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## MORTALITY TRENDS IN THE UNITED STATES, 1900-60

By Robert J. Myers  
Division of the Actuary

One of the most important elements in any actuarial analysis of the Old-Age, Survivors, and Disability Insurance system is the future trend of mortality. It is a quite common belief that the growth in the population aged 65 and over in the United States (both in absolute numbers and relative to the total population) has resulted from past improvements in mortality. It is true that this is a very important cause, but also of great significance in this respect is the changing age structure of the population resulting from past birth trend and immigration results. Nonetheless, for this reason (and for others as well) it is worthwhile to consider past trends in mortality in the United States as indicated by the series of official life tables.

One serious limitation in the life tables is that not until 1930 were all States reporting sufficiently adequately to be included in the Death Registration Area. Thus, the earlier life tables are not based on the entire United States, and accordingly any time-series consideration is possibly subject to some bias because of the non-homogeneous nature of the data. This point should be kept in mind in considering the following analysis.

Life tables have been prepared that center around the census date beginning with 1900. The complete official tables are not yet available for the 1960 period, but an abridged table has been prepared for 1960 that should give reasonably reliable and comparable results. The 1900-02 and 1909-11 tables were for an area that included only 11 States, which were all in the north-eastern section of the country (the 6 New England States, District of Columbia, Indiana, Michigan, New Jersey, and New York). Accordingly, for these two early tables there are insufficient data to present meaningful results for nonwhite persons. The 1919-21 table is based on a much more complete registration area, which included all but 14 States, mostly southern and western ones (Alabama, Arizona, Arkansas, Georgia, Idaho, Iowa, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, West Virginia, and

Wyoming). The life tables for 1929-31 and subsequent years are based on all States, with the 1960 tables including Alaska and Hawaii. Tables for each sex were prepared separately for white and nonwhite persons in all years, but tables for total persons were first developed beginning with 1939-41.

Table 1 shows the expectations of life for the various tables separately by sex and race for three selected ages--0, 20, and 65. The figure for age 0 is commonly used as indicating the life expectancy of a new-born baby, although actually it is only what this figure would be if mortality conditions of the particular period prevailed during the next century; in actual practice--with the mortality improvements that have occurred--the life expectancy of a baby born in a particular period (which is, of course, an average figure and not applicable equally to all persons) will undoubtedly be higher than the figures shown for the life table of that period.

The expectation of life at birth for white males rose from about 48 years at the turn of the century to somewhat more than 67 years currently, while for white females the corresponding rise was from 51 years to 74 years. Thus, there was a 40% increase for white males and a 45% increase for white females (see Table 2), which resulted in an increase in the favorable differential that women have over men. Most of this increase occurred before 1940, since thereafter the rise has been only 7% for white males and 10% for white females. In fact, the recent improvement occurred to a greater extent in the first half of the last 20 years than in the second half, since the increase in expectation of life at birth in the 1950's was only 2% for white males and 3% for white females.

The expectation of life at birth for nonwhite persons is significantly lower than for white persons although the differential has been decreasing with time. Thus, in 1919-21 the white versus nonwhite differential for males was 9.2 years, whereas cur-

rently it is 6.3 years; the corresponding figures for females are 11.6 years and 7.8 years, respectively.

The expectation of life at age 20 also increased significantly over the first 60 years of this century although the relative increase has been only about half as large as that at age 0. This results from the fact that a very significant part of the increase in the expectation of life at birth has come from drastic improvements in mortality at the childhood ages, especially in infant mortality (as will be shown later). Just as in the case of life expectancy at birth, so too at age 20 is the expectation of life for white persons significantly higher than for nonwhite persons, although the differential has been narrowed over the years.

The expectation of life at age 65 increased gradually over the last 60 years. For white males the increase has been at a somewhat lower rate than for the life expectancy at age 20, but for white females the two figures have increased at about the same rate. Thus, over the 60-year period the expectation of life at age 65 has increased for white males from 11.5 years to 12.9 years (or a rise of 1.4 years), whereas for white females the corresponding figures are 12.2 years and 15.9 years (or a rise of 3.7 years, which is about  $2\frac{1}{2}$  times as large as the increase for white males.

