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U.S. State Life Tables, 2021

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Abstract

Objectives—This report presents complete period life tables for each of the 50 states and the District of Columbia by sex based on age-specific death rates in 2021.

Methods—Data used to prepare the 2021 state-specific life tables include: 2021 final mortality statistics; July 1, 2021, population estimates based on the Blended Base population estimates produced by the U.S. Census Bureau; and 2021 Medicare data for people ages 66–99. The methodology used to estimate the state-specific life tables is the same as that used to estimate the 2021 national life tables, with some modifications.

Results—Among the 50 states and District of Columbia, Hawaii had the highest life expectancy at birth, 79.9 years in 2021, and Mississippi had the lowest, 70.9 years. From 2020 to 2021, life expectancy at birth declined for 39 states, increased for 11 states, and remained unchanged for the District of Columbia. In 2021, life expectancy at age 65 ranged from 16.1 years in Mississippi to 20.6 years in Hawaii. Life expectancy at birth was higher for females in all states and the District of Columbia. The difference in life expectancy between females and males ranged from 3.9 years in Utah to 7.6 years in New Mexico.

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 District of Columbia (D.C.) for 2021. Life tables were produced for the total, male, and female populations of each state and D.C. based on age-specific death rates for 2021. 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 2021 assumes a hypothetical cohort that is subject throughout its lifetime to the age-specific death rates prevailing for the actual population in 2021. 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 2021 in a series of annual, complete period state-specific life tables.

Data and Methods

The data used to prepare the U.S. state life tables for 2021 are state-specific final numbers of deaths for 2021; July 1, 2021, state-specific population estimates based on the Blended Base produced by the U.S. Census Bureau in lieu of the April 1, 2020, decennial population count. The Blended Base consists of the blend of 2020 postcensal population estimates, based on the April 1, 2010, census; 2020 Demographic Analysis Estimates; and the 2020 Census PL 94-171 Redistricting File (see https://www2.census.gov/programs-surveys/popest/technical-documentation/methodology/2020-2021/methods-statement-v2021.pdf); and state-specific death and population counts for Medicare beneficiaries ages 66–99 for 2021 from the Centers for Medicare & Medicaid Services. Data from the Medicare program are used to supplement vital statistics and census data for those ages 66 and older.

The methodology used to estimate the 2021 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 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 0.000756 (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 2021, 99,196 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 2021, 75 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 99,233 for males in the age interval 20–21 is the total number of years lived between the 20th and 21st birthdays by the 99,271 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 5,703,533 is the total number of years lived after reaching age 20 by the 99,271 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 57.5 years (5,703,533 divided by 99,271) (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, 2021” at: ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/73-07/. Table I lists table titles for each of these tables. Table numbering is based on the federal information processing standards, or FIPS, alphabetical 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.

Table A. Life expectancy at birth, rank, and standard error, by sex: Each state, District of Columbia, and United States, 2021

Area	Total			Male			Female		
	Rank	Life expectancy (years)	Standard error	Rank	Life expectancy (years)	Standard error	Rank	Life expectancy (years)	Standard error
Hawaii	1	79.9	0.118	1	77.0	0.172	1	83.1	0.155
Massachusetts	2	79.6	0.050	2	76.9	0.074	2	82.2	0.065
Connecticut	3	79.2	0.074	4	76.3	0.110	3	82.0	0.097
New York	4	79.0	0.031	7	76.3	0.045	4	81.6	0.040
New Jersey	5	79.0	0.045	5	76.3	0.065	5	81.6	0.058
Minnesota	6	78.8	0.059	3	76.3	0.086	6	81.4	0.078
New Hampshire	7	78.5	0.117	8	76.1	0.172	9	81.1	0.155
Rhode Island	8	78.5	0.130	9	75.9	0.191	10	81.0	0.171
Vermont	9	78.4	0.176	11	75.7	0.255	8	81.2	0.237
California	10	78.3	0.023	13	75.3	0.033	7	81.4	0.030
Washington	11	78.2	0.050	10	75.8	0.073	11	80.8	0.067
Utah	12	78.2	0.078	6	76.3	0.113	18	80.2	0.105
Nebraska	13	77.8	0.101	12	75.4	0.143	16	80.3	0.138
Wisconsin	14	77.8	0.059	14	75.2	0.085	14	80.5	0.079
Colorado	15	77.7	0.060	16	75.0	0.087	12	80.6	0.080
Iowa	16	77.7	0.077	15	75.2	0.111	15	80.4	0.103
North Dakota	17	77.6	0.164	17	75.0	0.232	13	80.5	0.224
Oregon	18	77.4	0.067	18	74.8	0.098	17	80.2	0.089
Maryland	19	77.2	0.059	20	74.3	0.087	20	79.9	0.077
Idaho	20	77.2	0.104	19	74.8	0.151	22	79.7	0.137
Illinois	21	77.1	0.041	21	74.2	0.060	19	80.0	0.054
Virginia	22	76.8	0.049	22	74.2	0.071	24	79.4	0.065
Maine	23	76.7	0.126	24	73.8	0.184	21	79.8	0.166
South Dakota	24	76.6	0.164	23	74.1	0.230	25	79.3	0.230
Pennsylvania	25	76.4	0.041	25	73.6	0.058	26	79.3	0.054
United States	…	76.4	…	…	73.5	…	…	79.3	…
Delaware	26	76.3	0.150	27	73.3	0.218	23	79.4	0.199
Florida	27	76.1	0.033	28	73.1	0.048	27	79.3	0.044
Kansas	28	76.0	0.086	26	73.4	0.122	29	78.7	0.116
Montana	29	75.8	0.145	29	73.1	0.210	28	78.8	0.195
Michigan	30	75.7	0.046	30	72.9	0.067	30	78.6	0.062
Texas	31	75.4	0.027	31	72.7	0.038	33	78.3	0.036
District of Columbia	32	75.3	0.190	37	71.9	0.275	31	78.5	0.258
Nevada	33	75.1	0.083	33	72.4	0.119	34	78.2	0.112
Arizona	34	75.0	0.057	36	72.0	0.082	32	78.3	0.076
Wyoming	35	75.0	0.199	32	72.5	0.281	37	77.7	0.275
North Carolina	36	74.9	0.046	35	72.0	0.068	35	77.9	0.061
Missouri	37	74.6	0.060	40	71.6	0.088	36	77.8	0.080
Indiana	38	74.6	0.057	38	71.8	0.083	39	77.5	0.077
Alaska	39	74.5	0.180	34	72.2	0.250	40	77.3	0.256
Ohio	40	74.5	0.044	39	71.7	0.063	38	77.5	0.058
Georgia	41	74.3	0.045	41	71.6	0.065	41	77.1	0.060
South Carolina	42	73.5	0.069	42	70.4	0.100	43	76.7	0.092
New Mexico	43	73.0	0.113	46	69.4	0.161	42	77.0	0.152
Oklahoma	44	72.7	0.074	43	70.0	0.105	45	75.6	0.103
Arkansas	45	72.5	0.089	44	69.7	0.127	46	75.6	0.121
Tennessee	46	72.4	0.057	47	69.4	0.083	47	75.5	0.077
Kentucky	47	72.3	0.071	45	69.6	0.101	49	75.3	0.096
Louisiana	48	72.2	0.073	49	68.8	0.105	44	75.9	0.098
Alabama	49	72.0	0.069	48	68.9	0.100	48	75.3	0.091
West Virginia	50	71.0	0.117	50	68.1	0.167	51	74.2	0.159
Mississippi	51	70.9	0.092	51	67.7	0.133	50	74.3	0.125

