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UNITED STATES LIFE TABLES FOR 1959-61

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OFFICIAL population life tables for the United States have been prepared for each decennial census beginning with 1900, based on the population enumerated by the census and on registered deaths during three consecutive years. These decennial life tables have been in the traditional complete life-table form, showing values by single years of age for various race-sex categories. At different times supplementary life tables have been prepared for geographic regions. Life tables were also prepared in connection with the 1850 to 1890 censuses, on the basis of population and death data obtained from the enumeration, but were usually only for a few states and cities. Beginning in 1945, a series of abridged life tables has been developed for each calendar year. Before that time, population life tables for intercensal periods had been prepared by the Metropolitan Life Insurance Company. These abridged life tables are of two forms: (1) provisional ones (beginning with 1958) for only the total population, based on a 10 per cent sample of death certificates, and (2) final ones for various race-sex categories, based on a complete count of all reported deaths. The latest such final abridged life tables relate to 1962.¹ These abridged tables are necessarily based upon postcensal estimates of population.

The complete population life tables for 1959-61 for the United States as a whole have now been released.² These consist of nine separate tables—for total persons, white persons, and nonwhite persons, by sex and also for both sexes combined.³ In addition, certain actuarial functions

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¹ "Life Tables," *Vital Statistics of the United States, 1962*, Vol. II, Sec. 5 (National Vital Statistics Division, National Center for Health Statistics, Public Health Service, U.S. Department of Health, Education, and Welfare).

² "Life Tables for 1959-61," Vol. I, No. 1 (National Center for Health Statistics, Public Health Service, U.S. Department of Health, Education, and Welfare).

³ Although there may be some question from a technical standpoint as to the significance and usefulness of life tables for males and females combined, requests from the general public are often received for this type of information. In the near future, other life tables are to be released including those for geographic divisions, by sex and race, and those for states, by sex and race. Tables for nonwhites may not be published for some states due to the small size of their population.

for the national life tables will be published, namely, D , N , M , and a ; for white males and white females, these values will be given for interest rates from $2\frac{1}{2}$ to $4\frac{1}{2}$ per cent by $\frac{1}{2}$ per cent intervals, while for total males and females and for nonwhite males and females, the values will be available at $2\frac{1}{2}$, $3\frac{1}{2}$, and $4\frac{1}{2}$ per cent interest. In addition, values at interest rates from $2\frac{1}{2}$ to 6 per cent by $\frac{1}{2}$ per cent intervals for these race-sex categories will be available, on request, from the authors.

In recent years, it has been the practice to accompany both the complete and the abridged life tables with a comprehensive exposition of the method used in their preparation. Such an account will also be available for the 1959-61 life tables. These tables have been prepared as a joint project of the Division of Health Records Statistics, National Center for Health Statistics, Public Health Service, and the Division of the Actuary, Social Security Administration, both of which are in the United States Department of Health, Education, and Welfare. The latter Division was primarily responsible for developing the methodology, while the former was responsible for assembling and processing the data. The staff members who bore the principal direct responsibility were Dr. Monroe G. Sirken, of the Division of Health Records Statistics, Zenas M. Sykes, FCAS, and Francisco Bayo, of the Division of the Actuary. In addition, valuable assistance was given to the project by an advisory committee consisting of Dr. Thomas N. E. Greville; Alton P. Morton; Robert J. Myers; Mortimer Spiegelman; Dr. George J. Stolnitz, Professor of Economics, Indiana University; and Dr. Conrad Taeuber, Assistant Director (Demographic Fields), Bureau of the Census.

This paper will first sketch briefly the methodology involved in the preparation of the national life tables for 1959-61. Then an analysis will be made of past mortality trends and current mortality differentials by age, sex, and race.

METHODOLOGY FOR NATIONAL LIFE TABLES

As in previous decennial national life tables, the principal data involved are the registered deaths in the period of the three calendar years surrounding the census and the number of persons reported in the census. In addition, in order to obtain more reliable mortality rates at the youngest ages, data on births in the years surrounding and immediately preceding the census have been utilized.

In general, it is considered that, for all except extreme old age, the data are sufficiently accurate so that there is need for only a minimum of graduation. It was found necessary, however, to adjust the population data for nonwhite persons in their sixties because of apparent error in

age reporting and to improve the smoothness of the mortality rates, just as was also the case in the 1949-51 life tables. The data for the very oldest ages did not seem to be reliable; accordingly, as in the case of the 1949-51 life tables, the current life tables were closed off through the use of the mortality experience of Union Civil War pensioners.⁴

The graduation procedure used was selected so as to follow closely the actual experience throughout most of the age range. The experienced quinquennial central death rates were exactly duplicated by the graduation, which thus had the purpose only of interpolating smooth q 's by single years of age. The full details of the methods of adjusting the data and of graduating them will be contained in the technical report that will be issued in the near future.

ANALYSIS OF DATA

In comparing the current population life tables with those of previous years, there are certain elements of basic differences that should first be mentioned. The death registration area was not substantially completed until 1930, so that the life tables for earlier periods are based upon data for only part of the country. Although this might introduce an inconsistency in the trend, it is hardly of sufficient magnitude to mitigate the trend analysis.

Although, for some purposes, it might be desirable to make trend analyses by sex for all races combined, life tables for total persons were not prepared for all years before 1939-41. Also, there was a difference in the race classification over the years. Until 1939-41, the tables generally related only to whites and Negroes, while thereafter the classification was whites and nonwhites. For 1939-41 only, there were separate tables for whites, Negroes, and other races.⁵ In the analyses by race in this paper, the data for Negroes will be considered as relating to nonwhites; this will not produce any appreciable error, in comparison, since Negroes make up about 95 per cent of the total nonwhite population.

