National Vital Statistics Reports

Volume 71, Number 2 August 23, 2022

U.S. State Life Tables, 2020

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Abstract

Objectives—This report presents complete period life tables for each of the 50 states and the District of Columbia (D.C.) by sex based on age-specific death rates in 2020.

Methods—Data used to prepare the 2020 state-specific life tables include: 2020 final mortality statistics; July 1, 2020, population estimates based on the 2010 decennial census; and 2020 Medicare data for people aged 66–99. The methodology used to estimate the state-specific life tables is the same as that used to estimate the 2020 national life tables, with some modifications.

Results—Among the 50 states and D.C., Hawaii had the highest life expectancy at birth, 80.7 years in 2020, and Mississippi had the lowest, 71.9 years. From 2019 to 2020, life expectancy declined for all 50 states and D.C., from 0.2 years for Hawaii to 3.0 years for New York. In 2020, life expectancy at age 65 ranged from 16.1 years in Mississippi to 21.0 years in Hawaii. Life expectancy at birth was higher for females in all states and D.C. The difference in life expectancy between females and males ranged from 3.9 years in Utah to 7.0 years in D.C.

Keywords: state life expectancy • survival • death rates • National Vital Statistics System

Introduction

This report presents annual complete period life tables for each of the 50 states and the District of Columbia (D.C.) for 2020. Life tables were produced for the total, male, and female populations of each state and D.C. based on age-specific death rates for 2020. The methodology used to estimate the state-specific life tables is the same as that used to estimate the annual U.S. life tables (1), with some minor modifications described in the Technical Notes.

Life tables are of two types: the cohort (or generation) life table and the period (or current) life table. The cohort life table presents the mortality experience of a particular birth cohort—all people born in 1900, for example—from the moment of birth through consecutive ages in successive calendar years. Based on age-specific death rates observed through consecutive calendar years, the cohort life table reflects the mortality experience of an actual cohort from birth until no lives remain in the group. To prepare just a single complete cohort life table requires data over many years. Due to data unavailability or incompleteness (2), constructing cohort life tables based entirely on observed data for real cohorts is usually not feasible. For instance, a life table representation of the mortality experience of a cohort of people born in 1970 would require the use of data projection techniques to estimate deaths into the future (3,4).

The period life table, by contrast, presents what would happen to a hypothetical cohort if it experienced throughout its entire life the mortality conditions of a particular period. For example, a period life table for 2020 assumes a hypothetical cohort that is subject throughout its lifetime to the age-specific death rates prevailing for the actual population in 2020. The period life table could be characterized as producing a snapshot of current mortality experience and showing the long-range implications of a set of age-specific death rates that prevailed in a given year. In this report, the term "life table" refers only to the period life table, not to the cohort life table.

Life tables can be classified in two ways according to the length of the age interval in which data are presented. A complete life table contains data for every single year of age. An abridged life table typically contains data by 5- or 10-year age intervals. A complete life table can be combined into 5- or 10-year age groups. U.S. decennial life tables and, beginning in 1997, U.S. annual life tables are complete life tables. This report presents the results for 2020 in a series of annual complete period state-specific life tables.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics
National Vital Statistics System

NCHS reports can be downloaded from: https://www.cdc.gov/nchs/products/index.htm.

Data and Methods

The data used to prepare the U.S. state life tables for 2020 are state-specific final numbers of deaths for 2020; July 1, 2020, state-specific population estimates based on the 2010 decennial census; and state-specific death and population counts for Medicare beneficiaries aged 66–99 for 2020 from the Centers for Medicare & Medicaid Services. Data from the Medicare program are used to supplement vital statistics and census data for ages 66 and over.

The methodology used to estimate the 2020 complete life tables for the 50 states and D.C. presented in this report is the same as that used to estimate the annual U.S. national life tables, with some modifications. For some states, very small age-specific or zero numbers of deaths in childhood ages sometimes required the use of additional smoothing techniques not needed in constructing the national life tables. A modification to the estimation of death rates in the oldest ages was also necessary because of the lack of state-specific census population estimates for ages 85–100. The methodology with modifications used to construct the first set of annual U.S. state life tables is detailed in the Technical Notes.

Explanation of life table columns

Column 1. Age (*between x and x +* 1)—Shows the age interval between the two exact ages indicated. For instance, 20–21 means the 1-year interval between the 20th and 21st birthdays.

Column 2. Probability of dying (q_x)—Shows the probability of dying between ages x and $x + 1$. For example, for males who reach age 20 in Massachusetts, the probability of dying before reaching their 21st birthday is 0.000658 (Table MA–2). This column forms the basis of the life table; all subsequent columns are calculated from it.

Column 3. Number surviving (l_x)—Shows the number of people from the original hypothetical cohort of 100,000 live births who survive to the beginning of each age interval. The l_x values are computed from the q_x values, which are successively applied to the remainder of the original 100,000 people still alive at the beginning of each age interval. For example, out of 100,000 male babies born alive in Massachusetts in 2020, 99,212 will survive to their 21st birthday (Table MA–2).

Column 4. Number dying (d_x)—Shows the number dying in each successive age interval out of the original 100,000 live births. For example, out of 100,000 males born alive in Massachusetts in 2020, 65 will die between ages 20 and 21 (Table MA–2). Each figure in column 4 is the difference between two successive figures in column 3.

Column 5. Person-years lived (L_x)—Shows the number of person-years lived by the hypothetical life table cohort within an age interval x to $x + 1$. Each figure in column 5 represents the total time (in years) lived between two indicated birthdays by all those reaching the earlier birthday. Consequently, the figure 99,245 for males in the age interval 20–21 is the total number of years lived between the 20th and 21st birthdays by the 99,277 males in Massachusetts (column 3) who reached their 20th birthday out of 100,000 males born alive (Table MA–2).

Column 6. Total number of person-years lived (T_x)—Shows the total number of person-years that would be lived after the beginning of the age interval x to $x + 1$ by the hypothetical life table cohort. For example, the figure 5,653,740 is the total number of years lived after reaching age 20 by the 99,277 males reaching that age in Massachusetts (Table MA–2).

Column 7. Expectation of life (e_x)—At any given age, shows the average number of years remaining to be lived by those surviving to that age, based on a given set of age-specific rates of dying. It is calculated by dividing the total person-years that would be lived beyond age x by the number of people who survived to that age interval (T_x / l_x). For example, the average remaining lifetime for males in Massachusetts who reach age 20 is 56.9 years (5,653,740 divided by 99,277) (Table MA–2).

Standard errors of probability of dying and life expectancy

Although based on complete counts of death, the life table functions presented in this report are subject to error. As a result, standard errors of the two most important functions, the probability of dying and life expectancy, are also presented. The mortality data on which state life tables are based are not affected by sampling error because they are based on complete counts of deaths and, as a result, standard errors reflect only stochastic (random) variation. While measurement errors such as age misreporting on death certificates or census data are known to affect mortality estimates, they are not considered in calculating the standard errors of the life table functions. In most cases, standard errors for life expectancy at birth and the probability of dying are small due to large numbers of deaths. However, for some states with small populations, particularly at the youngest ages, the standard errors presented are relatively large.

Results

Complete life tables for 50 states and D.C.

A set of complete period life tables for each state and D.C. is available online from "U.S. State Life Tables, 2020" at: ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/71-02/. Table I lists table titles for each of these tables. Table numbering is based on the federal information processing standards, or FIPS, alphabetic code for the state combined with a table code. The table codes are 1 for the total population, 2 for males, 3 for females, and 4 for the standard errors of the probability of dying and life expectancy. For example, Table FL–2 refers to the complete period life table for males in Florida.

Life expectancy in 50 states and D.C.

Table A shows life expectancy at birth for the total, male, and female populations for each state, D.C., and the United States. In 2020, among the 50 states and D.C., Hawaii ranked first for the total, male, and female populations, with life expectancies at birth of 80.7, 77.6, and 83.8 years, respectively. Mississippi ranked 51st among the 50 states and D.C. for the total, male, and female

Table A. Life expectancy at birth, rank, and standard error, by sex: Each state, District of Columbia, and United States, 2020

Area	Total			Male			Female		
	Rank	Life expectancy (years)	Standard error	Rank	Life expectancy (years)	Standard error	Rank	Life expectancy (years)	Standard error
Hawaii	1	80.7	0.119	1	77.6	0.170	1	83.8	0.159
Washington	2	79.2	0.049	2	76.9	0.072	3	81.6	0.065
Minnesota	3	79.1	0.056	3	76.8	0.083	7	81.4	0.074
California	4	79.0	0.022	8	76.2	0.032	2	82.0	0.029
Massachusetts	5	79.0	0.050	6	76.4	0.074	4	81.5	0.065
New Hampshire	6	79.0	0.117	5	76.5	0.173	5	81.5	0.153
Vermont	7	78.8	0.178	9	76.1	0.270	6	81.4	0.227
Oregon	8	78.8	0.067	7	76.3	0.099	8	81.3	0.088
Utah	9	78.6	0.078	4	76.7	0.113	15	80.6	0.105
Connecticut	10	78.4	0.073	12	75.6	0.109	9	81.3	0.093
Idaho	11	78.4	0.102	10	76.1	0.150	12	80.8	0.136
Colorado	12	78.3	0.058	11	75.8	0.085	11	80.9	0.077
Rhode Island	13	78.2	0.130	13	75.5	0.192	10	80.9	0.170
Maine	14	77.8	0.127	18	74.9	0.189	14	80.7	0.162
New York	15	77.7	0.031	19	74.8	0.045	13	80.7	0.040
Nebraska	16	77.7	0.099	15	75.2	0.145	18	80.3	0.131
Wisconsin	17	77.7	0.058	14	75.2	0.085	19	80.3	0.078
Virginia	18	77.6	0.048	16	75.1	0.070	21	80.1	0.064
Florida	19	77.5	0.032	20	74.6	0.047	16	80.5	0.042
New Jersey	20	77.5	0.045	21	74.6	0.066	17	80.5	0.059
Iowa	21	77.5	0.077	17	74.9	0.112	20	80.1	0.102
United States	…	77.0	…	…	74.2	…	…	79.9	…
North Dakota	22	76.9	0.164	24	74.2	0.236	22	80.0	0.220
Montana	23	76.8	0.142	23	74.2	0.203	26	79.6	0.193
Maryland	24	76.8	0.059	30	73.8	0.087	24	79.7	0.076
Pennsylvania	25	76.8	0.040	26	74.0	0.059	25	79.6	0.052
Illinois	26	76.8	0.040	29	73.8	0.059	23	79.8	0.052
Delaware	27	76.7	0.147	28	73.9	0.219	28	79.5	0.191
South Dakota	28	76.7	0.156	25	74.2	0.221	29	79.4	0.217
Alaska	29	76.6	0.176	22	74.3	0.249	31	79.2	0.242
Texas	30	76.5	0.026	32	73.7	0.038	30	79.3	0.035
Kansas	31	76.4	0.084	31	73.8	0.122	32	79.2	0.112
Wyoming	32	76.3	0.191	27	74.0	0.275	35	78.9	0.259
Arizona	33	76.3	0.055	35	73.4	0.081	27	79.5	0.072
Nevada	34	76.3	0.080	33	73.5	0.117	33	79.2	0.106
North Carolina	35	76.1	0.045	36	73.3	0.067	34	79.0	0.059
Michigan	36	76.0	0.046	34	73.4	0.067	36	78.8	0.062
Georgia	37	75.6	0.044	37	72.8	0.064	38	78.3	0.058
Ohio	38	75.3	0.043	38	72.5	0.062	40	78.1	0.057
District of Columbia	39	75.3	0.179	41	71.7	0.266	37	78.7	0.233
Missouri	40	75.1	0.059	40	72.1	0.087	39	78.1	0.078
Indiana	41	75.0	0.056	39	72.3	0.082	42	77.9	0.075
South Carolina	42	74.8	0.066	42	71.7	0.098	41	78.0	0.087
New Mexico	43	74.5	0.109	44	71.3	0.158	43	77.8	0.145
Oklahoma	44	74.1	0.072	43	71.5	0.104	45	76.9	0.097
Arkansas	45	73.8	0.086	45	71.1	0.125	46	76.6	0.116
Tennessee	46	73.8	0.057	46	70.7	0.083	44	77.0	0.074
Kentucky	47	73.5	0.071	47	70.6	0.102	47	76.5	0.094
Alabama	48	73.2	0.067	48	70.1	0.099	48	76.4	0.088
Louisiana	49	73.1	0.070	49	69.9	0.102	49	76.4	0.093
West Virginia	50	72.8	0.118	50	69.8	0.170	50	76.1	0.158
Mississippi	51	71.9	0.089	51	68.6	0.130	51	75.2	0.118