... 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 data file.

Life expectancy in 50 states and D.C.

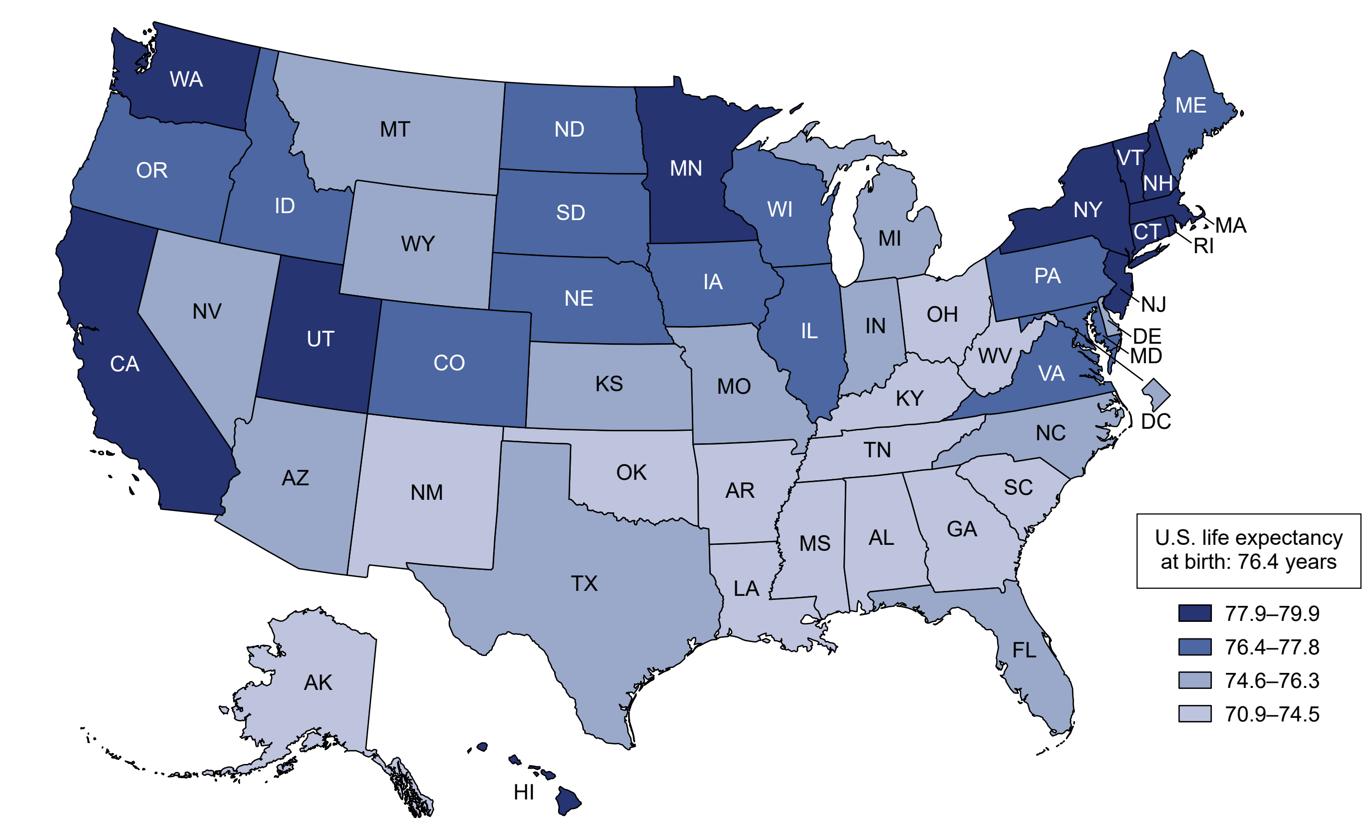
Table A shows life expectancy at birth for the total, male, and female populations for each state, D.C., and the United States. In 2021, among the 50 states and D.C., Hawaii ranked first for the total, male, and female populations, with life expectancies at birth of 79.9, 77.0, and 83.1 years, respectively. Mississippi ranked 51st among the 50 states and D.C. for the total and male populations, with life expectancies at birth of 70.9 and 67.7, respectively. West Virginia ranked 51st for females with a life expectancy of 74.2. In comparison, life expectancy at birth for the entire United States was 76.4, 73.5, and 79.3 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 (Oklahoma, Louisiana, Mississippi, Alabama, Georgia, South Carolina, Tennessee, Arkansas, Kentucky, and West Virginia) but also included New Mexico, Ohio, and Alaska. States with the highest life expectancy at birth were predominantly Western (Hawaii, California, and Washington) and Northeastern states (New York, Vermont, New Hampshire, Connecticut, Massachusetts, Rhode Island, and New Jersey) but also included Utah and Minnesota.

The difference in life expectancy between the sexes in the United States was 5.8 years in 2021, ranging from a high of 7.6 years in New Mexico 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 2021, Hawaii ranked first for the total, male, and female populations, with life expectancy at age 65 of 20.6, 18.9, and 22.2 years, respectively. Mississippi ranked 51st, with the lowest life expectancy among the 50 states and D.C. for the total and male populations, with life expectancy at age 65 of 16.1 and 14.6, respectively. West Virginia ranked 51st for females, with life expectancy at age 65 of 17.3 years. In comparison, life expectancy at age 65 for the entire United States was 18.4, 17.0, and 19.7 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.