The comparison in Table 1 demonstrates the close agreement between the death rates in the decennial tables for 1959-61 and the average of the interpolated rates from the 1959, 1960, and 1961 abridged tables. The differences at the older ages are due primarily to the fact that the 1959 abridged tables were calculated on the basis of estimates for the

⁴ For a description of this experience, see Robert J. Myers and Louis O. Shudde, "Mortality Experience of Union Civil War Veterans," *TSA*, VII, 63.

⁵ For an index of the United States life tables that have been prepared, see "Guide to United States Life Tables, 1900-59" (Public Health Service, U.S. Department of Health, Education, and Welfare, PHS Publication No. 1086).

1959 populations prepared before the results of the 1960 census were available.

The exclusion of data for Hawaii from the 1959 abridged tables and the different methodologies used probably had a negligible effect on the rates.

Table 2 presents the death rates for the United States Life Tables for 1959-61 by race and sex, for certain selected ages. These are also shown in Chart I for individual ages from 1 to 80, plotted on semilogarithmic paper for ease in graphing and presentation. The well-known facts that

TABLE 1
COMPARISON OF DEATH RATES FOR THE UNITED STATES
DECENNIAL LIFE TABLES FOR 1959-61 WITH THE AVERAGE
OF THOSE FOR THE ABRIDGED TABLES FOR
1959, 1960, AND 1961

AGE	WHITE PERSONS		NONWHITE PERSONS	
	Males	Females	Males	Females
Absolute Excess of Rates for Decennial Life Tables over Averaged Rates for Abridged Life Tables (Rates per Thousand)				
0.....	0.00	0.00	-0.16	-0.15
1.....	0.00	0.01	-0.06	-0.03
10.....	0.05	-0.01	0.04	0.01
20.....	0.03	0.01	0.10	0.02
30.....	-0.01	0.00	0.02	-0.02
40.....	-0.01	-0.01	-0.08	0.03
50.....	0.04	0.05	-0.15	0.05
60.....	0.17	0.13	-0.99	-0.50
70.....	-1.64	-0.88	-5.48	-3.67
80.....	1.97	3.14	7.46	5.52
Relative Excess of Rates for Decennial Life Tables over Averaged Rates for Abridged Life Tables				
0.....	0	0	0	0
1.....	0	1%	-2%	-1%
10.....	14%	-3	7	3
20.....	2	2	4	2
30.....	-1	0	1	-1
40.....	-0	-1	-1	-1
50.....	0	1	-1	0
60.....	1	1	-3	-2
70.....	-3	-3	-9	-8
80.....	2	4	9	8

male mortality is consistently higher than female mortality and that nonwhite mortality is consistently higher than white mortality are obvious. As an interesting, although probably not too meaningful point, the curves of mortality rates for white males and for nonwhite females cross each other three times (the white male mortality being higher from ages 9 to 24 and at ages 63 and over). Both the white male and white female mortality curves are very smooth, but those for nonwhites show a certain amount of waviness, which may be due to digit preference or other forms of bias in the census data.

TABLE 2
DEATH RATES BY RACE AND SEX, UNITED STATES LIFE TABLES FOR 1959-61
(Rates per Thousand)

Age	Total Males	Total Females	White Males	White Females	Nonwhite Males	Nonwhite Females
0....	29.13	22.56	25.92	19.64	46.99	38.28
1....	1.81	1.58	1.53	1.35	3.37	2.89
5....	0.66	0.52	0.62	0.47	0.87	0.77
10....	0.44	0.30	0.42	0.28	0.60	0.40
15....	0.97	0.44	0.93	0.41	1.20	0.63
20....	1.69	0.64	1.59	0.56	2.36	1.16
25....	1.75	0.79	1.56	0.65	3.16	1.71
30....	1.81	1.06	1.56	0.85	3.89	2.56
35....	2.40	1.51	2.07	1.22	5.13	3.74
40....	3.73	2.30	3.32	1.90	7.49	5.61
45....	6.05	3.51	5.58	3.03	10.38	7.69
50....	10.14	5.41	9.55	4.73	15.65	11.67
55....	15.49	7.83	14.75	6.87	22.73	17.31
60....	23.50	12.09	22.71	10.88	31.37	24.59
65....	34.74	18.54	33.89	17.42	43.65	30.72
70....	49.36	29.29	48.71	28.36	56.90	40.66
75....	70.35	47.67	70.66	47.42	66.73	51.27
80....	105.98	81.44	107.32	82.13	88.36	70.60

A very interesting phenomenon that frequently appears in modern life tables for economically well-developed countries shows up in the mortality curve for white males; namely, a peak in the early twenties, followed by a trough in the late twenties, before the inevitable rise that occurs with advancing age. For all four mortality curves, the customary trough occurs at about age 10, following the sharp decline from the mortality rates at the infant and younger ages. The secondary peak and subsequent trough in the twenties for white males were also noticeable, although to a much lesser extent, in the 1949-51 tables (no such phenomenon occurs for the other three categories, although there is a sloping-off of the mortality curve in the twenties).