… Category not applicable.

NOTE: Life expectancies shown are rounded, but rankings are based on unrounded life expectancies.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

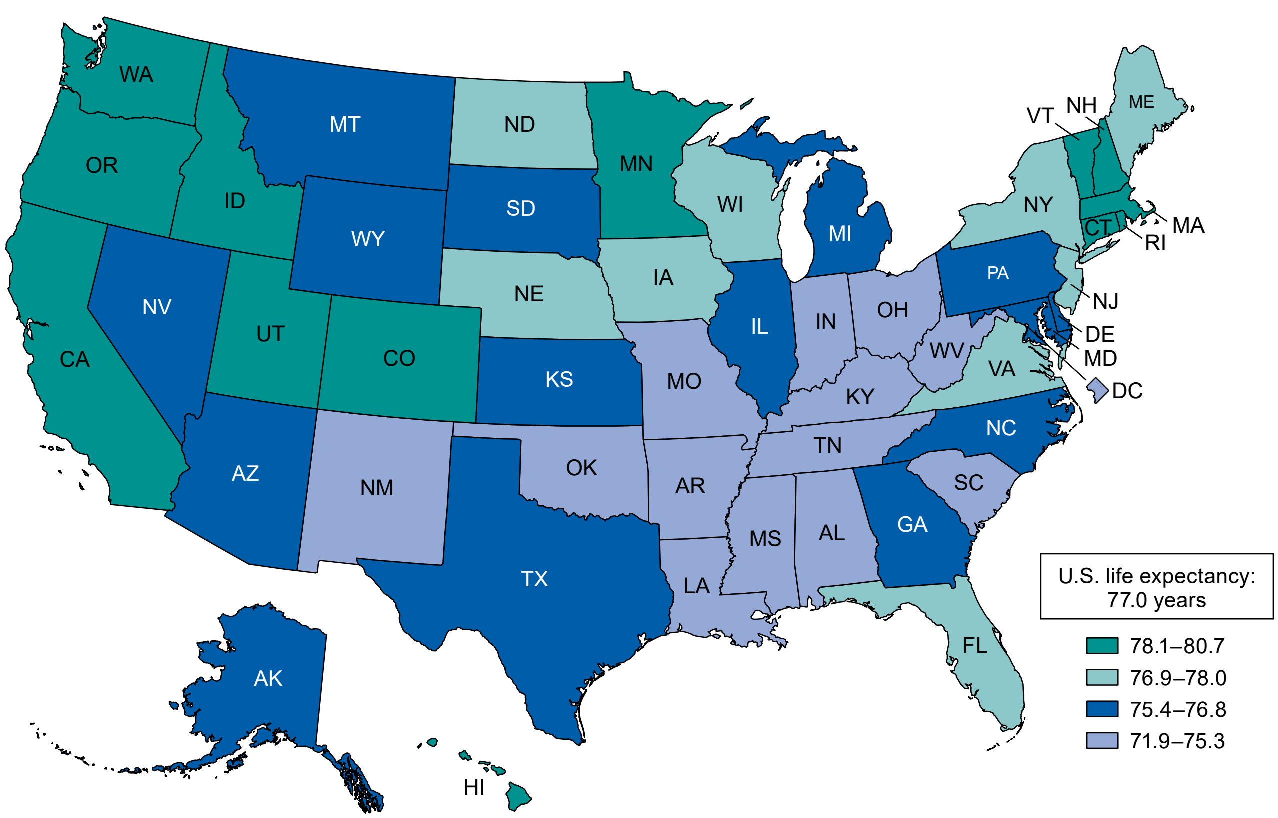
populations, with life expectancies at birth of 71.9, 68.6, and 75.2 years, respectively. In comparison, life expectancy at birth for the entire United States was 77.0, 74.2, and 79.9 for the total, male, and female populations, respectively. Figure 1 presents a U.S. map with state-specific life expectancy at birth grouped into quartiles. It shows that states with the lowest life expectancy at birth were mostly Southern states (Alabama, Arkansas, Kentucky, Louisiana, Mississippi, South Carolina, Tennessee, and West Virginia) but also included D.C., Indiana, Missouri, New Mexico, Ohio, and Oklahoma. States with the highest life expectancy at birth were predominantly Western (California, Hawaii, Idaho, Oregon, and Washington) and Northeastern states (Connecticut, Massachusetts, New Hampshire, Rhode Island, and Vermont) but also included Colorado, Minnesota, and Utah.

The difference in life expectancy between the sexes in the United States was 5.7 years in 2020, ranging from a high of 7.0 years in D.C. to a low of 3.9 years in Utah (Figure 2). With a few exceptions, the states with the largest differences by sex are those with lower life expectancy at birth, while the smallest sex differences are found mostly among states with higher life expectancy.

Table B shows life expectancy at age 65 for the total, male, and female populations for the 50 states, D.C., and United States. In 2020, Hawaii ranked first for the total, male, and female populations, with life expectancy at age 65 of 21.0, 19.0, and 22.7 years, respectively. Mississippi ranked 51st, with the lowest life expectancy among the 50 states and D.C. for the total, male, and female populations, with life expectancy at age 65 of 16.1, 14.6, and 17.5 years, respectively. In comparison, life expectancy at age 65 for the entire United States was 18.5, 17.0, and 19.8 for the total, male, and female populations, respectively. Figure 3 shows that states with the lowest life expectancies at age 65 are mostly concentrated in the South, with Florida being a noted exception, and those with the highest life expectancies are mostly in the West and Northeast.

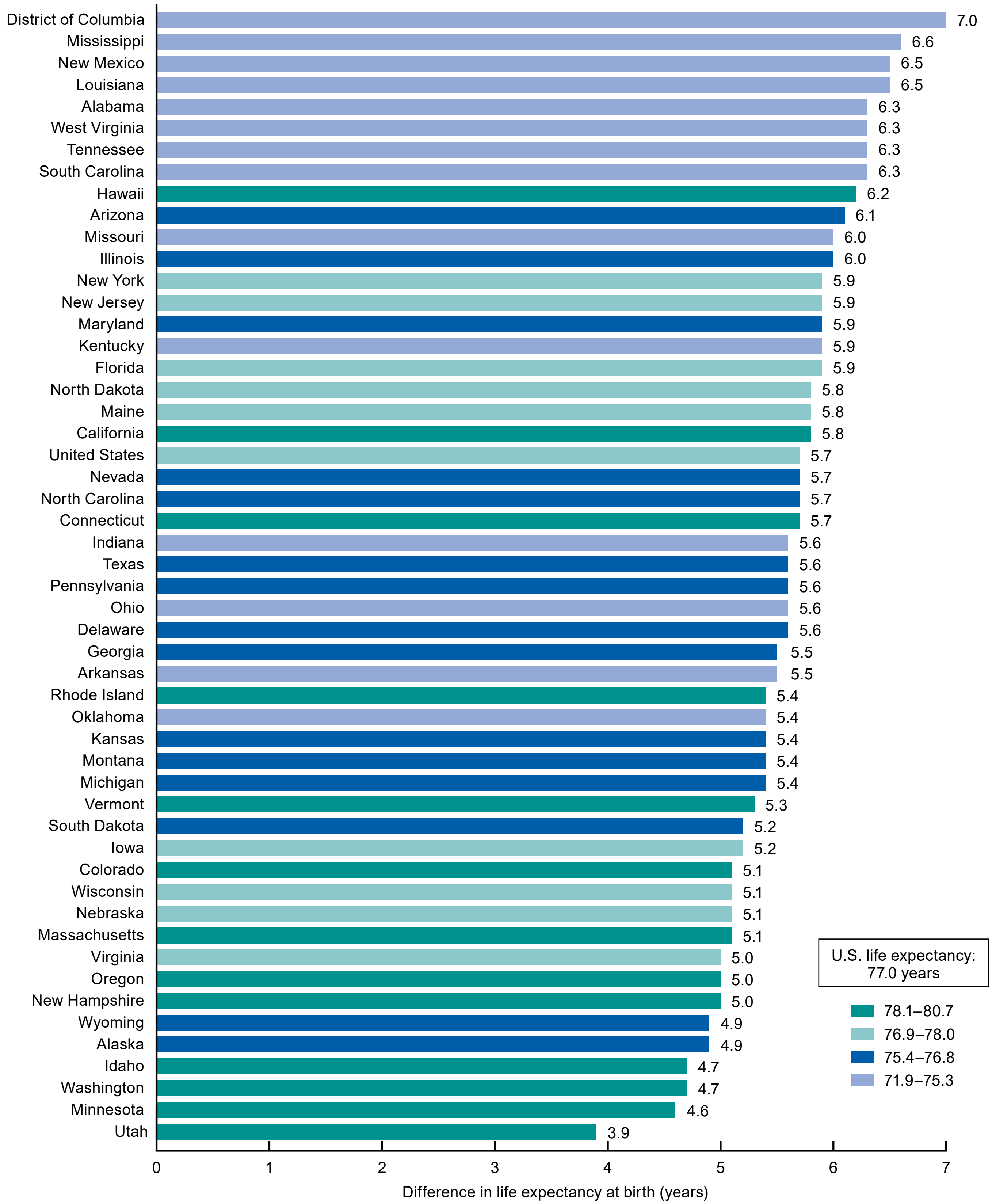
From 2019 to 2020, life expectancy at birth declined for all states and D.C. (Table C, Figure 4) (5). The declines ranged from 0.2 to 3.0 years. The states with the greatest decreases in life expectancy at birth from 2019 to 2020 included those in the Southwest and U.S.–Mexico border area (Arizona, New Mexico, and Texas), Louisiana, Mississippi, Illinois, New York, New Jersey, and D.C. New England (except for Connecticut), as well as Minnesota, Oregon, Washington, Idaho, Utah, Wyoming, Alaska, and Hawaii experienced the lowest declines in life expectancy at birth. Overall, life expectancy in the United States declined by 1.8 years from 2019 to 2020, mostly due to the COVID-19 pandemic and increases in unintentional injuries (mainly drug overdose deaths) (1).