The expectation of life at age 65 increased more or less steadily from one period to the next for white females, but this has not been the case for white males, although since 1929-31 a gradual increase has occurred each period. Unlike the situation at the younger ages, the expectation of life at age 65 for nonwhite persons has not been significantly lower than for white persons. In fact for 1939-41 and subsequently, the expectancy for nonwhite males aged 65 has been substantially the same as for white males, while for nonwhite females the recent experience has shown about a  $\frac{1}{2}$  year unfavorable differential for the nonwhites.

Many demographers believe that the relatively high expectations of life shown for nonwhite persons at ages 65 and over are the result of reporting errors. For example, if both ages at death and ages in the census are over-stated, the resulting age-specific mortality rates will be under-stated and the expectations of life will be too high. On the other hand, some demographers believe that population groups with relatively high mortality at the younger ages may well show relatively low mortality at the

older ages--under the theory that those who do survive through the periods of high mortality will be hearty, long-lived individuals.

Somewhat more insight on mortality trends may be obtained by considering age-specific mortality rates. In fact, in many ways such analysis is more significant than using expectations of life because the latter are global averages that tend to hide internal trends and differentials. Table 3 shows age-specific mortality rates for white persons for 1900-02, 1939-41, and 1960 and for total persons and nonwhite persons for 1939-41 and 1960. Similarly, Table 4 shows the relative decreases in these rates from 1900-02 to 1960 for white persons and from 1939-41 to 1960 separately for white persons, nonwhite persons, and total persons.

First, considering the 60-year period, mortality rates for white persons at ages 30 and under have decreased by the phenomenal amounts of 80 to 90% generally (for both males and females). In fact, at age 1 the decrease has been as high as 95%, or, in other words, current mortality rates are only  $1/20$  of what they were at the turn of the century. For ages beyond 30, there have also been large declines--significantly larger for women than for men. These decreases have been roughly 35% at age 50 and 20% at ages 60 and over for men, while for women, mortality rates were more than cut in half up to age 60, and even at age 80 there was a decline of about  $1/3$ .

In the last 20 years, mortality has continued to decrease. For both white and nonwhite persons, the decline has generally been more than 50% in the early childhood ages, while for white females and both nonwhite males and females there has been improvement of this magnitude extending even up through age 40. At ages 60 and beyond, the mortality rates for white females have declined by about  $1/3$ , but for the other three categories, the corresponding decreases have been much smaller--generally in the order of 10 to 20%.

In summary, this Actuarial Note has shown the very considerable and significant declines in mortality that have occurred in the past 60 years, although the decreases have been small in recent years. This trend has not yet by any means been halted, although the decreases in mortality seem to be occurring at a diminishing rate. The more favorable mortality for women as against men seems to be showing a continuing widening margin. On the other hand, the differential in mortality between

white persons and nonwhite persons is gradually being reduced. As mortality improves in the future, it is unlikely that there will be such large gains in the expectations of life at birth as there have in the past. Very little increase therein can come

from declining mortality at the younger ages (which is the primary cause for the great increase in life expectancy at birth in the past) since such age-specific mortality is already so low and therefore cannot decrease much further (in absolute terms).

Table 1  
EXPECTATIONS OF LIFE ACCORDING TO VARIOUS UNITED STATES POPULATION LIFE TABLES

Age	1900-02	1909-11	1919-21	1929-31	1939-41	1949-51	1960
White Males							
0	48.2	50.2	56.3	59.1	62.8	66.3	67.4
20	42.2	42.7	45.6	46.0	47.8	49.5	50.1
65	11.5	11.2	12.2	11.8	12.1	12.7	12.9
White Females							
0	51.1	53.6	58.5	62.7	67.3	72.0	74.1
20	43.8	44.9	46.5	48.5	51.4	54.6	56.2
65	12.2	12.0	12.7	12.8	13.6	15.0	15.9
Nonwhite Males							
0	*	*	47.1	47.5	52.3	58.9	61.1
20	*	*	38.4	35.9	39.5	43.7	45.5
65	*	*	12.1	10.9	12.2	12.7	12.7
Nonwhite Females							
0	*	*	46.9	49.5	55.6	62.7	66.3
20	*	*	37.2	37.2	42.0	46.8	49.9
65	*	*	12.4	12.2	13.9	14.5	15.2
Total Males							
0	*	*	*	*	61.6	65.5	66.6
20	*	*	*	*	46.9	48.9	49.6
65	*	*	*	*	12.1	12.7	12.8
Total Females							
0	*	*	*	*	65.9	71.0	73.1
20	*	*	*	*	50.4	53.7	55.5
65	*	*	*	*	13.6	14.9	15.8

\*No table for total persons prepared for this period. Table for nonwhite persons based on insufficient data to be meaningful.