CHART I
MORTALITY RATES OF U.S. LIFE TABLES FOR 1959-61

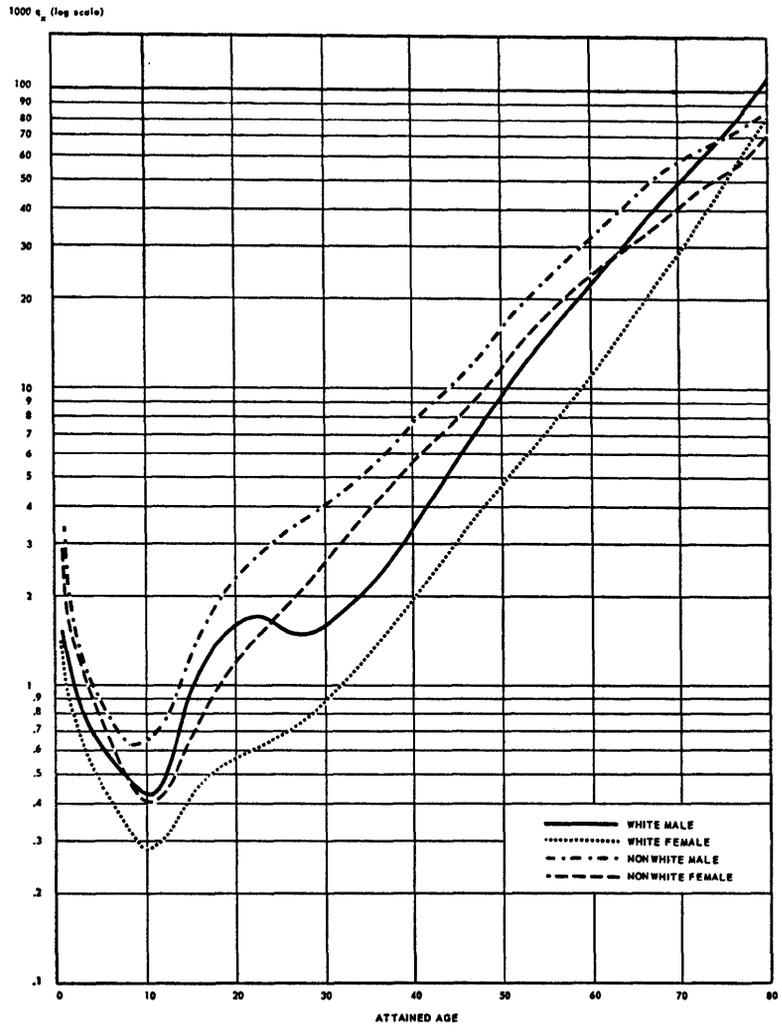


Table 3 presents the complete expectations of life by age for the United States Life Tables for 1959-61 for the several race-sex categories. The expectation of life at birth is 73.2 years for females, as against only 66.8 years for males. For a person at the retirement age of 65, the expectation of life is 15.8 years for females and 13.0 years for males.

Table 4 shows the death rates for white persons for various ages by sex for the earlier life tables as percentages of those for 1959-61. Similarly, Table 5 relates to nonwhite persons. The general and continuous improvement for all ages for each of the race-sex categories is evident.

TABLE 3
COMPLETE EXPECTATIONS OF LIFE BY RACE AND SEX,
UNITED STATES LIFE TABLES FOR 1959-61

Age	Total Males	Total Females	White Males	White Females	Nonwhite Males	Nonwhite Females
0....	66.80	73.24	67.55	74.19	61.48	66.47
1....	67.80	73.93	68.34	74.68	63.50	68.10
5....	64.10	70.21	64.61	70.92	59.98	64.54
10....	59.27	65.35	59.78	66.05	55.19	59.72
15....	54.43	60.45	54.93	61.15	50.39	54.85
20....	49.77	55.60	50.25	56.29	45.78	50.07
25....	45.19	50.79	45.65	51.45	41.38	45.40
30....	40.56	46.00	40.98	46.63	37.05	40.83
35....	35.94	41.27	36.31	41.84	32.81	36.41
40....	31.42	36.61	31.73	37.13	28.72	32.16
45....	27.09	32.09	27.34	32.53	24.89	28.14
50....	23.02	27.71	23.22	28.08	21.28	24.31
55....	19.32	23.53	19.45	23.81	18.11	20.89
60....	15.94	19.52	16.01	19.69	15.29	17.83
65....	12.95	15.80	12.97	15.88	12.84	15.12
70....	10.33	12.37	10.29	12.38	10.81	12.46
75....	7.99	9.33	7.92	9.28	8.93	10.10
80....	5.95	6.72	5.89	6.67	6.87	7.66

In all but a few cases the percentages decrease with time, the principal exceptions being for the middle and older ages between 1919-21 and 1929-31 and between 1900-1902 and 1909-11 (especially for nonwhites).

Mortality rates at the turn of the century were significantly higher than in the most recent period. The greatest improvement was shown for age 1, where the early mortality rates were almost twenty-five times as high as the recent ones. For infants and for older children and young adults, the mortality rates of the early 1900's were generally about five times (or more) those currently being experienced. For the older ages, the relative improvement has not been as large, although it has been significant. For both white males and nonwhite males aged 50-80, the mortality rates in the early 1900's were about 25-60 per cent higher

than those in 1959-61, while for nonwhite females the differential was 50-100 per cent, and for white females somewhat higher.

As between the two most recent sets of life tables, there has uniformly been an improvement in mortality. For both white and nonwhite males, the mortality rates of 1949-51 were generally about 10-30 per cent higher than in 1959-61 (even more of a differential for the youngest

TABLE 4
DEATH RATES FOR VARIOUS DECENNIAL LIFE TABLES AS PERCENTAGES OF THOSE FOR 1959-61 (WHITE PERSONS)

Age	1900-1902	1909-11	1919-21	1929-31	1939-41	1949-51
Males						
0....	515%	476%	310%	240%	186%	118%
1....	2,253	1,844	1,058	649	318	139
10....	652	567	502	350	238	143
20....	374	308	269	200	133	102
30....	512	423	367	265	179	117
40....	319	308	226	205	155	118
50....	161	163	123	134	121	106
60....	126	135	108	116	112	105
70....	121	128	112	119	112	103
80....	124	126	112	121	116	102
Females						
0....	563%	521%	325%	253%	193%	120%
1....	2,307	1,913	1,081	651	320	140
10....	879	736	639	404	250	143
20....	989	750	773	495	259	130
30....	908	709	709	440	259	135
40....	490	423	356	280	194	127
50....	283	266	226	203	161	119
60....	230	237	200	190	158	123
70....	189	200	177	172	149	120
80....	148	153	138	143	132	110

childhood ages, above infancy); however, there was relatively little decrease in mortality rates above age 50 for white males and above age 70 for nonwhite males. Female mortality showed even greater improvement in the decade. For white females, the 1949-51 mortality was about 30-40 per cent higher than it was in 1959-61 for ages 1-40 and about 20 per cent higher at most other ages. Nonwhite female mortality showed about the same relative trends as white female mortality, except that there was even greater improvement at some of the young adult ages.