Figure 1. Life expectancy at birth: Each state, District of Columbia, and United States, 2020



SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure 2. Difference between male and female life expectancy at birth: Each state, District of Columbia, and United States, 2020



NOTE: The color key reflects the range of life expectancy at birth for the total population for each area.
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table B. Life expectancy at age 65, rank, and standard error, by sex: Each state, District of Columbia, and United States, 2020

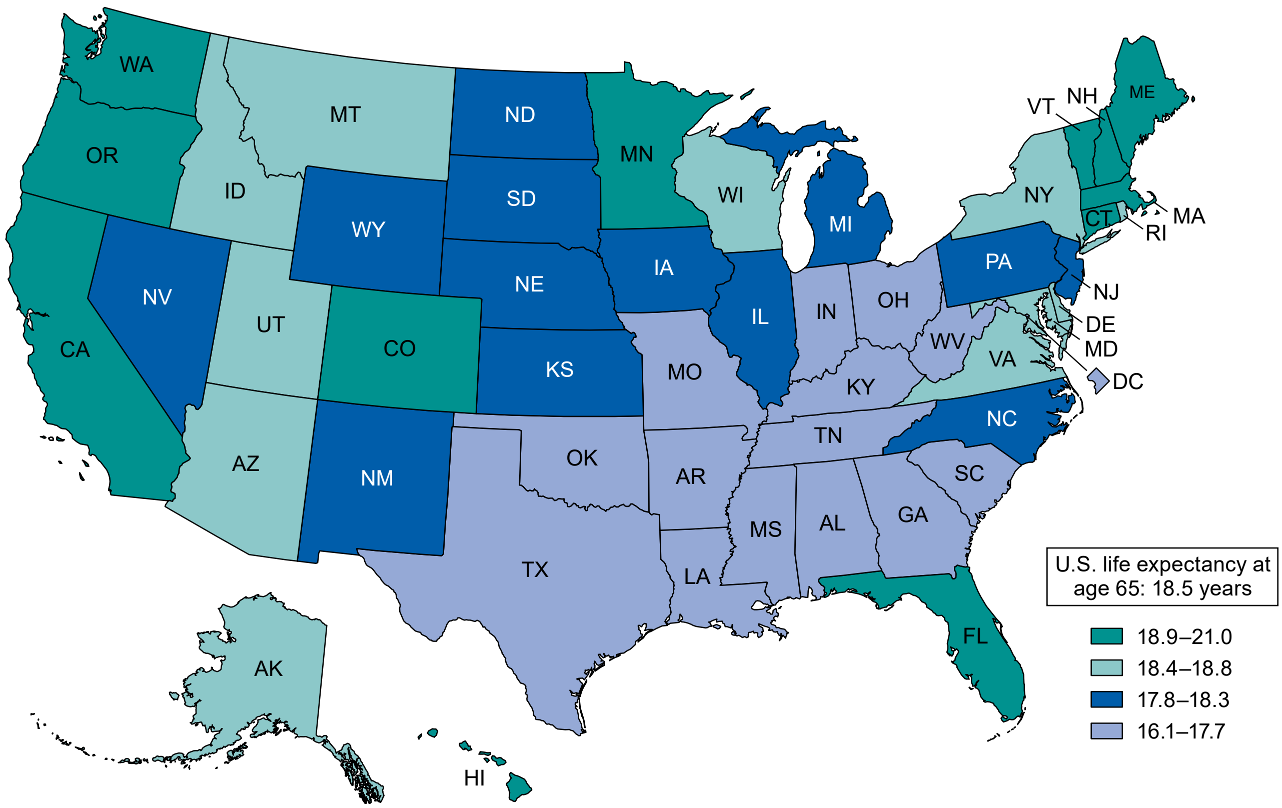
Area	Total			Male			Female		
	Rank	Life expectancy (years)	Standard error	Rank	Life expectancy (years)	Standard error	Rank	Life expectancy (years)	Standard error
Hawaii	1	21.0	0.066	1	19.0	0.092	1	22.7	0.090
California	2	19.5	0.013	5	17.9	0.018	2	20.9	0.017
Vermont	3	19.5	0.083	2	18.2	0.117	4	20.6	0.115
Washington	4	19.5	0.027	3	18.2	0.039	3	20.6	0.037
Oregon	5	19.3	0.035	4	18.0	0.050	6	20.5	0.048
Florida	6	19.2	0.016	11	17.7	0.023	5	20.6	0.021
New Hampshire	7	19.1	0.056	8	17.9	0.079	7	20.3	0.076
Minnesota	8	19.1	0.030	7	17.9	0.042	8	20.2	0.042
Colorado	9	19.0	0.030	10	17.8	0.043	9	20.2	0.042
Maine	10	19.0	0.055	9	17.8	0.079	13	20.1	0.076
Connecticut	11	19.0	0.038	13	17.6	0.053	10	20.2	0.052
Massachusetts	12	18.9	0.027	15	17.6	0.039	11	20.1	0.037
Utah	13	18.8	0.046	6	17.9	0.066	20	19.8	0.063
Idaho	14	18.8	0.053	12	17.6	0.074	14	20.1	0.074
Alaska	15	18.8	0.088	14	17.6	0.120	12	20.1	0.124
Rhode Island	16	18.6	0.067	20	17.1	0.096	15	19.9	0.092
Virginia	17	18.6	0.026	16	17.2	0.037	22	19.7	0.035
Wisconsin	18	18.5	0.029	17	17.2	0.040	19	19.8	0.040
Arizona	19	18.5	0.027	19	17.1	0.040	21	19.8	0.037
United States	…	18.5	…	…	17.0	…	…	19.8	…
Montana	20	18.4	0.064	21	17.1	0.089	17	19.9	0.088
New York	21	18.4	0.017	28	16.8	0.024	16	19.9	0.023
Delaware	22	18.4	0.067	18	17.2	0.099	28	19.5	0.091
Maryland	23	18.4	0.030	23	17.0	0.044	26	19.6	0.041
South Dakota	24	18.3	0.073	27	16.8	0.098	18	19.9	0.104
New Mexico	25	18.3	0.050	22	17.0	0.072	27	19.5	0.068
Nebraska	26	18.3	0.053	25	16.9	0.074	24	19.6	0.074
North Dakota	27	18.2	0.083	29	16.8	0.113	23	19.7	0.119
New Jersey	28	18.2	0.025	31	16.7	0.035	25	19.6	0.034
Iowa	29	18.2	0.040	26	16.8	0.056	29	19.4	0.057
Pennsylvania	30	18.1	0.019	30	16.7	0.027	30	19.4	0.027
Wyoming	31	18.1	0.090	24	17.0	0.123	33	19.3	0.128
Illinois	32	18.0	0.021	33	16.6	0.029	31	19.4	0.029
North Carolina	33	18.0	0.022	32	16.7	0.032	34	19.2	0.030
Kansas	34	17.9	0.043	35	16.4	0.060	35	19.2	0.060
Nevada	35	17.8	0.042	36	16.4	0.060	36	19.1	0.058
Michigan	36	17.8	0.022	34	16.4	0.031	39	19.0	0.031
South Carolina	37	17.7	0.031	37	16.3	0.045	38	19.0	0.042
District of Columbia	38	17.7	0.110	43	15.8	0.160	32	19.3	0.147
Texas	39	17.7	0.015	38	16.2	0.021	37	19.0	0.021
Ohio	40	17.5	0.021	39	16.1	0.029	40	18.7	0.028
Georgia	41	17.4	0.023	40	16.0	0.034	41	18.7	0.032
Missouri	42	17.4	0.029	41	16.0	0.041	42	18.7	0.040
Indiana	43	17.3	0.028	42	15.9	0.039	43	18.5	0.039
West Virginia	44	17.0	0.051	45	15.6	0.071	44	18.3	0.071
Tennessee	45	17.0	0.028	47	15.5	0.039	45	18.3	0.038
Arkansas	46	16.9	0.042	46	15.5	0.060	46	18.1	0.058
Kentucky	47	16.9	0.034	44	15.6	0.048	47	18.0	0.047
Louisiana	48	16.6	0.034	49	15.2	0.047	48	18.0	0.047
Oklahoma	49	16.6	0.037	48	15.3	0.053	50	17.8	0.052
Alabama	50	16.6	0.032	50	15.1	0.045	49	17.9	0.044
Mississippi	51	16.1	0.042	51	14.6	0.060	51	17.5	0.058

… Category not applicable.