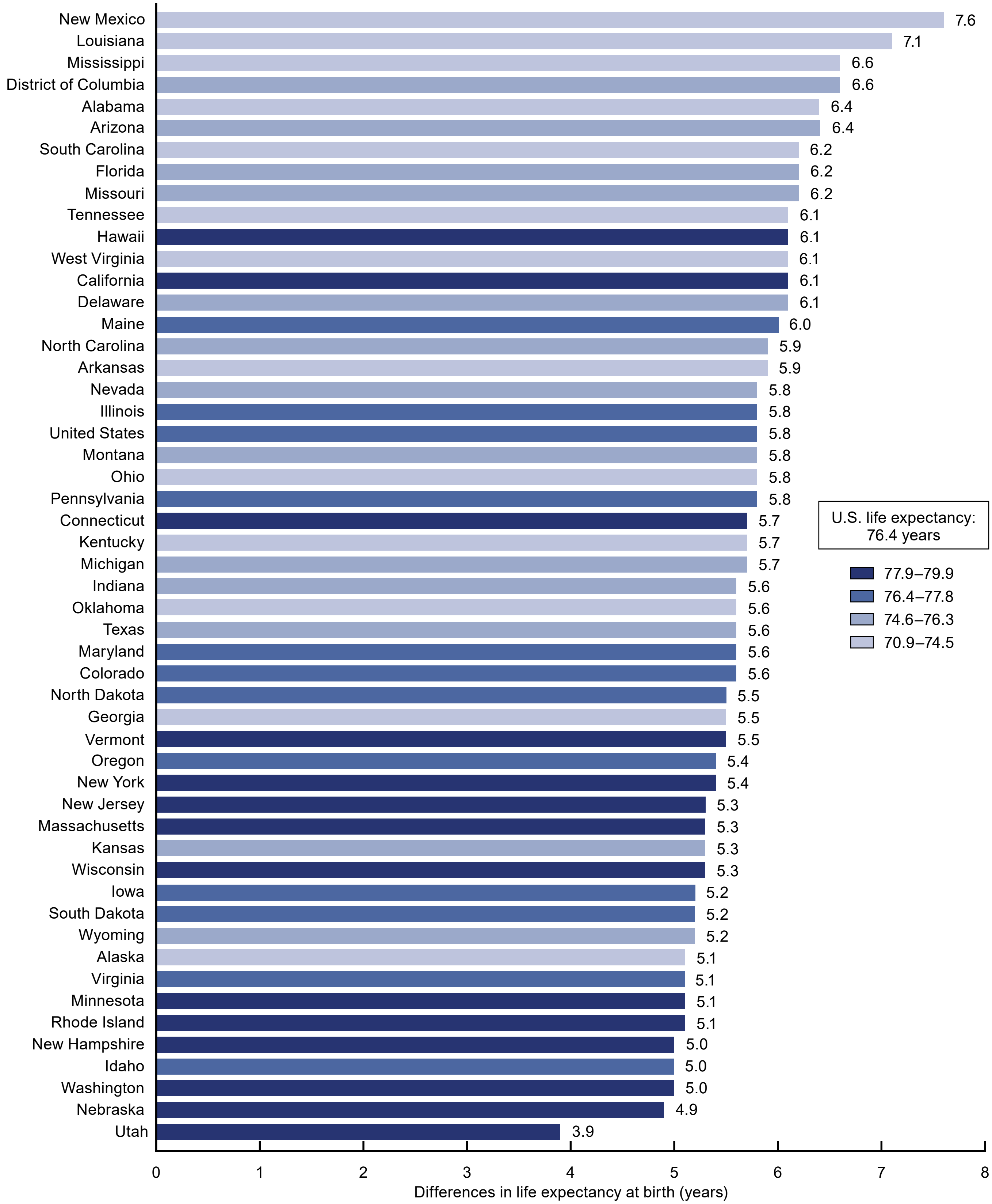
From 2020 to 2021, life expectancy at birth declined for 39 states (Table C, Figure 4) (5). The declines ranged from 0.1 to 2.1 years. Life expectancy increased for 11 states, with increases ranging from 0.1 to 1.5 years. The states with the greatest decreases in life expectancy at birth from 2020 to 2021 included Alaska, West Virginia, New Mexico, Florida, Oklahoma, Oregon, and Tennessee. The states that experienced increases in life expectancy included New Jersey, New York, Connecticut,

Figure 1. Life expectancy at birth: Each state, District of Columbia, and United States, 2021



SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

Figure 2. Difference between male and female life expectancy at birth: Each state, District of Columbia, and United States, 2021



NOTE: The color key reflects age ranges of life expectancy at birth for the total population for each area.
SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

Table B. Life expectancy at age 65, rank, and standard error, by sex: Each state, District of Columbia, and United States, 2021