Table 6 compares the percentage changes in the death rates from one decennial life table to the next for various ages for white males and females, while Table 7 gives similar data for nonwhites. Once again, the almost steady decrease in mortality rates for all categories is shown by the large proportion of the figures that indicate decreases. The 1929-31 mortality rates at the middle and older adult ages for white males and

TABLE 5
DEATH RATES FOR VARIOUS DECENNIAL LIFE TABLES AS PERCENTAGE FOR THOSE FOR 1959-61 (NONWHITE PERSONS)

Age	1900-1902	1909-11	1919-21	1929-31	1939-41	1949-51
Males						
0....	539%	467%	223%	186%	175%	108%
1....	2,294	1,983	756	492	278	138
10....	1,047	837	448	352	230	140
20....	504	507	460	364	231	133
30....	339	385	310	328	224	126
40....	221	281	195	242	182	117
50....	163	201	122	176	162	122
60....	140	162	101	132	125	117
70....	132	148	104	123	102	99
80....	159	149	129	147	121	103
Females						
0....	561%	483%	229%	188%	172%	107%
1....	2,430	2,036	797	497	275	134
10....	1,930	1,295	715	402	260	138
20....	982	926	999	760	459	196
30....	461	470	520	453	286	152
40....	277	312	274	290	211	137
50....	199	219	195	228	187	137
60....	161	185	152	172	141	120
70....	162	175	147	152	121	112
80....	152	170	146	139	115	104

for nonwhites generally show increases over those for 1919-21, which in turn show very sizable decreases over those for 1909-11. It is believed that this rather unusual trend resulted from the fact that the 1918 influenza epidemic removed, somewhat prematurely, a significant number of unhealthy lives who would otherwise have died in the next few years.

Table 8 presents data on the relative mortality differentials between women and men. Female mortality has always been lower than male mortality at the same age, with only a few exceptions, primarily for

nonwhites in 1919-21. The differential has been as much as 50 per cent in a number of instances.

In 1959-61, white female mortality rates were generally about 20-35 per cent lower than white male rates at the young childhood ages and about 50 per cent lower for the broad age span covering the older childhood ages up to about age 65; even at the oldest ages, the differential

TABLE 6

PERCENTAGE CHANGES IN DEATH RATES FOR GIVEN DECENNIAL LIFE TABLE AS COMPARED WITH IMMEDIATELY PRECEDING LIFE TABLE (WHITE PERSONS)

Age	1909-11	1919-21	1929-31	1939-41	1949-51	1959-61
	Males					
0.....	- 8%	-35%	-22%	-23%	-36%	-16%
1.....	-18	-43	-39	-51	-56	-28
10.....	-13	-11	-30	-32	-40	-30
20.....	-18	-13	-26	-33	-24	- 2
30.....	-17	-13	-28	-32	-35	-14
40.....	- 4	-27	- 9	-24	-24	-15
50.....	1	-24	9	-10	-12	- 6
60.....	8	-20	7	- 4	- 7	- 5
70.....	5	-12	6	- 6	- 8	- 3
80.....	2	-12	9	- 4	-12	- 2
	Females					
0.....	- 8%	-37%	-22%	-24%	-38%	-17%
1.....	-17	-44	-40	-51	-56	-29
10.....	-16	-13	-37	-38	-43	-30
20.....	-24	3	-36	-48	-50	-23
30.....	-22	0	-38	-41	-48	-26
40.....	-14	-16	-21	-31	-34	-21
50.....	- 6	-15	-10	-21	-26	-16
60.....	3	-16	- 5	-17	-22	-19
70.....	5	-11	- 3	-13	-19	-17
80.....	4	-10	4	- 8	-16	- 9

was as much as 25 per cent. Nonwhite females, too, had significantly lower mortality than nonwhite males, although generally the differentials were not so large as they were in the case of white persons; in the childhood ages, the differential ranged from 20 to 50 per cent, but thereafter, in most instances, it was only 20-25 per cent.

Over the years, the favorable mortality differential for women has been widening. Thus, for example, in 1900-1902, female mortality at almost all ages for all races was only about 5-15 per cent lower. In the

intervening years, the differential gradually and rather steadily increased, and there seems no reason to predict any reversal of this trend in the near future.

Table 9 compares mortality by race. In this connection it should be recognized that the nonwhite mortality data for the first three decennial

TABLE 7
PERCENTAGE CHANGES IN DEATH RATES FOR GIVEN DECENNIAL LIFE
TABLE AS COMPARED WITH IMMEDIATELY PRECEDING
LIFE TABLE (NONWHITE PERSONS)

Age	1909-11	1919-21	1929-31	1939-41	1949-51	1959-61
Males						
0.....	-13%	-52%	-17%	-6%	-38%	-8%
1.....	-14	-62	-35	-43	-50	-28
10.....	-20	-46	-22	-35	-39	-29
20.....	1	-9	-21	-37	-42	-25
30.....	14	-20	6	-32	-44	-21
40.....	27	-31	24	-25	-35	-15
50.....	23	-39	44	-8	-25	-18
60.....	15	-38	31	-6	-6	-15
70.....	11	-30	19	-17	-3	1
80.....	-7	-13	14	-17	-15	-3
Females						
0.....	-14%	-53%	-18%	-9%	-38%	-6%
1.....	-16	-61	-38	-45	-51	-26
10.....	-33	-45	-44	-35	-47	-27
20.....	-6	8	-24	-40	-57	-49
30.....	2	11	-13	-37	-47	-34
40.....	12	-12	6	-27	-35	-27
50.....	10	-11	17	-18	-27	-27
60.....	15	-18	13	-18	-15	-17
70.....	8	-16	4	-20	-7	-11
80.....	12	-14	-5	-17	-10	-4