NOTE: Life expectancies shown are rounded, but rankings are based on unrounded life expectancies.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure 3. Life expectancy at age 65: Each state, District of Columbia, and United States, 2020



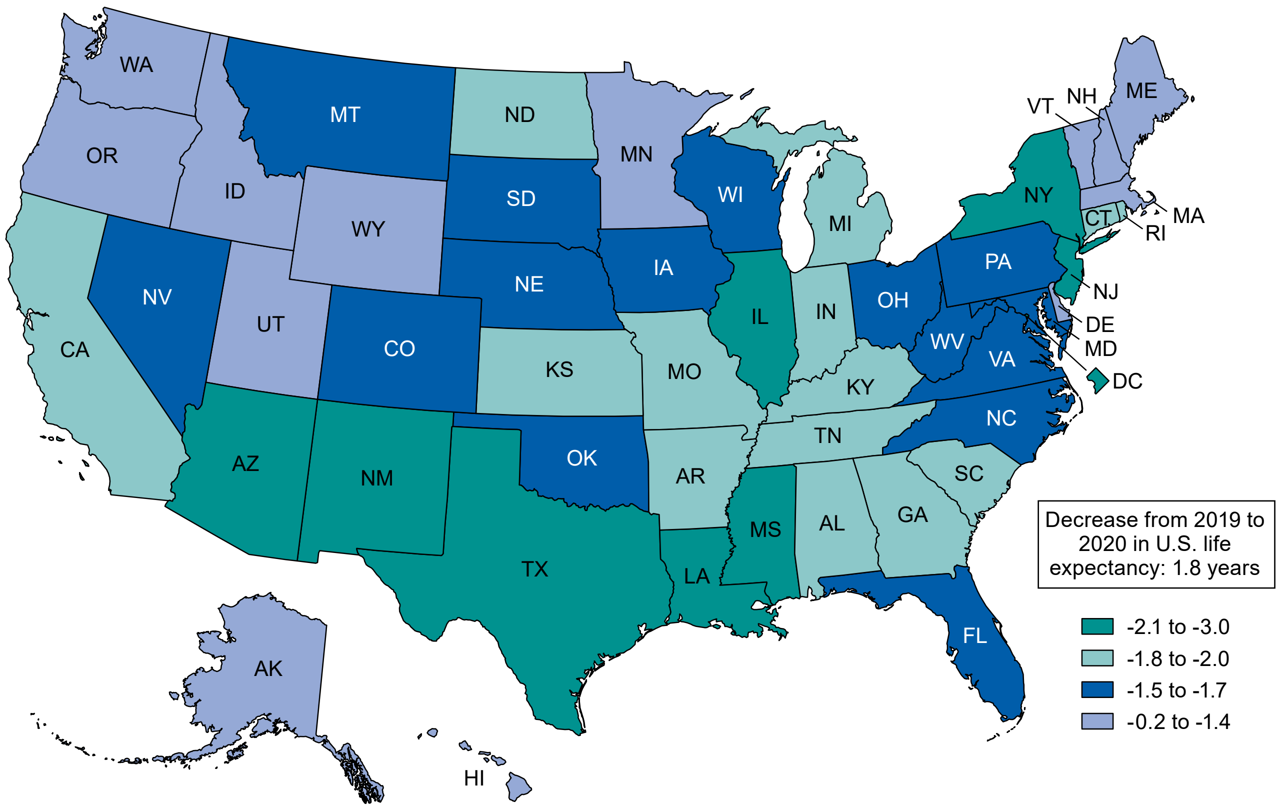
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Table C. Change in life expectancy at birth: Each state, District of Columbia, and United States, from 2019 to 2020

Area	2020	2019	Change in life expectancy from 2019 to 2020
New York	77.7	80.7	-3.0
District of Columbia	75.3	78.0	-2.7
Louisiana	73.1	75.7	-2.6
New Jersey	77.5	80.1	-2.6
Arizona	76.3	78.8	-2.5
Mississippi	71.9	74.4	-2.5
New Mexico	74.5	76.9	-2.4
Illinois	76.8	79.0	-2.2
Texas	76.5	78.6	-2.1
Alabama	73.2	75.2	-2.0
Indiana	75.0	77.0	-2.0
Kentucky	73.5	75.5	-2.0
Michigan	76.0	78.0	-2.0
South Carolina	74.8	76.8	-2.0
Arkansas	73.8	75.7	-1.9
California	79.0	80.9	-1.9
Connecticut	78.4	80.3	-1.9
North Dakota	76.9	78.8	-1.9
Georgia	75.6	77.4	-1.8
Missouri	75.1	76.9	-1.8
United States	77.0	78.8	-1.8
Kansas	76.4	78.2	-1.8
Tennessee	73.8	75.6	-1.8
Colorado	78.3	80.0	-1.7
Maryland	76.8	78.5	-1.7
Nevada	76.3	78.0	-1.7
South Dakota	76.7	78.4	-1.7
West Virginia	72.8	74.5	-1.7
Montana	76.8	78.4	-1.6
Ohio	75.3	76.9	-1.6
Oklahoma	74.1	75.7	-1.6
Wisconsin	77.7	79.3	-1.6
Florida	77.5	79.0	-1.5
Iowa	77.5	79.0	-1.5
Nebraska	77.7	79.2	-1.5
North Carolina	76.1	77.6	-1.5
Pennsylvania	76.8	78.3	-1.5
Virginia	77.6	79.1	-1.5
Massachusetts	79.0	80.4	-1.4
Wyoming	76.3	77.7	-1.4
Delaware	76.7	78.1	-1.4
Minnesota	79.1	80.4	-1.3
Rhode Island	78.2	79.5	-1.3
Alaska	76.6	77.7	-1.1
Utah	78.6	79.7	-1.1
Idaho	78.4	79.5	-1.1
Vermont	78.8	79.8	-1.0
Oregon	78.8	79.6	-0.8
Washington	79.2	80.0	-0.8
Maine	77.8	78.3	-0.5
New Hampshire	79.0	79.4	-0.4
Hawaii	80.7	80.9	-0.2

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure 4. Decrease in life expectancy at birth from 2019 to 2020: Each state, District of Columbia, and United States, 2020



SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

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Technical Notes

The methods used to estimate the 2020 complete life tables for the 50 states and the District of Columbia (D.C.) are the same as those used to estimate the U.S. annual life tables, with two modifications (1). First, for states with zero death counts at single ages 1–4 years, linear interpolation was used to replace those zero death counts. For a few states, linear interpolation was also used to replace zero and negative death counts resulting from application of the Beers' smoothing technique to very small death counts for ages 6–12 years. Second, a modification was made to the estimation of the age-specific death rates for ages 66–99. Because state age-specific census population estimates for ages 85–100 are not available, the age range needed to be modified where vital and Medicare death rates are blended and where Medicare data are used exclusively. Details of the methodology and modifications follow.

Data for calculating life table functions

The data used to prepare the U.S. state life tables (Table I) include state-specific final death counts from the National Vital Statistics System (NVSS), state-specific population estimates from the U.S. Census Bureau, and state-specific death and population counts for Medicare beneficiaries aged 66–99 from the Centers for Medicare & Medicaid Services (CMS).

Vital statistics data

Death counts used for computing the life tables presented in this report are state-specific final numbers of deaths for 2020 collected from death certificates filed in state vital statistics offices and reported to the National Center for Health Statistics (NCHS) as part of NVSS.

Census population data

The population data used to estimate the life tables shown in this report are state-specific postcensal population estimates based on the 2010 decennial census and are available from the Census Bureau website at: https://www2.census.gov/programs-surveys/popest/datasets/2010-2020/counties/asrh/CC-EST2020-ALLDATA6.csv.

Medicare data

Data from the Medicare program are used to supplement vital statistics and census data for ages 66–99 for the total population and by sex for each state and D.C.

Medicare data are considered more accurate than vital statistics and census data at the oldest ages because Medicare enrollees must have proof of age to enroll (6). However, the reliability of Medicare data beyond age 100 declines because of the small percentage of people who enrolled at the start of the Medicare program in 1965 for whom it was not possible to verify exact age (6).

Table I. Complete period life tables: 50 states and District of Columbia, 2020

Available from: https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/71-02/

	Table title
AK–1.	Life table for total population: Alaska, 2020
AK–2.	Life table for males: Alaska, 2020
AK–3.	Life table for females: Alaska, 2020
AK–4.	Standard errors of probability of dying and life expectancy: Alaska, 2020
AL–1.	Life table for total population: Alabama, 2020
AL–2.	Life table for males: Alabama, 2020
AL–3.	Life table for females: Alabama, 2020
AL–4.	Standard errors of probability of dying and life expectancy: Alabama, 2020
AR–1.	Life table for total population: Arkansas, 2020
AR–2.	Life table for males: Arkansas, 2020
AR–3.	Life table for females: Arkansas, 2020
AR–4.	Standard errors of probability of dying and life expectancy: Arkansas, 2020
AZ–1.	Life table for total population: Arizona, 2020
AZ–2.	Life table for males: Arizona, 2020
AZ–3.	Life table for females: Arizona, 2020
AZ–4.	Standard errors of probability of dying and life expectancy: Arizona, 2020
CA–1.	Life table for total population: California, 2020
CA–2.	Life table for males: California, 2020
CA–3.	Life table for females: California, 2020
CA–4.	Standard errors of probability of dying and life expectancy: California, 2020
CO–1.	Life table for total population: Colorado, 2020
CO–2.	Life table for males: Colorado, 2020
CO–3.	Life table for females: Colorado, 2020
CO–4.	Standard errors of probability of dying and life expectancy: Colorado, 2020
CT–1.	Life table for total population: Connecticut, 2020
CT–2.	Life table for males: Connecticut, 2020
CT–3.	Life table for females: Connecticut, 2020
CT–4.	Standard errors of probability of dying and life expectancy: Connecticut, 2020
DC–1.	Life table for total population: District of Columbia, 2020
DC–2.	Life table for males: District of Columbia, 2020
DC–3.	Life table for females: District of Columbia, 2020
DC–4.	Standard errors of probability of dying and life expectancy: District of Columbia, 2020
DE–1.	Life table for total population: Delaware, 2020
DE–2.	Life table for males: Delaware, 2020
DE–3.	Life table for females: Delaware, 2020
DE–4.	Standard errors of probability of dying and life expectancy: Delaware, 2020
FL–1.	Life table for total population: Florida, 2020
FL–2.	Life table for males: Florida, 2020
FL–3.	Life table for females: Florida, 2020
FL–4.	Standard errors of probability of dying and life expectancy: Florida, 2020
GA–1.	Life table for total population: Georgia, 2020
GA–2.	Life table for males: Georgia, 2020
GA–3.	Life table for females: Georgia, 2020
GA–4.	Standard errors of probability of dying and life expectancy: Georgia, 2020
HI–1.	Life table for total population: Hawaii, 2020
HI–2.	Life table for males: Hawaii, 2020
HI–3.	Life table for females: Hawaii, 2020
HI–4.	Standard errors of probability of dying and life expectancy: Hawaii, 2020
IA–1.	Life table for total population: Iowa, 2020
IA–2.	Life table for males: Iowa, 2020
IA–3.	Life table for females: Iowa, 2020
IA–4.	Standard errors of probability of dying and life expectancy: Iowa, 2020

See footnote at end of table.

Table I. Complete period life tables: 50 states and District of Columbia, 2020—Con.