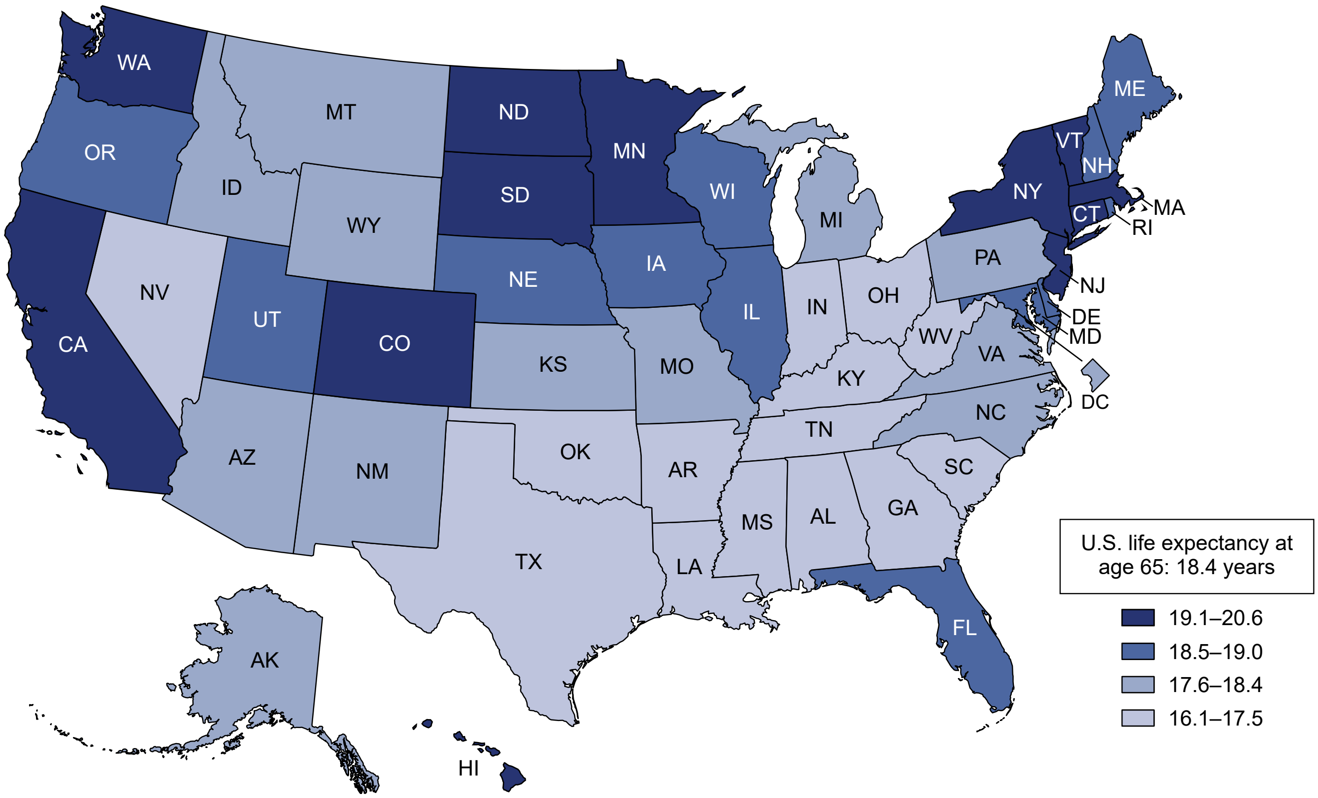
Area	Total			Male			Female		
	Rank	Life expectancy (years)	Standard error	Rank	Life expectancy (years)	Standard error	Rank	Life expectancy (years)	Standard error
Hawaii	1	20.6	0.064	1	18.9	0.089	1	22.2	0.088
Connecticut	2	19.9	0.038	2	18.4	0.053	2	21.2	0.053
Massachusetts	3	19.6	0.028	4	18.1	0.039	3	20.9	0.038
Minnesota	4	19.4	0.031	5	18.1	0.042	5	20.7	0.043
New York	5	19.4	0.017	6	17.9	0.024	6	20.7	0.023
Vermont	6	19.4	0.081	3	18.2	0.114	10	20.5	0.114
New Jersey	7	19.4	0.025	7	17.9	0.034	8	20.6	0.034
California	8	19.3	0.013	11	17.8	0.018	4	20.7	0.018
South Dakota	9	19.2	0.077	12	17.8	0.104	7	20.6	0.110
North Dakota	10	19.1	0.089	14	17.6	0.119	9	20.6	0.128
Colorado	11	19.1	0.031	10	17.8	0.044	11	20.4	0.043
Washington	12	19.1	0.027	13	17.7	0.038	12	20.3	0.037
New Hampshire	13	19.0	0.057	9	17.8	0.079	15	20.2	0.079
Rhode Island	14	19.0	0.067	15	17.6	0.095	13	20.3	0.093
Wisconsin	15	18.9	0.029	16	17.5	0.040	14	20.2	0.041
Utah	16	18.8	0.046	8	17.9	0.065	25	19.7	0.064
Nebraska	17	18.8	0.054	21	17.2	0.074	16	20.2	0.076
Maryland	18	18.7	0.030	17	17.4	0.043	20	19.9	0.042
Florida	19	18.7	0.016	22	17.2	0.022	17	20.2	0.021
Oregon	20	18.6	0.035	19	17.3	0.049	21	19.9	0.048
Delaware	21	18.6	0.068	25	17.1	0.096	18	20.0	0.094
Maine	22	18.6	0.055	18	17.3	0.077	24	19.8	0.076
Illinois	23	18.6	0.021	24	17.1	0.030	22	19.9	0.030
Iowa	24	18.6	0.041	26	17.1	0.056	19	19.9	0.059
United States	…	18.4	…	…	17.0	…	…	19.7	…
Idaho	25	18.4	0.052	20	17.2	0.073	29	19.5	0.074
Montana	26	18.4	0.064	23	17.1	0.088	26	19.6	0.090
New Mexico	27	18.3	0.050	27	16.9	0.071	27	19.6	0.070
District of Columbia	28	18.3	0.117	33	16.5	0.171	23	19.8	0.157
Virginia	29	18.2	0.026	28	16.9	0.036	31	19.4	0.036
Pennsylvania	30	18.2	0.020	31	16.7	0.027	28	19.6	0.028
Arizona	31	18.1	0.028	32	16.6	0.040	30	19.5	0.038
Kansas	32	18.0	0.044	34	16.5	0.061	32	19.4	0.062
Alaska	33	17.9	0.087	29	16.7	0.118	33	19.2	0.126
Michigan	34	17.9	0.022	35	16.5	0.031	34	19.1	0.031
Wyoming	35	17.8	0.091	30	16.7	0.126	37	18.9	0.129
North Carolina	36	17.7	0.023	36	16.3	0.032	36	18.9	0.031
Missouri	37	17.6	0.029	37	16.2	0.041	38	18.8	0.041
Nevada	38	17.5	0.042	38	16.1	0.060	35	19.0	0.059
Texas	39	17.5	0.015	39	16.1	0.021	40	18.7	0.021
South Carolina	40	17.4	0.031	40	16.0	0.045	39	18.8	0.043
Ohio	41	17.3	0.021	42	15.9	0.029	41	18.6	0.029
Indiana	42	17.3	0.029	41	16.0	0.039	42	18.6	0.040
Georgia	43	17.1	0.023	43	15.7	0.033	43	18.3	0.032
Louisiana	44	16.8	0.034	44	15.3	0.048	44	18.3	0.048
Arkansas	45	16.6	0.043	46	15.2	0.060	45	18.1	0.059
Tennessee	46	16.6	0.028	45	15.3	0.039	46	17.8	0.038
Kentucky	47	16.4	0.034	47	15.1	0.047	49	17.6	0.048
Oklahoma	48	16.4	0.038	48	15.0	0.052	48	17.7	0.053
Alabama	49	16.4	0.032	49	14.9	0.045	47	17.7	0.044
West Virginia	50	16.1	0.050	50	14.8	0.070	51	17.3	0.071
Mississippi	51	16.1	0.043	51	14.6	0.060	50	17.5	0.060

... 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 data file.