life tables of this century are based upon data for only part of the country and, therefore, are not necessarily representative of the country as a whole. For 1959-61, nonwhite male mortality was significantly higher than white male mortality. The differential was as much as 100 per cent at the very youngest childhood ages and at ages 30 and 40, although about 50 per cent at the older childhood ages and in middle life. A significant reduction in the differential occurred for the older ages until at age 80 nonwhite mortality is shown to be almost 20 per cent lower than

white mortality. Similarly, current nonwhite female mortality tends to be significantly higher than white female mortality. In fact, the differentials are even larger than those for males—ranging from 100 to 200 per cent at most of the ages up to 60 but then gradually reducing until for age 80 nonwhite female mortality is shown to be about 15 per cent lower.

When mortality by race is examined over the entire sixty-year period,

TABLE 8
FEMALE DEATH RATES AS PERCENTAGES OF MALE DEATH RATES
FOR VARIOUS DECENNIAL LIFE TABLES

Age	1900-1902	1909-11	1919-21	1929-31	1939-41	1949-51	1959-61
White Persons							
0.....	83%	83%	80%	80%	79%	77%	76%
1.....	90	92	90	89	89	89	88
10.....	90	87	85	77	70	67	67
20.....	93	86	101	87	68	45	35
30.....	97	91	105	91	79	63	54
40.....	88	79	90	78	72	62	57
50.....	87	81	91	75	66	55	50
60.....	88	84	88	78	67	56	48
70.....	91	91	92	84	78	68	58
80.....	91	93	95	90	87	82	77
Nonwhite Persons							
0.....	85%	84%	83%	83%	80%	80%	81%
1.....	91	88	90	87	85	83	86
10.....	123	103	106	76	75	65	67
20.....	96	90	106	103	98	72	49
30.....	90	80	110	91	84	79	66
40.....	94	83	105	90	87	88	75
50.....	91	81	119	97	86	84	75
60.....	90	90	118	102	89	80	78
70.....	88	85	101	88	85	81	71
80.....	76	91	91	75	76	81	80

no definite trend in the differential is apparent. All race categories showed very significant improvements in mortality during the period so that, although the relative differences did not change greatly, the absolute differences were significantly decreased. For example, for males aged 1, nonwhite mortality was about two and a quarter times as high as white mortality in both 1900-1902 and 1959-61, but the absolute differences in the death rates were 42.84 and 1.84 per thousand, respectively. The same situation occurs when the differential ratios are ex-

amined for the life tables for the last two or three decades, that is, generally, no significant trend in the mortality differential by race. However, there seems to be some indication of a reduction in the differential at the young and middle adult ages.

Table 10 analyzes the increases in the expectation of life that have occurred over the sixty-year period by indicating, for each race-sex cate-

TABLE 9
NONWHITE DEATH RATES AS PERCENTAGES OF WHITE DEATH RATES
FOR VARIOUS DECENNIAL LIFE TABLES

Age	1900-1902	1909-11	1919-21	1929-31	1939-41	1949-51	1959-61
Males							
0.....	190%	178%	131%	140%	171%	166%	181%
1.....	224	237	157	167	192	220	220
10.....	229	211	127	144	138	140	143
20.....	200	245	254	270	257	194	148
30.....	165	227	210	309	313	270	249
40.....	156	206	195	267	265	225	226
50.....	166	202	163	215	220	189	164
60.....	154	165	129	157	153	154	138
70.....	128	135	108	121	106	112	117
80.....	105	97	95	100	86	83	82
Females							
0.....	194%	181%	137%	145%	174%	174%	195%
1.....	225	228	158	163	184	205	214
10.....	314	251	160	142	149	138	143
20.....	206	256	268	318	367	311	207
30.....	153	199	221	310	333	339	301
40.....	167	218	227	305	321	318	295
50.....	173	203	214	278	287	285	247
60.....	158	176	172	205	203	220	226
70.....	123	126	119	127	116	134	143
80.....	88	95	91	83	75	81	86

gory, for ages 0, 20, and 65, the excess of the value based on 1959-61 mortality over those shown in previous life tables. The expectation of life at birth has shown phenomenal increases since the turn of the century, ranging from 19.3 years for white males to 31.4 years for nonwhite females. Thus, although the mortality differential between the races has not especially narrowed during this period, the effect of the great decline in mortality rates for all categories has been to produce a larger absolute increase in expectation of life at birth for nonwhites than for whites. Of

course, as would be expected, the more rapid decline in mortality rates for females than for males has produced a greater increase in the expectation of life at birth for women.

The increase since 1900-1902 in the expectation of life for persons entering adulthood has been only about 40 per cent as large as that for age 0—a result to be expected because so much of the increase in the latter was due to declines in mortality at the infant and younger childhood ages. Correspondingly, the expectation of life at age 65 has shown relatively small increases, in terms of years, during the sixty-year period.

Although most of the increase in the expectation of life occurred in the first portion of this century, nonetheless the last decade has shown some improvements. The expectation of life at birth in the 1959-61 life table exceeded that in the 1949-51 table by amounts ranging from 1½

TABLE 10
INCREASES IN COMPLETE EXPECTATION OF LIFE FOR 1959-61
OVER VARIOUS DECENNIAL LIFE TABLES

Age	1900-1902	1909-11	1919-21	1929-31	1939-41	1949-51
White Males						
0....	19.32	17.32	11.21	8.43	4.74	1.24
20....	8.06	7.54	4.65	4.23	2.49	0.73
65....	1.46	1.72	0.76	1.20	0.90	0.22
White Females						
0....	23.11	20.57	15.66	11.52	6.90	2.16
20....	12.52	11.41	9.83	7.77	4.91	1.73
65....	3.65	3.91	3.13	3.07	2.32	0.88
Nonwhite Males						
0....	28.94	27.43	14.34	13.93	9.22	2.57
20....	10.67	12.32	7.42	9.83	6.26	2.05
65....	2.46	3.10	0.77	1.97	0.63	0.09
Nonwhite Females						
0....	31.43	28.80	19.55	16.96	10.91	3.77
20....	13.18	13.93	12.92	12.85	8.03	3.30
65....	3.74	4.30	2.71	2.88	1.19	0.58

years for white males to $3\frac{3}{4}$ years for nonwhite females. Even for age 65, the expectation of life showed small but significant improvement for all categories during the decade.

