least squares method by fitting a straight line to 1929-1931, 1939-1941, and 1949-1951 f's from United States life tables. For nonwhite males and females, the f's from the 1929-1931 United States Negro life tables were used. The projected f's for the four population groups, by years, are as follows:

	1960	1965	1970
White Males	.07254	.05077	.02900
White Females	.09039	.07016	.04993
Nonwhite Males	.11525	.09346	.07168
Nonwhite Females	.12683	.10646	.08610

<sup>6</sup> Greville, T. N. E.: Short Methods of Constructing Abridged Life Tables. *The Record of the American Institute of Actuaries*, June, 1943, XXXII, Part One, No. 65, pp. 29-42; and Dublin, Louis I.; Lotka, A. J.; and Spiegelman, Mortimer: LENGTH OF LIFE. New York, The Ronald Press Company, Revised Edition, 1949, pp. 312-16.

Continued expansions of medical knowledge and widespread application of sanitation practices will, of course, swell the numbers surviving at various ages throughout the life span. These anticipated gains between 1955 and 1970 are shown in the increasing numbers living at the beginning of each age interval, *lx* values in actuarial notation, and are taken from 1955 life tables and hypothetical 1970 life tables (Table 4). For instance, notable increases in the number of persons out of every cohort attaining age 1 will occur between 1955 and 1970. According to these figures, the number of white male infant deaths out of each cohort of 100,000 born will decline from 2,675 in 1955 to 1,882 in 1970. The corresponding 1955 and 1970 infant deaths are 2,037 and 1,272 for white females; 4,722 and 2,995 for nonwhite males; and 3,886 and 2,333 for nonwhite females.

The increased chances of survival will prolong lives, aug-

Table 4. Number surviving to specified ages out of 100,000 born alive, by color and sex, United States, 1955\* and 1970.

AGE	WHITE MALE		WHITE FEMALE		NONWHITE MALE		NONWHITE FEMALE	
	1955	1970	1955	1970	1955	1970	1955	1970
0	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
1	97,325	98,118	97,963	98,728	95,278	97,005	96,114	97,667
5	96,906	97,961	97,614	98,610	94,506	96,695	95,423	97,394
10	96,641	97,814	97,429	98,511	94,171	96,502	95,153	97,248
15	96,360	97,667	97,271	98,413	93,790	96,309	94,907	97,151
20	95,743	97,277	97,013	98,314	93,046	95,877	94,485	96,957
25	94,891	96,695	96,703	98,216	91,649	95,112	93,698	96,618
30	94,134	96,261	96,342	98,069	89,957	94,260	92,645	96,136
35	93,307	95,781	95,860	97,873	88,059	93,182	91,136	95,370
40	92,092	95,018	95,113	97,482	85,237	91,610	88,805	94,043
45	90,183	93,649	93,969	96,850	81,601	89,167	85,960	91,949
50	87,044	91,060	92,235	95,695	76,482	85,066	81,624	88,560
55	82,188	86,481	89,662	93,798	69,483	77,448	75,528	83,350
60	75,276	79,532	85,854	90,841	60,612	68,204	67,948	77,466
65	65,704	70,039	79,982	86,272	50,005	57,711	58,944	69,470
70	53,375	58,312	70,755	79,101	37,511	45,022	46,975	58,338
75	39,735	45,098	58,621	68,232	26,768	34,802	36,562	47,018
80	25,372	30,544	42,257	52,475	18,632	24,878	27,562	36,980
85 and Over	12,717	17,214	24,005	33,700	11,237	16,370	18,409	26,218

\* SOURCE: United States Department of Health, Education, and Welfare, Public Health Service, National Office of Vital Statistics; Abridged Life Tables: United States, 1955, Vital Statistics—Special Reports, National Summaries, July 2, 1957, 46, No. 9.

menting the number of persons living to working age and add to the growing number of persons reaching age 65 and over. Over 70,000 white males and 86,000 white females out of every 100,000 born in 1970, assuming they are subject throughout life to projected mortality rates for that year, can expect to attain age 65, compared to 65,700 white males and 80,000 white females in 1955.