Figure 3. Life expectancy at age 65: Each state, District of Columbia, and United States, 2021



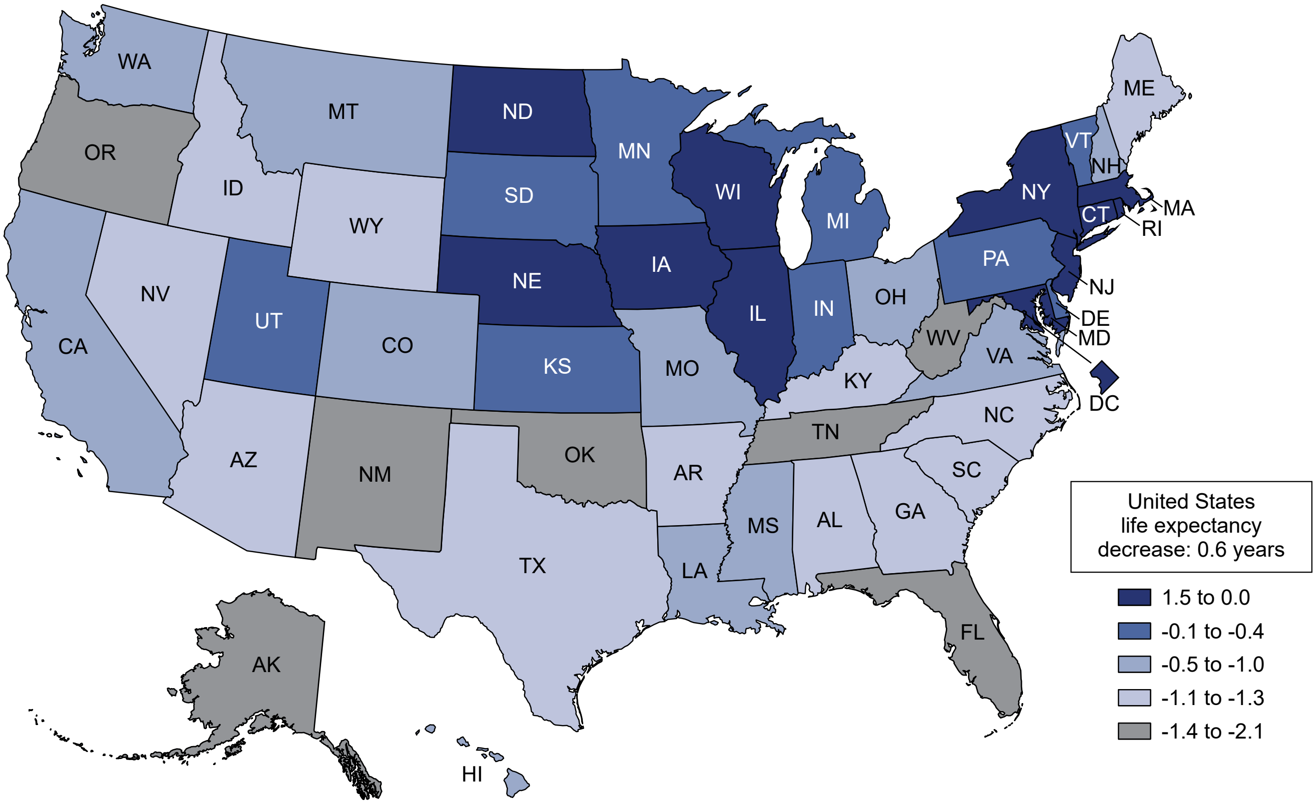
SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

Table C. Change in life expectancy at birth: Each state, District of Columbia, and United States, from 2020 to 2021

Area	2021	2020	Change in life expectancy from 2020 to 2021
Alaska	74.5	76.6	-2.1
West Virginia	71.0	72.8	-1.8
New Mexico	73.0	74.5	-1.5
Florida	76.1	77.5	-1.4
Oklahoma	72.7	74.1	-1.4
Oregon	77.4	78.8	-1.4
Tennessee	72.4	73.8	-1.4
Arizona	75.0	76.3	-1.3
Arkansas	72.5	73.8	-1.3
Georgia	74.3	75.6	-1.3
South Carolina	73.5	74.8	-1.3
Wyoming	75.0	76.3	-1.3
Alabama	72.0	73.2	-1.2
Idaho	77.2	78.4	-1.2
Kentucky	72.3	73.5	-1.2
Nevada	75.1	76.3	-1.2
North Carolina	74.9	76.1	-1.2
Maine	76.7	77.8	-1.1
Texas	75.4	76.5	-1.1
Mississippi	70.9	71.9	-1.0
Montana	75.8	76.8	-1.0
Washington	78.2	79.2	-1.0
Louisiana	72.2	73.1	-0.9
Hawaii	79.9	80.7	-0.8
Ohio	74.5	75.3	-0.8
Virginia	76.8	77.6	-0.8
California	78.3	79.0	-0.7
Colorado	77.7	78.3	-0.6
United States	76.4	77.0	-0.6
Missouri	74.6	75.1	-0.5
New Hampshire	78.5	79.0	-0.5
Delaware	76.3	76.7	-0.4
Indiana	74.6	75.0	-0.4
Kansas	76.0	76.4	-0.4
Pennsylvania	76.4	76.8	-0.4
Utah	78.2	78.6	-0.4
Vermont	78.4	78.8	-0.4
Michigan	75.7	76.0	-0.3
Minnesota	78.8	79.1	-0.3
South Dakota	76.6	76.7	-0.1
District of Columbia	75.3	75.3	0.0
Nebraska	77.8	77.7	0.1
Wisconsin	77.8	77.7	0.1
Iowa	77.7	77.5	0.2
Illinois	77.1	76.8	0.3
Rhode Island	78.5	78.2	0.3
Maryland	77.2	76.8	0.4
Massachusetts	79.6	79.0	0.6
North Dakota	77.6	76.9	0.7
Connecticut	79.2	78.4	0.8
New York	79.0	77.7	1.3
New Jersey	79.0	77.5	1.5

SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

Figure 4. Change in life expectancy at birth from 2020 to 2021: Each state, District of Columbia, and United States, 2021



SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

North Dakota, Massachusetts, Maryland, Rhode Island, Illinois, Iowa, Wisconsin, and Nebraska. Life expectancy did not change for D.C. Overall, life expectancy in the United States declined by 0.6 years from 2020 to 2021, mostly due to the COVID-19 pandemic and increases in unintentional injuries (mainly drug overdose deaths) (1).