Table 11 compares the expectations of life between the sexes and the races for the several life tables. For both white and nonwhite persons,

TABLE 11
COMPARISON OF EXPECTATIONS OF LIFE FOR VARIOUS DECENNIAL
LIFE TABLES, BY SEX AND BY RACE

Age	1900-1902	1909-11	1919-21	1929-31	1939-41	1949-51	1959-61
Excess of White Females over White Males							
0.....	2.85	3.39	2.19	3.55	4.48	5.72	6.64
20.....	1.58	2.17	0.86	2.50	3.62	5.04	6.04
65.....	0.72	0.72	0.54	1.04	1.49	2.25	2.91
Excess of Nonwhite Females over Nonwhite Males							
0.....	2.50	3.62	- 0.22	1.96	3.30	3.79	4.99
20.....	1.78	2.68	- 1.21	1.27	2.52	3.04	4.29
65.....	1.00	1.08	0.34	1.37	1.72	1.79	2.28
Excess of White Males over Nonwhite Males							
0.....	15.69	16.18	9.20	11.57	10.55	7.40	6.07
20.....	7.08	9.25	7.24	10.07	8.24	5.79	4.47
65.....	1.13	1.51	0.14	0.90	- 0.14	0.00	0.13
Excess of White Females over Nonwhite Females							
0.....	16.04	15.95	11.61	13.16	11.73	9.33	7.72
20.....	6.88	8.74	9.31	11.30	9.34	7.79	6.22
65.....	0.85	1.15	0.34	0.57	- 0.37	0.46	0.76

at all ages the expectation of life for females has had an increasing differential over that for males. For example, for white persons, the expectation of life at birth was 2.8 years higher for women than for men in 1900-1902, whereas in 1959-61 the differential was 6.6 years. At age 20, the differential in favor of females in the 1959-61 life tables was almost as large as at birth. Even by age 65, the differential in the 1959-61 life tables is still large—about 3 years for white females and $2\frac{1}{4}$ years for

nonwhite females—whereas at the turn of the century this differential was only about 1 year.

The expectation of life at birth for white males in 1900-1902 was about 15.7 years greater than that for nonwhite males, but this differential has been significantly decreased over the years, until for the current life tables it is only 6.1 years. Similarly, the differential in the expectation of life at birth for white females as against nonwhite females has been more than halved—from the 16.0 years according to the 1900-1902 life tables to the 7.7 years currently.

The differential in the expectation of life between the races at age 20 has been significantly reduced since 1929-31; before that time, the trend is less clear. The expectation of life at age 65 has, in recent years, been about the same for white and nonwhite males, although in the early decades of the century, white males showed an excess of somewhat more than 1 year. For white females, however, the expectation of life at age 65 in the most recent tables has been about one-half year higher than that for nonwhite females, although the trend is not clear.

In summary, the availability of the official complete United States Life Tables for 1959-61 confirms that mortality rates have been steadily declining in this country throughout the twentieth century. Although the decline has been slackening off, from a relative standpoint it continues to be significant at all ages. Furthermore, female mortality continues to be decreasing at a somewhat faster rate than male mortality, and accordingly the favorable differential with regard to women is continuing to widen. White and nonwhite mortality rates are, on the whole, decreasing at about the same relative rate, so that the unfavorable differential for nonwhites continues at about the same relative magnitude. However, because absolute mortality rates have declined so significantly, the increases in the expectations of life at various ages have been significantly greater (in terms of years) for nonwhites than for whites; correspondingly, the differences in expectations of life at various ages between the two races have been narrowing.

DISCUSSION OF PRECEDING PAPER

PETER M. THEXTON:

This paper gives prominent display to mortality differences by race and sex. The authors say, "The well-known facts that male mortality is consistently higher than female mortality and that nonwhite mortality is consistently higher than white mortality are obvious." It is unfortunate that no clues are indicated with respect to possible reasons for these results because the only thing obvious is that they are well known; they are not necessarily facts.

It has for too long been merely accepted that Negro mortality is higher than white mortality, although this conclusion is superficially unreasonable and is based on data not qualified with respect to other factors known to affect mortality. No study of mortality differences by race, to my knowledge, has been conducted with a view to learning the reasons or causes for differences which appear, nor has a rationale or theory been presented.

Those who are active in the civil rights movement know that in personal relations there is nothing which can be associated with Negro. "Negroness" is a quality conceived and perpetuated by people who are generally white, apparently in order to establish the superiority of "whiteness," a false distinction. In mental and emotional reactions there are virtually no substantially identified correlations with skin color except those which are equally correlated with sociological conditions. Mortality correlations with skin color, therefore, should be viewed skeptically and investigated carefully with respect to all other factors, or false conclusions may appear.

To give only one specific example, higher mortality is associated with urban living, the more crowded the living conditions the higher the mortality. Since Negroes are generally forced into the most crowded urban areas it is to be expected that Negro mortality rates will, on the average, appear higher without there necessarily being any basic difference between Negro and white mortality. Without investigation the question is still moot and should be so qualified.

Considering the volume of controversy for many years over the reality or nonreality of racial differences, it seems to me that there should be some data in greater detail than shown or projected in this paper—in particular, the Census-collected extensive sociological data concerning

housing, income, family size, residence, etc. Surely the deaths were also coded, at least in part, so that the truth about mortality differences by race, if any, can be actuarially investigated.