At birth, the life expectancy, or  $e_x$  values in actuarial notation, implied in United States age-specific mortality projections, as compared to 1949-1951 and 1955 experience, is as follows:

	1949-1951	1955	1960	1965	1970
White Males	66.3	67.3	68.5	69.4	70.3
White Females	72.0	73.6	75.1	76.5	77.8
Nonwhite Males	58.9	61.2	63.3	65.1	66.8
Nonwhite Females	62.7	65.9	68.6	70.8	72.8

Because life expectancy, from birth onward, increases more rapidly for females than for males, these differentials will be even greater in 1970 than at present. In 1955, the average life expectancy at birth was 6.3 years greater for white females than for white males, and by 1970 it will be 7.5 years greater. For nonwhites, it was 4.7 years greater for females than for males in 1955, and by 1970 it will be 6.0 years greater. This marked trend will augment the growing excess of females over males at older ages. Also, it increases the probability that wives will outlive their husbands, further enlarging the proportions of widowed females in this country and lengthening the period of widowhood of women bereft of their husbands.

According to these projections, one may anticipate gains in human longevity of 3.0 years for white males, 4.2 years among white females, 5.6 years for nonwhite males, and 6.9 years among nonwhite females between 1955 and 1970. Therefore, the above projections indicate a relatively greater increase in the life expectancy at birth for nonwhites than for whites, and a greater improvement for females than for males.

The proportionate increases in life expectation between 1955



and 1970 are most pronounced in infancy and childhood, diminishing as age increases (Table 5). For example, white males born in 1970 may expect to live three full years longer than those born in 1955, whereas white males reaching age 80 in 1970 may expect only .7 of a year more life than those of the same age in 1955.

At 70 years of age and over, nonwhites of both sexes live longer than whites. (It is very likely that errors in basic vital statistics account for part of this variation.) By 1970, nonwhites have prospects of greater increases in life expectancy than whites of these same ages.

Coincident with the anticipated reductions in mortality during the 15-year period, the chances of survival from birth to the productive ages will increase markedly. Also, substantially more of those in the working ages in 1970 can look forward to surviving until retirement. For example, a white male worker

Table 5. Average remaining lifetime in years at specified ages, by color and sex, United States, 1955\* and 1970.

AGE	WHITE MALE		WHITE FEMALE		NONWHITE MALE		NONWHITE FEMALE	
	1955	1970	1955	1970	1955	1970	1955	1970
0	67.3	70.3	73.6	77.8	61.2	66.8	65.9	72.8
1	68.2	70.6	74.2	77.8	63.2	67.8	67.5	73.5
5	64.5	66.7	70.4	73.9	59.7	64.0	64.0	69.7
10	59.6	61.8	65.6	69.0	54.9	59.2	59.2	64.8
15	54.8	56.9	60.7	64.1	50.1	54.3	54.3	59.9
20	50.1	52.2	55.8	59.1	45.5	49.5	49.6	55.0
25	45.6	47.4	51.0	54.2	41.2	44.9	45.0	50.2
30	40.9	42.6	46.2	49.3	36.9	40.3	40.5	45.4
35	36.3	37.9	41.4	44.4	32.6	35.7	36.1	40.8
40	31.7	33.1	36.7	39.5	28.6	31.3	32.0	36.3
45	27.3	28.6	32.1	34.8	24.8	27.1	27.9	32.1
50	23.2	24.3	27.7	30.1	21.3	23.2	24.3	28.2
55	19.4	20.5	23.4	25.7	18.1	20.3	21.0	24.8
60	16.0	17.0	19.3	21.5	15.4	17.6	18.1	21.5
65	12.9	14.0	15.5	17.4	13.2	15.4	15.5	18.6
70	10.3	11.2	12.2	13.8	11.7	14.0	13.8	16.7
75	8.0	8.8	9.2	10.6	10.4	12.3	12.0	15.1
80	6.1	6.8	6.7	8.0	8.9	11.2	10.1	13.5
85 and Over	4.8	5.0	5.0	6.0	8.2	10.8	8.9	13.0

\* SOURCE: United States Department of Health, Education, and Welfare, Public Health Service, National Office of Vital Statistics: Abridged Life Tables: United States, 1955, Vital Statistics—Special Reports, National Summaries, July 2, 1957, 46, No. 9.

who retired in 1955 at age 65 could expect to celebrate his 77th birthday, living almost to his 78th birth date. By 1970, one who retires at the same age can expect to reach his 79th birthday, living 1.1 years longer than in 1955. Correspondingly, a woman at age 65 in 1970 is likely to live nearly two years longer than one of the same age in 1955.