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Technical Notes

The methods used to estimate the 2021 complete life tables for the 50 states and 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, state-specific population estimates from the U.S. Census Bureau, and state-specific death and population counts for Medicare beneficiaries ages 66–99 from the Centers for Medicare & Medicaid Services.

Vital statistics data

Death counts used for computing the life tables presented in this report are state-specific final numbers of deaths for 2021 collected from death certificates filed in state vital statistics offices and reported to the National Center for Health Statistics as part of the National Vital Statistics System.

Census population data

The population data used to estimate the life tables shown in this report are postcensal population estimates based on the Blended Base created by the U.S. Census Bureau to produce post-2020 census population estimates. The Blended Base consists of the blend of Vintage 2020 postcensal population estimates, based on the April 1, 2010, decennial census; the 2020 Demographic Analysis Estimates; and the 2020 Census PL 94-171 Redistricting File (see https://www2.census.gov/programs-surveys/popest/technical-documentation/methodology/2020-2021/methods-statement-v2021.pdf).

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

Table I. Complete period life tables: 50 states and District of Columbia, 2021

Available from: https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/73-07/

Table title
AK–1. Life table for total population: Alaska, 2021
AK–2. Life table for males: Alaska, 2021
AK–3. Life table for females: Alaska, 2021
AK–4. Standard errors of probability of dying and life expectancy: Alaska, 2021
AL–1. Life table for total population: Alabama, 2021
AL–2. Life table for males: Alabama, 2021
AL–3. Life table for females: Alabama, 2021
AL–4. Standard errors of probability of dying and life expectancy: Alabama, 2021
AR–1. Life table for total population: Arkansas, 2021
AR–2. Life table for males: Arkansas, 2021
AR–3. Life table for females: Arkansas, 2021
AR–4. Standard errors of probability of dying and life expectancy: Arkansas, 2021
AZ–1. Life table for total population: Arizona, 2021
AZ–2. Life table for males: Arizona, 2021
AZ–3. Life table for females: Arizona, 2021
AZ–4. Standard errors of probability of dying and life expectancy: Arizona, 2021
CA–1. Life table for total population: California, 2021
CA–2. Life table for males: California, 2021
CA–3. Life table for females: California, 2021
CA–4. Standard errors of probability of dying and life expectancy: California, 2021
CO–1. Life table for total population: Colorado, 2021
CO–2. Life table for males: Colorado, 2021
CO–3. Life table for females: Colorado, 2021
CO–4. Standard errors of probability of dying and life expectancy: Colorado, 2021
CT–1. Life table for total population: Connecticut, 2021
CT–2. Life table for males: Connecticut, 2021
CT–3. Life table for females: Connecticut, 2021
CT–4. Standard errors of probability of dying and life expectancy: Connecticut, 2021
DC–1. Life table for total population: District of Columbia, 2021
DC–2. Life table for males: District of Columbia, 2021
DC–3. Life table for females: District of Columbia, 2021
DC–4. Standard errors of probability of dying and life expectancy: District of Columbia, 2021
DE–1. Life table for total population: Delaware, 2021
DE–2. Life table for males: Delaware, 2021
DE–3. Life table for females: Delaware, 2021
DE–4. Standard errors of probability of dying and life expectancy: Delaware, 2021
FL–1. Life table for total population: Florida, 2021
FL–2. Life table for males: Florida, 2021
FL–3. Life table for females: Florida, 2021
FL–4. Standard errors of probability of dying and life expectancy: Florida, 2021
GA–1. Life table for total population: Georgia, 2021
GA–2. Life table for males: Georgia, 2021
GA–3. Life table for females: Georgia, 2021
GA–4. Standard errors of probability of dying and life expectancy: Georgia, 2021
HI–1. Life table for total population: Hawaii, 2021
HI–2. Life table for males: Hawaii, 2021
HI–3. Life table for females: Hawaii, 2021
HI–4. Standard errors of probability of dying and life expectancy: Hawaii, 2021

See footnotes at end of table.

Table I. Complete period life tables: 50 states and District of Columbia, 2021—Con.

Available from: https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/73-07/