It should be noted that the law in many states prohibits insurance companies from using race as an underwriting index or even coding applications by race. Only the federal government, therefore, can collect these data.

In fact, it may be difficult for the government because, as I understand the procedure, the people who collected the Census data were required to accept the answer given with respect to race or color. The extent of error may be quite large. Is it possible that the death data are more "accurate" than the Census data?

As actuaries our responsibility is larger than merely to find a convenient experience index or to continue traditional indexes. We should use a little imagination and try to dig for basic truth, especially when the surface result is unreasonable.

MORTIMER SPIEGELMAN:

Our studies of the mortality experience of industrial policyholders of the Metropolitan Life Insurance Company go into detail regarding causes of death, in addition to distinction by age, sex, and race.¹ These have shown some interesting characteristics from which we surmise that a large element in the difference between the races may be attributed to social-economic factors. However, there are a few causes of death which seem to be definitely associated with race, one example being the much higher mortality from cancer of the skin for whites as compared with nonwhites.

Mr. Thexton also referred to studies that might be undertaken by government. He should be aware that the federal government already has a long history of studies concerned with differences between white and non-white mortality; these are available in various publications by the United States Public Health Service. Among the more recent such studies, reference might be made to that on occupational mortality which, among other things, presented data in relation to social-economic categories for men aged 20-64 years, separately for whites and nonwhites.² In general, they show an improvement in mortality, for both whites and nonwhites, in proceeding up the social-economic scale. However, for each social-economic category, the nonwhites had a higher mortality than the whites. Further insight into this matter should come from the study now being conducted

¹ See, e.g., *TSA*, IX, 148.

² Cited in *TSA*, XIV, 561, and XV, 620.

by Kitagawa and Hauser at the University of Chicago.³ For this study, death certificates for a short period following the 1960 Census of Population are being matched individually with the returns on the 1960 Census schedules. In that way, study will be possible not only with regard to age, sex, and race but also in relation to such items on the Census schedule as education, income, decedent's family and household characteristics, and housing. Another forthcoming source of analyses of mortality, which will take race into account, is the series of vital and health statistics monographs now in preparation under the auspices of a committee, of which I am chairman, within the American Public Health Association.⁴

I would also like to refer to a commonly observed feature in a comparison of white and nonwhite mortality, namely, the lower rates for the latter at the advanced ages. Mr. Myers noted a similar feature in comparing mortality in the Soviet Union with that of the United States. I found the same crossing of mortality in midlife or later in comparing Puerto Rico with the United States and also in comparing the Canadian population with the Jews in Canada.⁵ In the case of the nonwhites in the United States, their lower mortality at the higher ages is generally attributed to misstatement of ages and perhaps unrecorded deaths in some degree. Without depreciating the likelihood of such errors in the basic data, I suspect that there is another element which may be common to the comparisons just mentioned. It seems plausible to say that, in a situation of high mortality at the early ages, there is a weeding-out process which is particularly unfavorable to unhealthy lives, so that a rather hardy stock is left to go into the higher ages. On the other hand, in these comparisons the population with the lower mortality at the younger ages has the benefit of the better control of disease by avoiding infection and by prolonging lifetimes of the physically impaired.

WILLIAM J. NOVEMBER:

In the comment by the authors relating to Tables 4A on, the theme is one of "general and continuous improvement." This comment, while true in terms of the decennial Census reports, masks a significant change which has occurred beginning in about 1954, particularly for males. Mortality rates have leveled off for middle and older age groups, and there is some evidence of an increase at the high ages. For young male lives such downward trend as persists is of modest proportions. For females the downward trend is still operating at most ages but at a much slower pace.

³ Cited in *TSA*, XV, 627.

⁴ Cited in *TSA*, XV, 627.

⁵ *Population Studies*, II (December, 1948), 292.

This development is of course of great interest and importance to us and should not be overlooked in an examination of periodic Census data. The phenomenon was the subject of an intensive analysis by the National Center for Health Statistics of the Public Health Service and was discussed in a report of March, 1964, bearing the title *The Change in Mortality Trend in the United States*.

It appears that deaths from infectious and communicable diseases are now at such a low level that further improvement cannot have much of an impact on the over-all death rates. For males the relatively level death rates from cardiovascular-renal disease at ages 35 and over and the increasing death rates from cancer at ages 25 and over are now the dominating factors, aided and abetted by a prolonged rise in deaths from cirrhosis

TABLE 1
RATIOS OF NONWHITE TO WHITE AGE-ADJUSTED DEATH RATES

	1900	1910	1920	1930	1940	1950	1960
Males.....	1.55	1.49	1.44	1.65	1.53	1.41	1.32
Females.....	1.62	1.62	1.60	1.82	1.71	1.70	1.61

of the liver. For females, the trend for CVR and cancer deaths continues to be downward at almost all ages, but cirrhosis of the liver has had the same upward trend as males. For both males and females, accidents other than motor vehicle have continued to decline, but the death rates from motor-vehicle accidents have been fairly level, while suicides and homicides have in recent years shown an upward tendency.

There is one other observation of a somewhat different nature that I would like to offer. The relationship between nonwhite and white death rates is of considerable interest right now. A summarization of what has been taking place can be obtained by looking at age-adjusted death rates for the population as a whole. When this is done, we find that the relationship of nonwhite to white mortality has been on a relative plateau insofar as the percentage differentials go except for some improvement for males since 1940. Table 1 gives the ratio of the nonwhite to white age-adjusted mortality rates as derived from Vital Statistics reports, with standardization based on 1940 population.

This table is offered with the knowledge that the use of a year other than 1940 as the basis of standardization might have changed the series by shifting the weights of the death rates for various age groups. Nevertheless, it does confirm the authors' generalization that no definite trend in the differentials is apparent.