Table 2  
RELATIVE INCREASE IN EXPECTATION OF LIFE FROM 1900-02 TO 1960, FROM 1939-41 TO 1960,  
AND FROM 1949-51 TO 1960, UNITED STATES POPULATION LIFE TABLES

Age	Increase, 1960 vs. 1900-02		Increase, 1960 vs. 1939-41		Increase, 1960 vs. 1949-51	
	Males	Females	Males	Females	Males	Females
White Persons						
0	40%	45%	7%	10%	2%	3%
20	19	28	5	9	1	3
65	12	30	7	17	2	6
Nonwhite Persons						
0	*	*	17%	19%	4%	6%
20	*	*	15	19	4	7
65	*	*	4	9	0	5
Total Persons						
0	*	*	8%	11%	2%	3%
20	*	*	6	10	1	3
65	*	*	6	16	1	6

\*No table for total persons prepared for 1900-02. Table for nonwhite persons based on insufficient data to be meaningful.

Table 3

AGE-SPECIFIC MORTALITY RATES ACCORDING TO  
VARIOUS UNITED STATES POPULATION LIFE TABLES  
(Rates per thousand)

Age	White Males			White Females		
	1900-02	1939-41	1960	1900-02	1939-41	1960
0	133.5	48.1	26.0	110.6	37.9	19.6
1	34.5	4.9	1.6	31.2	4.3	1.4
10	2.7	1.0	.4	2.5	.7	.3
20	5.9	2.1	1.6	5.5	1.5	.6
30	8.0	2.8	1.6	7.7	2.2	.8
40	10.6	5.1	3.3	9.3	3.7	2.0
50	15.4	11.6	9.7	13.4	7.6	4.7
60	28.6	25.5	23.0	25.1	17.1	11.1
70	58.9	54.5	49.9	53.7	42.3	28.8
80	133.5	124.7	107.3	121.2	108.2	81.0

  

Age	Nonwhite Males		Nonwhite Females		Total Males		Total Females	
	1939-41	1960	1939-41	1960	1939-41	1960	1939-41	1960
0	82.3	48.0	65.8	38.6	52.4	29.4	41.5	22.6
1	9.4	3.7	8.0	3.0	5.5	1.9	4.9	1.6
10	1.4	.6	1.0	.4	1.1	.4	.8	.3
20	5.4	2.3	5.3	1.1	2.5	1.7	1.9	.6
30	8.7	3.8	7.3	2.6	3.4	1.8	2.8	1.1
40	13.6	7.5	11.8	5.6	6.0	3.8	4.5	2.4
50	25.4	16.4	21.9	12.0	12.6	10.6	8.8	5.5
60	39.1	33.6	34.7	25.7	26.5	23.9	18.4	12.3
70	58.0	58.5	49.1	41.2	54.8	50.6	42.7	29.7
80	107.3	87.5	81.3	69.6	123.9	105.8	106.9	80.3

Table 4

RELATIVE DECREASE IN AGE-SPECIFIC MORTALITY RATES FROM  
1900-02 TO 1960 AND FROM 1939-41 TO 1960,  
UNITED STATES POPULATION LIFE TABLES

Age	Decrease, 1960 vs. 1900-02		Decrease, 1960 vs. 1939-41	
	Males	Females	Males	Females
White Persons				
0	81%	82%	46%	48%
1	95	96	67	67
10	85	88	60	57
20	73	89	24	60
30	80	90	43	64
40	69	78	35	46
50	37	65	16	38
60	20	56	10	35
70	15	46	8	32
80	20	33	14	25
Decrease, 1960 vs. 1939-41				
Nonwhite Persons			Total Persons	
0	42%	41%	44%	46%
1	61	63	65	67
10	53	60	64	63
20	57	79	32	68
30	56	64	47	61
40	45	53	37	47
50	35	45	16	38
60	14	26	10	33
70	-1	16	8	30
80	18	14	15	25