Table title

IA–1. Life table for total population: Iowa, 2021
IA–2. Life table for males: Iowa, 2021
IA–3. Life table for females: Iowa, 2021
IA–4. Standard errors of probability of dying and life expectancy: Iowa, 2021
ID–1. Life table for total population: Idaho, 2021
ID–2. Life table for males: Idaho, 2021
ID–3. Life table for females: Idaho, 2021
ID–4. Standard errors of probability of dying and life expectancy: Idaho, 2021
IL–1. Life table for total population: Illinois, 2021
IL–2. Life table for males: Illinois, 2021
IL–3. Life table for females: Illinois, 2021
IL–4. Standard errors of probability of dying and life expectancy: Illinois, 2021
IN–1. Life table for total population: Indiana, 2021
IN–2. Life table for males: Indiana, 2021
IN–3. Life table for females: Indiana, 2021
IN–4. Standard errors of probability of dying and life expectancy: Indiana, 2021
KS–1. Life table for total population: Kansas, 2021
KS–2. Life table for males: Kansas, 2021
KS–3. Life table for females: Kansas, 2021
KS–4. Standard errors of probability of dying and life expectancy: Kansas, 2021
KY–1. Life table for total population: Kentucky, 2021
KY–2. Life table for males: Kentucky, 2021
KY–3. Life table for females: Kentucky, 2021
KY–4. Standard errors of probability of dying and life expectancy: Kentucky, 2021
LA–1. Life table for total population: Louisiana, 2021
LA–2. Life table for males: Louisiana, 2021
LA–3. Life table for females: Louisiana, 2021
LA–4. Standard errors of probability of dying and life expectancy: Louisiana, 2021
MA–1. Life table for total population: Massachusetts, 2021
MA–2. Life table for males: Massachusetts, 2021
MA–3. Life table for females: Massachusetts, 2021
MA–4. Standard errors of probability of dying and life expectancy: Massachusetts, 2021
MD–1. Life table for total population: Maryland, 2021
MD–2. Life table for males: Maryland, 2021
MD–3. Life table for females: Maryland, 2021
MD–4. Standard errors of probability of dying and life expectancy: Maryland, 2021
ME–1. Life table for total population: Maine, 2021
ME–2. Life table for males: Maine, 2021
ME–3. Life table for females: Maine, 2021
ME–4. Standard errors of probability of dying and life expectancy: Maine, 2021
MI–1. Life table for total population: Michigan, 2021
MI–2. Life table for males: Michigan, 2021
MI–3. Life table for females: Michigan, 2021
MI–4. Standard errors of probability of dying and life expectancy: Michigan, 2021
MN–1. Life table for total population: Minnesota, 2021
MN–2. Life table for males: Minnesota, 2021
MN–3. Life table for females: Minnesota, 2021
MN–4. Standard errors of probability of dying and life expectancy: Minnesota, 2021
MO–1. Life table for total population: Missouri, 2021
MO–2. Life table for males: Missouri, 2021
MO–3. Life table for females: Missouri, 2021
MO–4. Standard errors of probability of dying and life expectancy: Missouri, 2021
MS–1. Life table for total population: Mississippi, 2021
MS–2. Life table for males: Mississippi, 2021
MS–3. Life table for females: Mississippi, 2021
MS–4. Standard errors of probability of dying and life expectancy: Mississippi, 2021
MT–1. Life table for total population: Montana, 2021
MT–2. Life table for males: Montana, 2021
MT–3. Life table for females: Montana, 2021
MT–4. Standard errors of probability of dying and life expectancy: Montana, 2021
NC–1. Life table for total population: North Carolina, 2021
NC–2. Life table for males: North Carolina, 2021
NC–3. Life table for females: North Carolina, 2021
NC–4. Standard errors of probability of dying and life expectancy: North Carolina, 2021
ND–1. Life table for total population: North Dakota, 2021
ND–2. Life table for males: North Dakota, 2021
ND–3. Life table for females: North Dakota, 2021
ND–4. Standard errors of probability of dying and life expectancy: North Dakota, 2021
NE–1. Life table for total population: Nebraska, 2021
NE–2. Life table for males: Nebraska, 2021
NE–3. Life table for females: Nebraska, 2021
NE–4. Standard errors of probability of dying and life expectancy: Nebraska, 2021
NH–1. Life table for total population: New Hampshire, 2021
NH–2. Life table for males: New Hampshire, 2021
NH–3. Life table for females: New Hampshire, 2021
NH–4. Standard errors of probability of dying and life expectancy: New Hampshire, 2021
NJ–1. Life table for total population: New Jersey, 2021
NJ–2. Life table for males: New Jersey, 2021
NJ–3. Life table for females: New Jersey, 2021
NJ–4. Standard errors of probability of dying and life expectancy: New Jersey, 2021
NM–1. Life table for total population: New Mexico, 2021
NM–2. Life table for males: New Mexico, 2021
NM–3. Life table for females: New Mexico, 2021
NM–4. Standard errors of probability of dying and life expectancy: New Mexico, 2021
NV–1. Life table for total population: Nevada, 2021
NV–2. Life table for males: Nevada, 2021
NV–3. Life table for females: Nevada, 2021
NV–4. Standard errors of probability of dying and life expectancy: Nevada, 2021
NY–1. Life table for total population: New York, 2021
NY–2. Life table for males: New York, 2021
NY–3. Life table for females: New York, 2021
NY–4. Standard errors of probability of dying and life expectancy: New York, 2021
OH–1. Life table for total population: Ohio, 2021
OH–2. Life table for males: Ohio, 2021
OH–3. Life table for females: Ohio, 2021
OH–4. Standard errors of probability of dying and life expectancy: Ohio, 2021
OK–1. Life table for total population: Oklahoma, 2021
OK–2. Life table for males: Oklahoma, 2021
OK–3. Life table for females: Oklahoma, 2021
OK–4. Standard errors of probability of dying and life expectancy: Oklahoma, 2021
OR–1. Life table for total population: Oregon, 2021
OR–2. Life table for males: Oregon, 2021
OR–3. Life table for females: Oregon, 2021
OR–4. Standard errors of probability of dying and life expectancy: Oregon, 2021
PA–1. Life table for total population: Pennsylvania, 2021
PA–2. Life table for males: Pennsylvania, 2021
PA–3. Life table for females: Pennsylvania, 2021

See footnotes at end of table.

Table I. Complete period life tables: 50 states and District of Columbia, 2021—Con.

Available from: https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/73-07/