Available from: https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/71-02/

Table title
ID–1. Life table for total population: Idaho, 2020
ID–2. Life table for males: Idaho, 2020
ID–3. Life table for females: Idaho, 2020
ID–4. Standard errors of probability of dying and life expectancy: Idaho, 2020
IL–1. Life table for total population: Illinois, 2020
IL–2. Life table for males: Illinois, 2020
IL–3. Life table for females: Illinois, 2020
IL–4. Standard errors of probability of dying and life expectancy: Illinois, 2020
IN–1. Life table for total population: Indiana, 2020
IN–2. Life table for males: Indiana, 2020
IN–3. Life table for females: Indiana, 2020
IN–4. Standard errors of probability of dying and life expectancy: Indiana, 2020
KS–1. Life table for total population: Kansas, 2020
KS–2. Life table for males: Kansas, 2020
KS–3. Life table for females: Kansas, 2020
KS–4. Standard errors of probability of dying and life expectancy: Kansas, 2020
KY–1. Life table for total population: Kentucky, 2020
KY–2. Life table for males: Kentucky, 2020
KY–3. Life table for females: Kentucky, 2020
KY–4. Standard errors of probability of dying and life expectancy: Kentucky, 2020
LA–1. Life table for total population: Louisiana, 2020
LA–2. Life table for males: Louisiana, 2020
LA–3. Life table for females: Louisiana, 2020
LA–4. Standard errors of probability of dying and life expectancy: Louisiana, 2020
MA–1. Life table for total population: Massachusetts, 2020
MA–2. Life table for males: Massachusetts, 2020
MA–3. Life table for females: Massachusetts, 2020
MA–4. Standard errors of probability of dying and life expectancy: Massachusetts, 2020
MD–1. Life table for total population: Maryland, 2020
MD–2. Life table for males: Maryland, 2020
MD–3. Life table for females: Maryland, 2020
MD–4. Standard errors of probability of dying and life expectancy: Maryland, 2020
ME–1. Life table for total population: Maine, 2020
ME–2. Life table for males: Maine, 2020
ME–3. Life table for females: Maine, 2020
ME–4. Standard errors of probability of dying and life expectancy: Maine, 2020
MI–1. Life table for total population: Michigan, 2020
MI–2. Life table for males: Michigan, 2020
MI–3. Life table for females: Michigan, 2020
MI–4. Standard errors of probability of dying and life expectancy: Michigan, 2020
MN–1. Life table for total population: Minnesota, 2020
MN–2. Life table for males: Minnesota, 2020
MN–3. Life table for females: Minnesota, 2020
MN–4. Standard errors of probability of dying and life expectancy: Minnesota, 2020
MO–1. Life table for total population: Missouri, 2020
MO–2. Life table for males: Missouri, 2020
MO–3. Life table for females: Missouri, 2020
MO–4. Standard errors of probability of dying and life expectancy: Missouri, 2020
MS–1. Life table for total population: Mississippi, 2020
MS–2. Life table for males: Mississippi, 2020
MS–3. Life table for females: Mississippi, 2020
MS–4. Standard errors of probability of dying and life expectancy: Mississippi, 2020
MT–1. Life table for total population: Montana, 2020
MT–2. Life table for males: Montana, 2020
MT–3. Life table for females: Montana, 2020
MT–4. Standard errors of probability of dying and life expectancy: Montana, 2020
NC–1. Life table for total population: North Carolina, 2020
NC–2. Life table for males: North Carolina, 2020
NC–3. Life table for females: North Carolina, 2020
NC–4. Standard errors of probability of dying and life expectancy: North Carolina, 2020
ND–1. Life table for total population: North Dakota, 2020
ND–2. Life table for males: North Dakota, 2020
ND–3. Life table for females: North Dakota, 2020
ND–4. Standard errors of probability of dying and life expectancy: North Dakota, 2020
NE–1. Life table for total population: Nebraska, 2020
NE–2. Life table for males: Nebraska, 2020
NE–3. Life table for females: Nebraska, 2020
NE–4. Standard errors of probability of dying and life expectancy: Nebraska, 2020
NH–1. Life table for total population: New Hampshire, 2020
NH–2. Life table for males: New Hampshire, 2020
NH–3. Life table for females: New Hampshire, 2020
NH–4. Standard errors of probability of dying and life expectancy: New Hampshire, 2020
NJ–1. Life table for total population: New Jersey, 2020
NJ–2. Life table for males: New Jersey, 2020
NJ–3. Life table for females: New Jersey, 2020
NJ–4. Standard errors of probability of dying and life expectancy: New Jersey, 2020
NM–1. Life table for total population: New Mexico, 2020
NM–2. Life table for males: New Mexico, 2020
NM–3. Life table for females: New Mexico, 2020
NM–4. Standard errors of probability of dying and life expectancy: New Mexico, 2020
NV–1. Life table for total population: Nevada, 2020
NV–2. Life table for males: Nevada, 2020
NV–3. Life table for females: Nevada, 2020
NV–4. Standard errors of probability of dying and life expectancy: Nevada, 2020
NY–1. Life table for total population: New York, 2020
NY–2. Life table for males: New York, 2020
NY–3. Life table for females: New York, 2020
NY–4. Standard errors of probability of dying and life expectancy: New York, 2020
OH–1. Life table for total population: Ohio, 2020
OH–2. Life table for males: Ohio, 2020
OH–3. Life table for females: Ohio, 2020
OH–4. Standard errors of probability of dying and life expectancy: Ohio, 2020
OK–1. Life table for total population: Oklahoma, 2020
OK–2. Life table for males: Oklahoma, 2020
OK–3. Life table for females: Oklahoma, 2020
OK–4. Standard errors of probability of dying and life expectancy: Oklahoma, 2020
OR–1. Life table for total population: Oregon, 2020
OR–2. Life table for males: Oregon, 2020
OR–3. Life table for females: Oregon, 2020
OR–4. Standard errors of probability of dying and life expectancy: Oregon, 2020
PA–1. Life table for total population: Pennsylvania, 2020
PA–2. Life table for males: Pennsylvania, 2020
PA–3. Life table for females: Pennsylvania, 2020

See footnote at end of table.

Table I. Complete period life tables: 50 states and District of Columbia, 2020—Con.

Available from: https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/71-02/

	Table title
PA–4.	Standard errors of probability of dying and life expectancy: Pennsylvania, 2020
RI–1.	Life table for total population: Rhode Island, 2020
RI–2.	Life table for males: Rhode Island, 2020
RI–3.	Life table for females: Rhode Island, 2020
RI–4.	Standard errors of probability of dying and life expectancy: Rhode Island, 2020
SC–1.	Life table for total population: South Carolina, 2020
SC–2.	Life table for males: South Carolina, 2020
SC–3.	Life table for females: South Carolina, 2020
SC–4.	Standard errors of probability of dying and life expectancy: South Carolina, 2020
SD–1.	Life table for total population: South Dakota, 2020
SD–2.	Life table for males: South Dakota, 2020
SD–3.	Life table for females: South Dakota, 2020
SD–4.	Standard errors of probability of dying and life expectancy: South Dakota, 2020
TN–1.	Life table for total population: Tennessee, 2020
TN–2.	Life table for males: Tennessee, 2020
TN–3.	Life table for females: Tennessee, 2020
TN–4.	Standard errors of probability of dying and life expectancy: Tennessee, 2020
TX–1.	Life table for total population: Texas, 2020
TX–2.	Life table for males: Texas, 2020
TX–3.	Life table for females: Texas, 2020
TX–4.	Standard errors of probability of dying and life expectancy: Texas, 2020
UT–1.	Life table for total population: Utah, 2020
UT–2.	Life table for males: Utah, 2020
UT–3.	Life table for females: Utah, 2020
UT–4.	Standard errors of probability of dying and life expectancy: Utah, 2020
VA–1.	Life table for total population: Virginia, 2020
VA–2.	Life table for males: Virginia, 2020
VA–3.	Life table for females: Virginia, 2020
VA–4.	Standard errors of probability of dying and life expectancy: Virginia, 2020
VT–1.	Life table for total population: Vermont, 2020
VT–2.	Life table for males: Vermont, 2020
VT–3.	Life table for females: Vermont, 2020
VT–4.	Standard errors of probability of dying and life expectancy: Vermont, 2020
WA–1.	Life table for total population: Washington, 2020
WA–2.	Life table for males: Washington, 2020
WA–3.	Life table for females: Washington, 2020
WA–4.	Standard errors of probability of dying and life expectancy: Washington, 2020
WI–1.	Life table for total population: Wisconsin, 2020
WI–2.	Life table for males: Wisconsin, 2020
WI–3.	Life table for females: Wisconsin, 2020
WI–4.	Standard errors of probability of dying and life expectancy: Wisconsin, 2020
WV–1.	Life table for total population: West Virginia, 2020
WV–2.	Life table for males: West Virginia, 2020
WV–3.	Life table for females: West Virginia, 2020
WV–4.	Standard errors of probability of dying and life expectancy: West Virginia, 2020
WY–1.	Life table for total population: Wyoming, 2020
WY–2.	Life table for males: Wyoming, 2020
WY–3.	Life table for females: Wyoming, 2020
WY–4.	Standard errors of probability of dying and life expectancy: Wyoming, 2020

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

To estimate death rates for the state-specific Medicare populations in 2020, sex- and age-specific numbers of deaths and population counts were used for the population aged 66–99 in each state and D.C. from the 2020 Medicare file. The data file, created by CMS for the Social Security Administration, is shared with NCHS under a special agreement. The 2020 file contains state-specific 2020 midyear Medicare population counts (as of June 30, 2020) and calendar-year Medicare death counts (for January 1 through December 31, 2020). Age for both death and midyear population counts is calculated as age at last birthday.

Preliminary adjustment of data

Adjustments for unknown age

An adjustment is made to account for the small proportion of deaths each year for which age is not reported on the death certificate. The number of deaths in each age category is adjusted proportionally to account for those with not-stated age. An adjustment factor (F) is used to distribute deaths with nonstated ages. F is calculated for the total population and by sex for each state and D.C. as:

$$F = \frac{D}{D^a} \qquad [1]$$

where D is the total number of deaths and D^a is the total number of deaths for which age is stated. F is then applied by multiplying it by the number of deaths in each age group.

Interpolation of P_x and D_x

Anomalies—both random and those associated with reporting age at death—can be problematic when using vital statistics and census data by single years of age to estimate the probability of death (2,7). Graduation techniques are often used to eliminate these anomalies and to derive a smooth curve by age. Beers' ordinary minimized fifth difference formula is used to obtain smoothed values of population counts (P_x) and death counts (D_x) from 5-year age groupings of ${}_nP_x$ from ages 0–99 and ${}_nD_x$ from ages 5–99, and where ${}_nD_x$ has first been adjusted for not-reported age on the death certificate (see reference 8 for details on the application of Beers' method). Beers' interpolation is not applied to deaths at ages 0–4.

For states with zero death counts in the age range 1–4 years, those counts needed to be replaced using linear interpolation; otherwise, zero death counts would have resulted in discontinuation of the age-specific mortality distribution. In a few other cases, application of Beers' interpolation of deaths in the age range 6–10 resulted in zero or negative death counts because of very small numbers of deaths, so linear interpolation was also applied. The assumption of linearity is warranted because mortality declines somewhat linearly between ages 1 and 10 or so, and the results led to smooth age patterns of mortality (see Table II for a list of states and ages where linear interpolation was used).