A. M. NIESSEN:

Students of mortality trends will be grateful to Messrs. Myers and Bayo for including in their paper a wealth of analytical information which is not ordinarily found in published United States Life Tables. The comparative data close with age 80, probably because the statistics for the older ages were not considered sufficiently reliable. However, some light on recent mortality trends at ages 80 and over is shed by the experience of the Railroad Retirement Board, which is summarized in Table 1.

TABLE 1
MORTALITY OF RAILROAD ANNUITANTS AT AGES 80 AND OVER
IN 1953-62, BY ATTAINED AGE AND PERIOD
(Death Rates per 1,000 by Number of Lives)

ATTAINED AGE*	POLICY YEARS			
	1953-56†	1955-58	1958-62	1955-62
80.....	109.70	112.69	116.08	114.78
81.....	119.79	117.28	124.55	121.71
82.....	134.67	130.44	134.36	132.82
83.....	145.56	144.55	147.09	146.08
84.....	151.28	154.53	158.59	157.01
85.....	170.03	168.67	167.15	167.73
86.....	172.31	182.06	180.07	180.81
87.....	193.94	213.15	197.75	203.33
88.....	199.04	211.64	210.66	211.01
89.....	203.35	216.18	224.73	221.71
90.....	239.62	240.88	243.15	242.40
91.....	236.84	262.50	263.30	263.07
92.....	263.16	229.12	289.38	274.92
93.....	320.44	300.37	307.17	305.58
94.....	220.93	254.44	323.29	305.85
95.....	303.03	304.35	335.94	327.59
96.....	382.35	350.88	325.58	333.33
97.....	‡	384.62	364.86	370.00
98.....	‡	‡	384.62	348.48
99 and over...	‡	‡	‡	400.00§
Total expo- sure.....	88,663	107,247	175,079	282,326
Total actual deaths...	12,671	15,715	26,751	42,466

* Age last birthday at beginning of year of exposure.

† Reported in *TSA*, X, 218.

‡ Less than 10 actual deaths.

§ Experience of pensioners during calendar years 1960-63. Based on 95 years of exposure and 38 actual deaths. The oldest age for this group was 108.

The population studied consisted almost entirely of white males. With few exceptions, their ages had been verified, and the deaths occurring among them had been reported without too much delay. Thus the experience here presented may be among the best available for the very old ages and thus useful for purposes of comparisons.

A glance at the first three columns of the table shows that there was no decrease in the death rates during the decade 1953-62. The rates remained fairly stable during the whole period and, if anything, were slightly higher in the latter part than in the earlier parts. This experience would seem to indicate that mortality projections at the very old ages are of questionable validity.

(AUTHORS' REVIEW OF DISCUSSION)

ROBERT J. MYERS AND FRANCISCO BAYO:

We are pleased to have the several discussions of our paper, since these add considerable value in regard to certain subsidiary matters.

In regard to Mr. Thexton's comment, it must be reiterated that we were interested in presenting a brief analysis of the past mortality trends in the United States and current mortality differentials by age, sex, and race according to official statistics. We certainly do not know (and we do not believe anybody does know) what the intrinsic mortality differential is by age, sex, or race. In our paper we studied life table values based on observed facts of acceptable recording accuracy, and we cannot presume to know whether the differentials would have been smaller, larger, or even reversed if the two races (or sexes) had fared equally in the past. These *observed* differentials are, nevertheless, factual and well known.

It might be possible to perform research establishing, on a scientific basis, the equality by race of intrinsic human mortality, something that Mr. Thexton assumes to be true, but this is not one of the basic responsibilities of the actuarial profession. It seems unreasonable to us to request the actuary to become responsible for any inequities that exist in our social structure. In the particular case of racial discrimination, it does not seem to us that a great advance would be accomplished by scientifically either proving or disproving mortality equality. We believe that those who discriminate racially hardly base their actions on scientific principles or truths. Their activities are of an irrational nature which do not admit any type of reasoned truth. And whether or not mortality by race (or, for that matter, by sex!) is different, this has no bearing on the matter of civil rights.

We cannot agree with Mr. Spiegelman that the lower mortality of the nonwhite at the older ages could, in some major degree, be due to a weed-

ing-out of the unhealthy at the younger ages. The difficulty with this principle is that it is based on the exceptions and not on the most frequently observed events. We find that, in the great majority of cases, mortality differentials are in the same direction throughout the whole life-span, and there seems no reason to believe that a sudden reversal will occur. The principle, if one has to be established, is of a continuation of the same mortality differential at the older ages, not a reversal of it. This principle was followed by the United Nations in its preparation of model life tables. The argument of weeding-out, we believe, is subject to the opposite, but equally persuasive, argument that, by the time people reach old age, if their mortality was high at the younger ages, their organism must be weak or impaired due to all the battles against the dangerous diseases. According to this counterargument (we do not subscribe to either of them), instead of the younger-age diseases weeding out the unhealthy lives, they actually create unhealthiness among those who survive.

Regarding Mr. November's comment about the trend of male mortality at the older ages since 1954, we would like to point out that, according to a study of OASDI primary beneficiaries aged 65 and over which we are currently conducting and which we plan to publish in the near future, we conclude that mortality for ages 65-80 has continued to decrease, although at a slower pace (somewhat faster at 65-69 than at 75-79). The rates seem to have leveled off for ages 80-84 and to have shown a tendency to increase for ages 85 and over.

As to Mr. Niessen's comments, we observe that at ages above 80 the Railroad Retirement annuitant mortality is about 3 per cent higher than for the general population. Our preliminary figures show, on the other hand, that the OASDI beneficiaries are subject to a mortality that is about 6 per cent lower than for the general population, which implies that Railroad Retirement mortality at those ages is about 10 per cent higher than OASDI mortality. We can offer no reasons why this should be so, if it really is.