Moreover, the extension of average life expectancy, accompanied by a pronounced earlier withdrawal of older workers from the labor force, will protract the period of retirement, thereby accentuating existing gerontological problems. Wolfbein estimates that the average number of years spent by men in retirement has more than doubled since 1900, and current trends indicate a tripling of this figure by the year 2000.<sup>7</sup> For example, in the United States in 1900, a male worker 20 years of age could look forward to living 42.2 additional years, spending 39.4 years working and 2.8 years in retirement. By 1955, a male worker of the same age could expect to live 49.5 years, having a working life expectancy of 43.0 years and a period of retirement of 6.5 years.

#### SUMMARY

Age-specific death rates for the four United States race-sex population groups were projected to 1960, 1965, and 1970 by exponential curves using the least squares method. Straight line and parabolic fits were obtained for the natural logarithms of 1930–1954 age-specific mortality rates versus years coded with 1930 as zero. Then, 1960, 1965, and 1970 hypothetical abridged life tables were constructed to establish  $l_x$ ,  $dx$ ,  $e_x$ , and other life table values.

This paper has shown that:

*First*, the reductions in death rates during 1955–1970 will be much greater, proportionately, in infancy and early childhood than in the adult and advanced ages.

*Second*, at middle age and over, females will experience

<sup>7</sup> Wolfbein, Seymour L.: "The Length of Working Life." Mimeographed paper presented at the Fourth International Gerontological Congress, Merano, Italy, July, 1957, p. 5.

relatively greater reductions in mortality than males. This further will enlarge the excess of females over males, reduce the sex ratios in these age groups, increase the number of widows, and extend the duration of widowhood.

*Third*, diminished mortality will increase the chances of infants living to successive ages. This will augment the number reaching productive ages. Also, by 1970, over 70,000 white males out of each cohort of 100,000 born, as compared to 66,000 in 1955, can expect to attain age 65. The extension of average life expectancy will increase the number of persons aged 65 and over, further enlarging the number receiving Social Security retirement benefits. Accordingly this will lengthen the period workers spend in retirement, greatly intensifying problems associated with geriatrics.

*Fourth*, projected increases in longevity between 1955 and 1970, range from 3.0 years for white males to 6.9 years for nonwhite females. Nonwhites will experience a relatively greater increase than whites, while females will have proportionately greater gains than males.

*Fifth*, the rises in life expectancy between 1955-1970 will become progressively smaller as age increases. At ages 70 and over, the relative gains for nonwhites will surpass those for the whites.

These projections may seem optimistic, especially after the temporary 1957 reversal in the death rates concomitant with the widespread prevalence of Asian influenza and other respiratory infections.<sup>8</sup> Nevertheless, numerous factors and trends indicate further reductions in mortality. Apparently, a gradual and progressive diminution of death rates will continue for infants and young adults. On the other hand, the greatest possible mortality reductions lie among aged populations, especially males.

<sup>8</sup> The national "low mortality" estimates prepared by the Division of the Actuary of the Social Security Administration for the year 2000 yield an expectation of life at birth of 73.97 years for males and 78.87 years for females. Greville, T. N. E.: ILLUSTRATIVE UNITED STATES POPULATION PROJECTIONS. United States Department of Health, Education, and Welfare, Social Security Administration, Division of the Actuary, Actuarial Study No. 46, May, 1957, Table 5.

Appreciable reductions among the aged may occur, but they await the conquering of such degenerative diseases as those of the circulatory system, the respiratory system, and of the other vital organs, including the numerous forms of malignancy and other causes of death concentrated in old age. It seems likely that new advances and discoveries will arrest somewhat the high death rates of the aged. Nevertheless, it is quite improbable that the second half of this century can duplicate the accomplishments of the first half in increasing the average length of life. After all, the real accomplishment in mortality reduction is merely the postponement of death to later ages.

Health progress will continue, but its rapidity is unpredictable. Inasmuch as one cannot predetermine future age-specific death rates precisely, these forecasts are projections rather than predictions. Some degree of uncertainty attends any type of extrapolation, and the further one extends it, the greater the uncertainty becomes.