Table II. Application of linear interpolation by selected area, age, and sex

Area	Age (years)	
	Male	Female
Alaska	2	1
Colorado	…	6
District of Columbia	4	2,3
Delaware	3,9,10	1,4
Hawaii	2,3,4	4
Idaho	…	3
Maine	3	1,3
Mississippi	…	4
Montana	2	4
North Dakota	…	2,3
New Hampshire	3	2,4
Nevada	2,4	…
Oregon	…	4
Rhode Island	3,4	3
South Dakota	…	1,4
Vermont	1,2,3	1,2,3,4
Wyoming	2,4	2,3

… Category not applicable.

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Calculation of probability of dying (q_x)

The first step in the calculation of a complete period life table is estimation of the age-specific probability of dying, q_x, which is derived from the age-specific death rate, m_x (2,4). In the life table cohort,

$$m_x = \frac{d_x}{L_x}$$

where d_x is the number of deaths occurring between ages x and $x + 1$, and L_x is the number of person-years lived by the life table cohort between ages x and $x + 1$. The conversion of the age-specific death rate, m_x, to the age-specific probability of death, q_x, is:

$$q_x = \frac{m_x}{1+(1-a_x)m_x} \quad [2]$$

where a_x is the fraction of the number of person-years lived in the age interval by members of the life table cohort who died in the interval. When the age interval is 1 year, except at infancy, a_x = 1/2; in other words, deaths occur on average midway through the age interval. As a result,

$$q_x = \frac{m_x}{1+\frac{1}{2}m_x} \quad [3]$$

Because the complete period life table is based on the age-specific death rates of a current population observed for a specific calendar year, the life table death rate is equivalent to the observed death rate of the current population:

$$m_x = \frac{d_x}{L_x} = M_x = \frac{D_x}{P_x}$$

where D_x is the Beers' smoothed (or linearly interpolated) number of deaths adjusted for not-stated age and P_x is the Beers' smoothed population at risk of dying between ages x and $x + 1$. Then,

$$q_x = \frac{M_x}{1+\frac{1}{2}M_x} = \frac{D_x}{P_x+\frac{1}{2}D_x} \quad [4]$$

This procedure is used to estimate vital statistics age-specific probabilities of death for ages 1–84.

Calculation of q_x at age 0

The higher mortality observed in infancy is associated with a high concentration of deaths occurring at the beginning of the age interval rather than in the middle. Consequently, assigning deaths to the appropriate birth cohorts is best whenever possible. As a result, the probability of death at birth, q_0, is calculated using a birth cohort method that uses a separation factor (f) defined as the proportion of infant deaths in year t occurring to infants born in the previous year ($t - 1$). The value f is estimated by categorizing infant deaths by date of birth. The probability of death is then calculated as:

$$q_0 = \frac{D_0(1-f)}{B^t} + \frac{D_0(f)}{B^{t-1}} \quad [5]$$

where D_0 is the number of infant deaths adjusted for not-stated age in 2020, B^t is the number of live births in 2020, and B^{t-1} is the number of live births in 2019.

Probabilities of dying at oldest ages

Medicare data are used to supplement vital statistics data for the estimation of q_x at the oldest ages because these data are more accurate, given that proof of age is required for enrollment in the Medicare program. Medicare data are used here to estimate the probability of dying for ages 66–99.

For this method, these steps are followed: First, vital statistics and Medicare death rates are blended in the age range 66–99. Second, a logistic model is used to smooth the blended death rates in the age range 85–99 and to predict death rates for ages 100–120. Third, final resulting death rates, M_x, are converted to probabilities of dying, q_x.

For the national life tables, vital statistics, M_x^V, and Medicare, M_x^M, death rates are blended in the age range 66–94 with a weighting process that gives gradually declining weight to vital statistics data and gradually increasing weight to Medicare data. For ages 95–99, M_x^M is used exclusively. Due to the unavailability of census state population estimates for ages 85–100, calculating M_x^V for this age span is not possible. As a result, the blending technique was modified such that M_x^V and M_x^M are blended in the age range 66–84, and M_x^M is used exclusively in the age range 85–99. Blended M_x is obtained as:

$$M_x = \frac{1}{20}[(85-x)M_x^V + (x-65)M_x^M] \quad [6]$$

when x = 66,…,84, and

$$M_x = M_x^M$$

when $x = 85,\ldots,99$. M_x^M is estimated as:

$$M_x^M = \frac{D_x^M}{P_x^M}$$

where D_x^M is the age-specific Medicare death count, and P_x^M is the age-specific Medicare midyear population count.

The exclusive use of Medicare death rates beginning at age 85 for the state life tables is expected to have a negligible biasing effect on mortality at older ages in the life tables compared with the national life tables. As Figures I–III show, while large differences are found between Medicare and vital statistics death rates at ages 85 and over for the U.S. population, blended Medicare and vital statistics death rates are very similar to Medicare death rates for ages 85 and over.

A logistic model proposed by Kannisto is then used to smooth M_x in the age range 85–99 and to predict M_x in the age range 100–120 (8). The start of the modeled age range varies by sex because it is a function of the age at which the rate of change in the age-specific death rates peaks. In current times, the rate of change in the age-specific death rate rises steadily up to about ages 80–85 and then begins to decline. As a result, modeling a large age span such as 65–100 with one simple model is difficult without oversmoothing and consequently altering the underlying mortality pattern observed in the population of interest (9). Further, the observed data for the age range 65–85 or so is reliable and robust, as indicated by the very close similarity between vital statistics and Medicare death rates, making it unnecessary to model, or smooth, the entire age span (65–100).

The Kannisto model is a simple form of a logistic model in which the logit of u_x (or the natural log of the odds of u_x) is a linear function of age x (8). It is expressed as:

$$\ln[\frac{u_x}{1-u_x}] = \ln(\alpha) + \beta x \quad [7]$$

where u_x, the force of mortality (or the instantaneous death rate) is defined as:

$$u_x = \frac{\alpha e^{\beta x}}{1+\alpha e^{\beta x}}$$

Because u_x is not directly observed but is closely approximated by m_x, and $m_x = M_x$, then the logit of M_x is modeled instead. A maximum-likelihood generalized linear model estimation procedure is used to fit the following model in the age range 85–99:

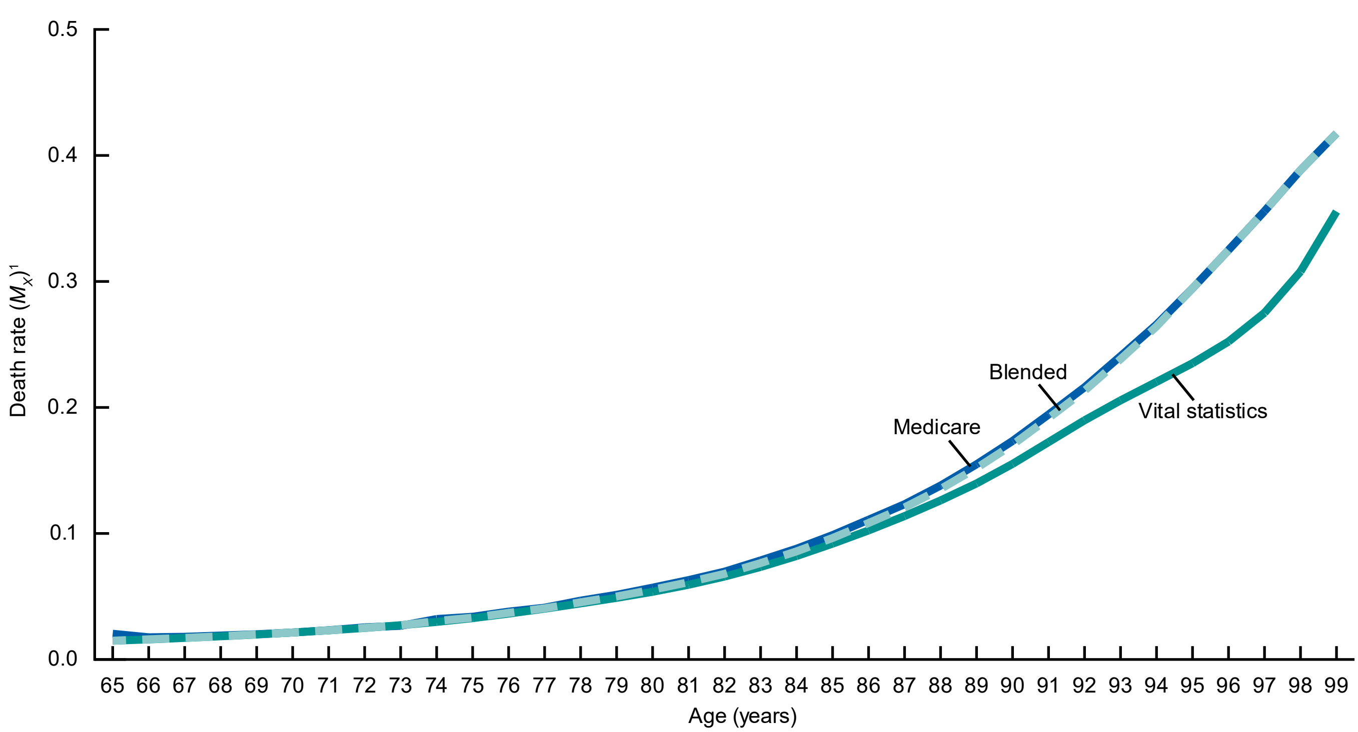
$$\ln[\frac{M_x}{1-M_x}] = \ln(\alpha) + \beta x \quad [8]$$

Then, the estimated parameters are used to predict $\overline{M}_x$ as:

$$\overline{M}_x = \frac{e^a e^{bx}}{1+e^a e^{bx}} \text{ or, equivalently, } \overline{M}_x = \frac{e^{a+bx}}{1+e^{a+bx}} \quad [9]$$

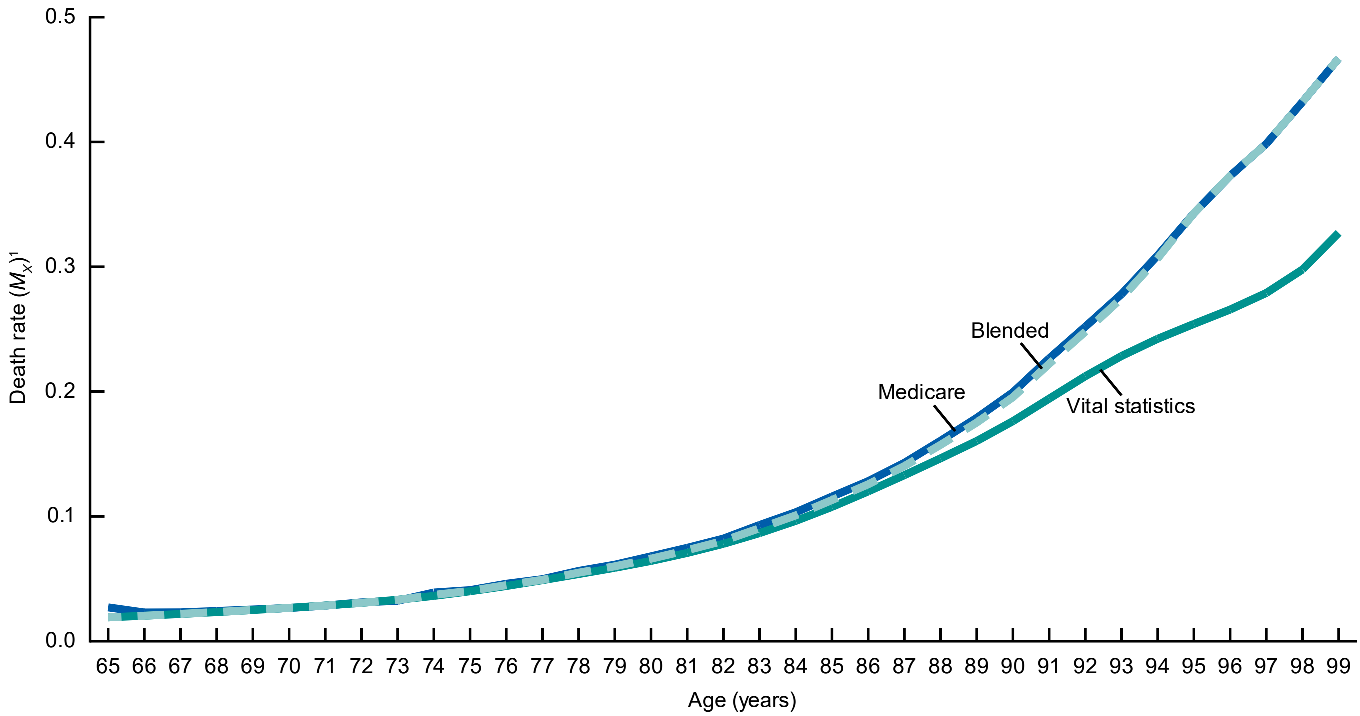
where a and b are the predicted values of parameters $\ln(\alpha)$ and β, respectively, given by fitting model 8.

Figure I. Age-specific vital statistics, Medicare, and blended death rates for total population: United States, 2020



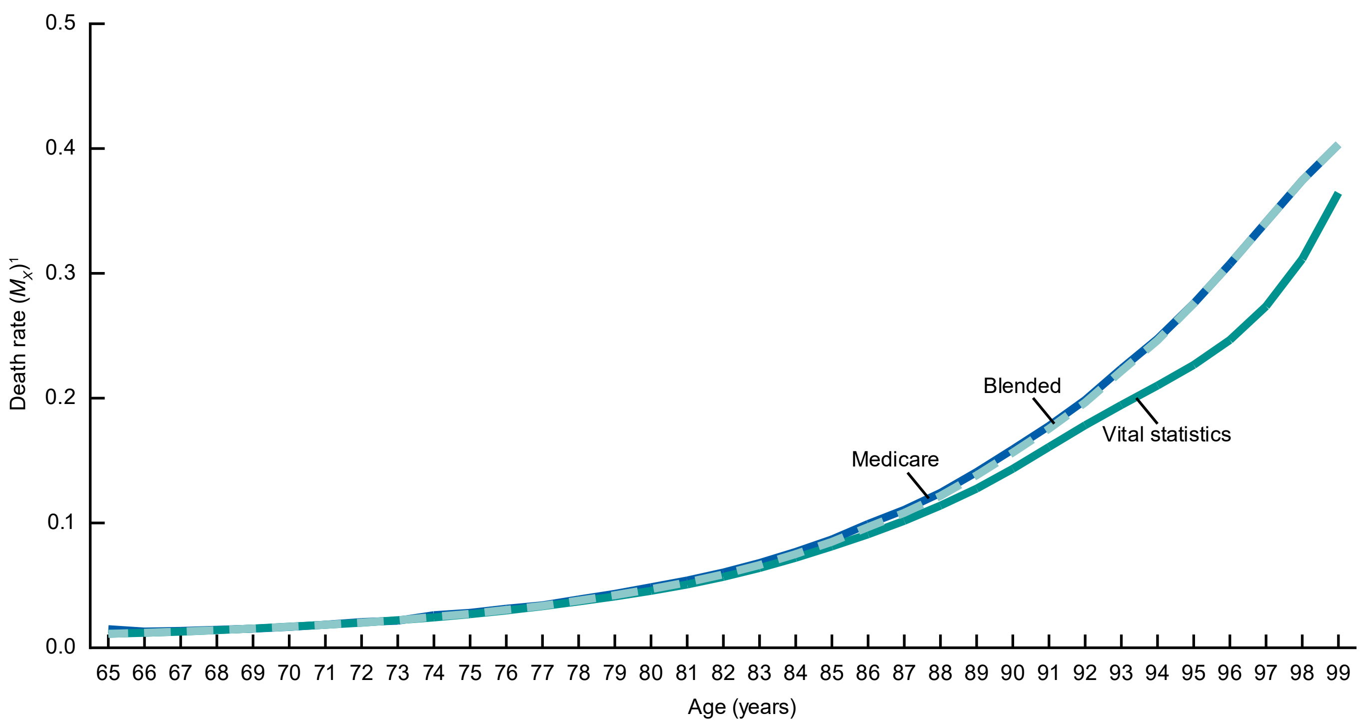
[1]Rate (M_x) is defined as the number of deaths during the year divided by the midyear population (D_x/P_x).
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure II. Age-specific vital statistics, Medicare, and blended death rates for male population: United States, 2020



[1]Rate (M_x) is defined as the number of deaths during the year divided by the midyear population (D_x/P_x).
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure III. Age-specific vital statistics, Medicare, and blended death rates for female population: United States, 2020



[1]Rate (M_x) is defined as the number of deaths during the year divided by the midyear population (D_x/P_x).
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Finally, the predicted probability of death, $\bar{q}_x$, for ages 85–120 is estimated by converting $\bar{M}_x$ as:

$$\bar{q}_x = \frac{\bar{M}_x}{1+\frac{1}{2}\bar{M}_x} \quad [10]$$

The probability of death is extrapolated to age 120 to estimate the life table population until no survivors remain. This information is then used to estimate L_x for ages 100–120, which is used to close the table with the age category 100 and over, combined (see following discussion).

Figures IV–VI show the age-specific probability of dying, q_x, estimates for each of the 50 states and D.C. compared with the values for the United States in 2020. The observed probabilities for the states and D.C. are shown as circles, which appear as vertical bars where they overlap, and the U.S. probabilities are shown as an intersecting connected line. The state estimates fall about the U.S. values as expected, with a few outliers in the youngest childhood ages. These few cases are predominantly the result of a very small number of deaths, consistent with very low mortality in this age range, combined with very small populations in states such as Vermont, Wyoming, and North Dakota. Overall, age-specific estimates for the 50 states and D.C. follow the expected age pattern of mortality and are consistent with the mortality pattern observed for the entire United States.

Calculation of remaining life table functions for all groups

Survivor function (l_x)

The life table radix, l_0, is set at 100,000. For ages over 0, the number of survivors remaining at exact age x is calculated as

$$l_x = l_{x-1}(1-q_{x-1}) \quad [11]$$

Decrement function (d_x)

The number of deaths occurring between ages x and $x+1$ is calculated from the survivor function:

$$d_x = l_x - l_{x+1} = l_x q_x \quad [12]$$

Note that ${}_{\infty}d_{100} = {}_{\infty}l_{100}$ because ${}_{\infty}q_{100} = 1.0$.

Person-years lived (L_x)

Person-years lived for ages 1–99 are calculated assuming that the survivor function declines linearly between ages x and $x+1$. This gives the formula:

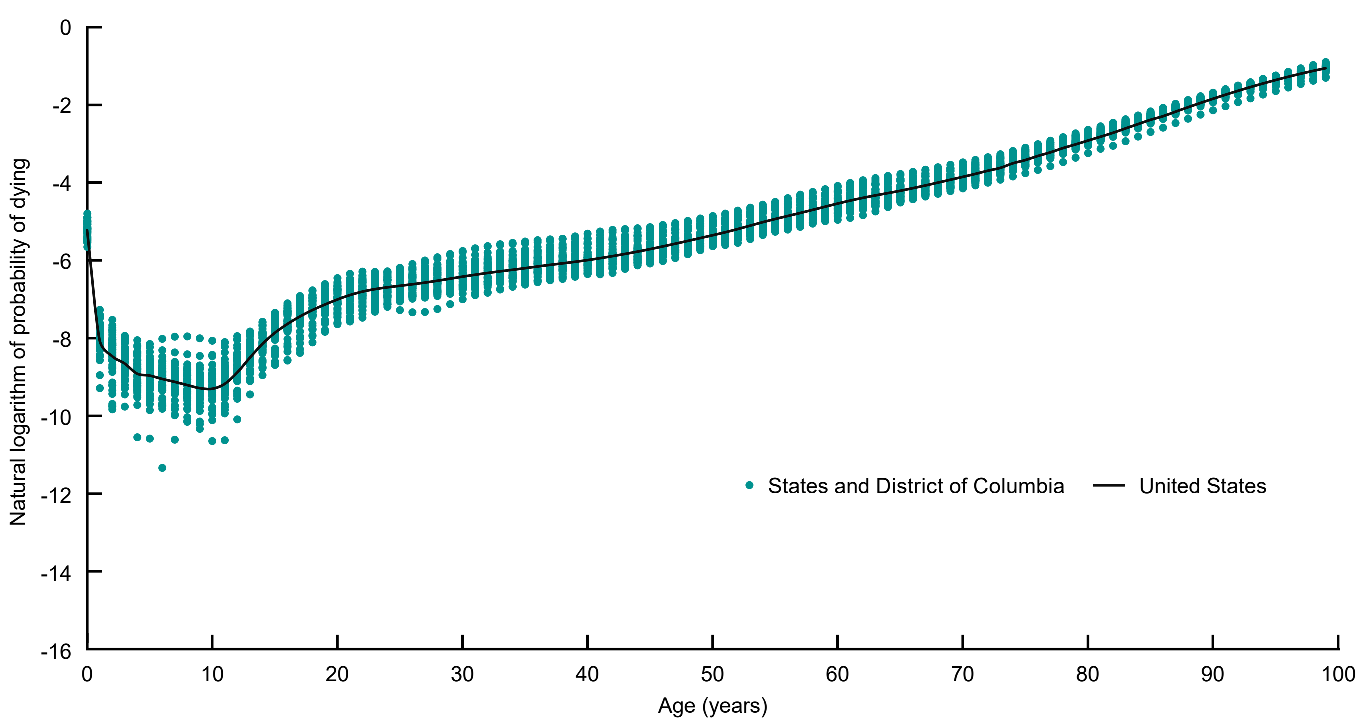
$$L_x = \frac{1}{2}(l_x + l_{x+1}) = l_x - \frac{1}{2}d_x \quad [13]$$

For $x = 0$, the separation factor f is used to calculate L_0:

$$L_0 = fl_0 + (1-f)\,l_1 \quad [14]$$

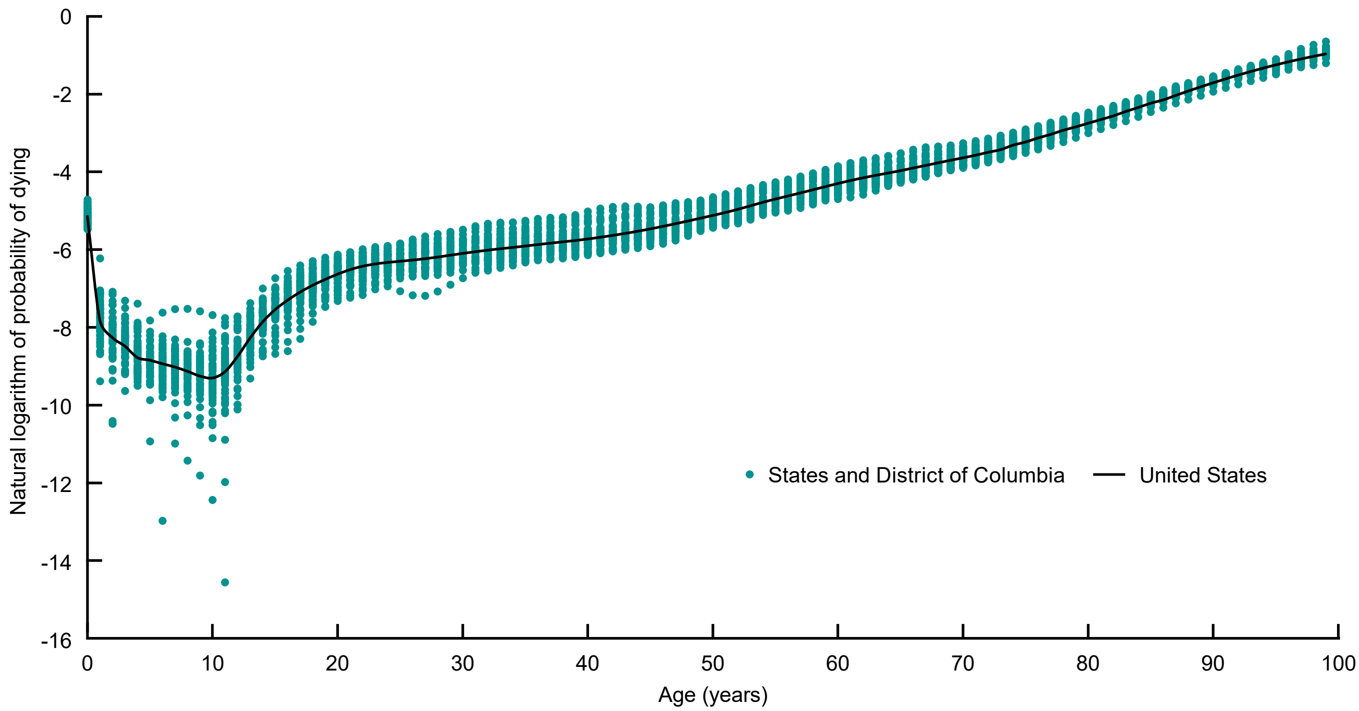
Finally, ${}_{\infty}L_{100}$ is estimated as the sum of the extrapolated L_x values for ages 100–120.

Figure IV. Age patterns of mortality for states and District of Columbia compared with United States, 2020



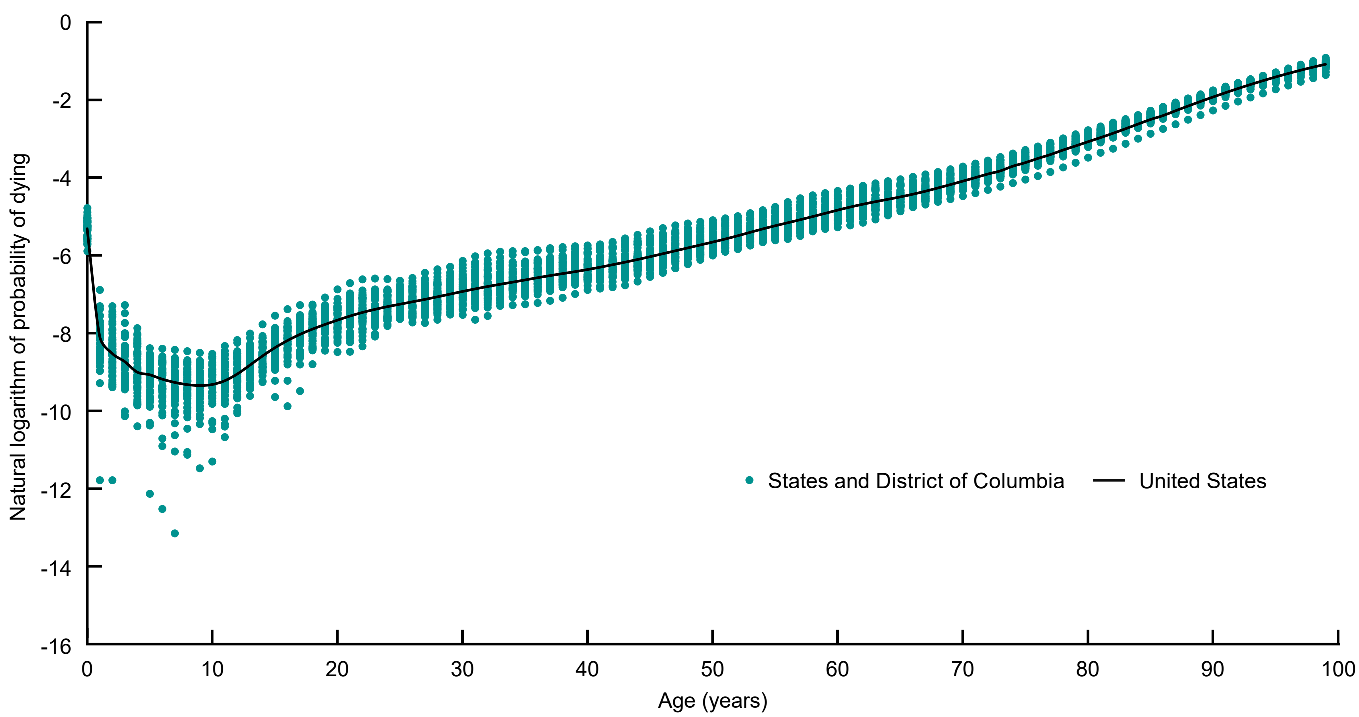
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure V. Male age patterns of mortality for states and District of Columbia compared with United States, 2020



SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Figure VI. Female age patterns of mortality for states and District of Columbia compared with United States, 2020



SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality.

Person-years lived at age *x* and over (T_x)

T_x is calculated by summing L_x values at age x and over:

$$T_x = \sum_{x=0}^{\infty} L_x \qquad [15]$$

Life expectancy at age *x* (e_x)

Life expectancy at exact age x is calculated as:

$$e_x = \frac{T_x}{l_x} \qquad [16]$$

Variances and standard errors of probability of dying and life expectancy

The mortality data on which the life tables are based are not affected by sampling error because the data are based on complete counts of deaths, and, as a result, variances and standard errors reflect only random variation. While measurement errors such as age misreporting are known to affect mortality estimates, they are not considered in the calculation of the variances or standard errors of the life table functions. Because the state life tables presented in this report are based on relatively large numbers of deaths, the variances and standard errors presented are rather small.

The methods used to estimate the variances of q_x and e_x are based on Chiang (10) with some necessary modifications due to the use of statistical modeling for smoothing and prediction of older-age death rates. Based on the assumption that deaths are binomially distributed, Chiang proposed the following equation for the variance of q_x:

$$Var\,(q_x) = \frac{q_x^2(1-q_x)}{D_x} \qquad [17]$$

where D_x is the age-specific death count. This equation is used to estimate $Var(q_x)$ throughout the age span with a modification where, for ages under age 66, D_x is the deaths from vital statistics data, smoothed by interpolation and adjusted for the number of deaths with age not stated. For ages 66 and over, D_x is obtained by treating the population as a cohort population and calculated from q_x because blended vital statistics and Medicare data were used for estimation (7):

$$P_x = \frac{(P_{x-1} - 0.5D_{x-1})(2 - q_x)}{2}$$

$$D_x = \frac{q_x P_x}{1 - 0.5q_x}$$

Standard error of q_x

The standard error of q_x is calculated as:

$$SE\,(q_x) = \sqrt{Var\,(q_x)} \qquad [18]$$

Variances of the life expectancies for ages 0–99 are estimated using Chiang's equation:

$$Var(e_x) = \frac{\sum_{x=0}^{x=99} l_x^2 \bullet [(1-0.5) + e_x]^2 \bullet Var\,(q_x)}{l_x^2} \qquad [19]$$

Chiang assumed that because q_{100+} = 1.00, then $Var(q_{100+})$ = 0, and as a result, $Var(e_{100+})$ = 0. Silcocks et al. proposed that in the final age group, life expectancy is dependent on the mean length of survival and not on the probability of survival, and consequently the assumption of no variance is incorrect. $Var(e_{100+})$ can be approximated as (11):

$$Var\left(e_{100+}\right) \approx \left[\frac{l_{100+}^2}{M_{100+}^4} \bullet Var\left(M_{100+}\right)\right] / \, l_{100+}^2 \qquad [20]$$

Standard error of e_x

The standard error of e_x is calculated as:

$$SE\,(e_x) = \sqrt{Var\,(e_x)} \qquad [21]$$

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National Vital Statistics Reports, Vol. 71, No. 2, August 23, 2022

Contents

Acknowledgments

The authors are grateful for the reviews and comments provided by Robert N. Anderson, Mortality Statistics Branch, Division of Vital Statistics (DVS); Andrés A. Berruti, DVS; and Amy Branum, Office of the Director. The authors thank Anne Driscoll, Danielle Ely, and Brady Hamilton of the Reproductive Statistics Branch for their assistance with birth data. NCHS Office of Information Services, Information Design and Publishing Staff edited and produced this report: editor Jane Sudol, typesetter Ebony Davis, typesetter and graphic designer Kyung Park, and designer Michael W. Jones (contractor).

Suggested citation

Arias E, Xu JQ, Tejada-Vera B, Murphy SL, Bastian B. U.S. state life tables, 2020. National Vital Statistics Reports; vol 71 no 2. Hyattsville, MD: National Center for Health Statistics. 2022. DOI: https://dx.doi.org/10.15620/cdc:118271.