Table title
PA–4. Standard errors of probability of dying and life expectancy: Pennsylvania, 2021
RI–1. Life table for total population: Rhode Island, 2021
RI–2. Life table for males: Rhode Island, 2021
RI–3. Life table for females: Rhode Island, 2021
RI–4. Standard errors of probability of dying and life expectancy: Rhode Island, 2021
SC–1. Life table for total population: South Carolina, 2021
SC–2. Life table for males: South Carolina, 2021
SC–3. Life table for females: South Carolina, 2021
SC–4. Standard errors of probability of dying and life expectancy: South Carolina, 2021
SD–1. Life table for total population: South Dakota, 2021
SD–2. Life table for males: South Dakota, 2021
SD–3. Life table for females: South Dakota, 2021
SD–4. Standard errors of probability of dying and life expectancy: South Dakota, 2021
TN–1. Life table for total population: Tennessee, 2021
TN–2. Life table for males: Tennessee, 2021
TN–3. Life table for females: Tennessee, 2021
TN–4. Standard errors of probability of dying and life expectancy: Tennessee, 2021
TX–1. Life table for total population: Texas, 2021
TX–2. Life table for males: Texas, 2021
TX–3. Life table for females: Texas, 2021
TX–4. Standard errors of probability of dying and life expectancy: Texas, 2021
UT–1. Life table for total population: Utah, 2021
UT–2. Life table for males: Utah, 2021
UT–3. Life table for females: Utah, 2021
UT–4. Standard errors of probability of dying and life expectancy: Utah, 2021
VA–1. Life table for total population: Virginia, 2021
VA–2. Life table for males: Virginia, 2021
VA–3. Life table for females: Virginia, 2021
VA–4. Standard errors of probability of dying and life expectancy: Virginia, 2021
VT–1. Life table for total population: Vermont, 2021
VT–2. Life table for males: Vermont, 2021
VT–3. Life table for females: Vermont, 2021
VT–4. Standard errors of probability of dying and life expectancy: Vermont, 2021
WA–1. Life table for total population: Washington, 2021
WA–2. Life table for males: Washington, 2021
WA–3. Life table for females: Washington, 2021
WA–4. Standard errors of probability of dying and life expectancy: Washington, 2021
WI–1. Life table for total population: Wisconsin, 2021
WI–2. Life table for males: Wisconsin, 2021
WI–3. Life table for females: Wisconsin, 2021
WI–4. Standard errors of probability of dying and life expectancy: Wisconsin, 2021
WV–1. Life table for total population: West Virginia, 2021
WV–2. Life table for males: West Virginia, 2021
WV–3. Life table for females: West Virginia, 2021
WV–4. Standard errors of probability of dying and life expectancy: West Virginia, 2021
WY–1. Life table for total population: Wyoming, 2021
WY–2. Life table for males: Wyoming, 2021
WY–3. Life table for females: Wyoming, 2021
WY–4. Standard errors of probability of dying and life expectancy: Wyoming, 2021

SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

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).

To estimate death rates for the state-specific Medicare populations in 2021, sex- and age-specific numbers of deaths and population counts were used for the population ages 66–99 in each state and D.C. from the 2021 Medicare file. The data file, created by the Centers for Medicare & Medicaid Services for the Social Security Administration, is shared with the National Center for Health Statistics under a special agreement. The 2021 file contains state-specific 2021 midyear Medicare population counts (as of June 30, 2021) and calendar-year Medicare death counts (for January 1 through December 31, 2021). 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 area, sex, and age

Area	Age (years)	
	Male	Female
Alaska	...	9,10
Connecticut	...	2,7
Delaware	...	4
District of Columbia	2	1–4
Hawaii	3	3,4
Maine	...	2
Montana	3	2,4
New Hampshire	...	2,3
North Dakota	...	1,3,4
Oregon	...	3
Rhode Island	3,4	2–4
Vermont	2–4,6	2,3
West Virginia	2	...
Wyoming	3	3,4

... Category not applicable.

SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

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 2021, B^t is the number of live births in 2021, and B^{t-1} is the number of live births in 2020.

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,…,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 older for the U.S. population, blended Medicare and vital statistics death rates are very similar to Medicare death rates for ages 85 and older.

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:

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

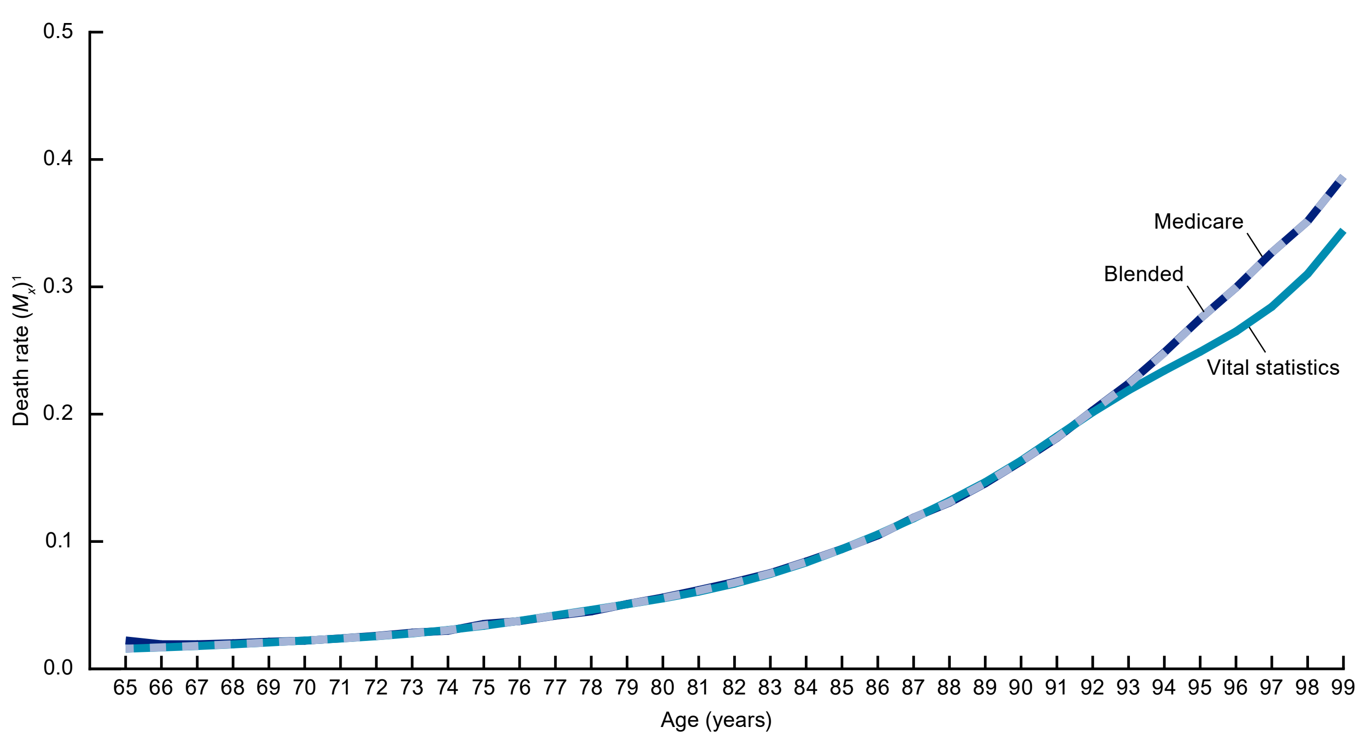
Because u_x is not directly observed but is closely approximated by m_x, and m_x = M_x, then the logit of M_x is modeled instead. A maximum-likelihood generalized linear model estimation procedure is used to fit the following model in the age range 85–99:

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

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

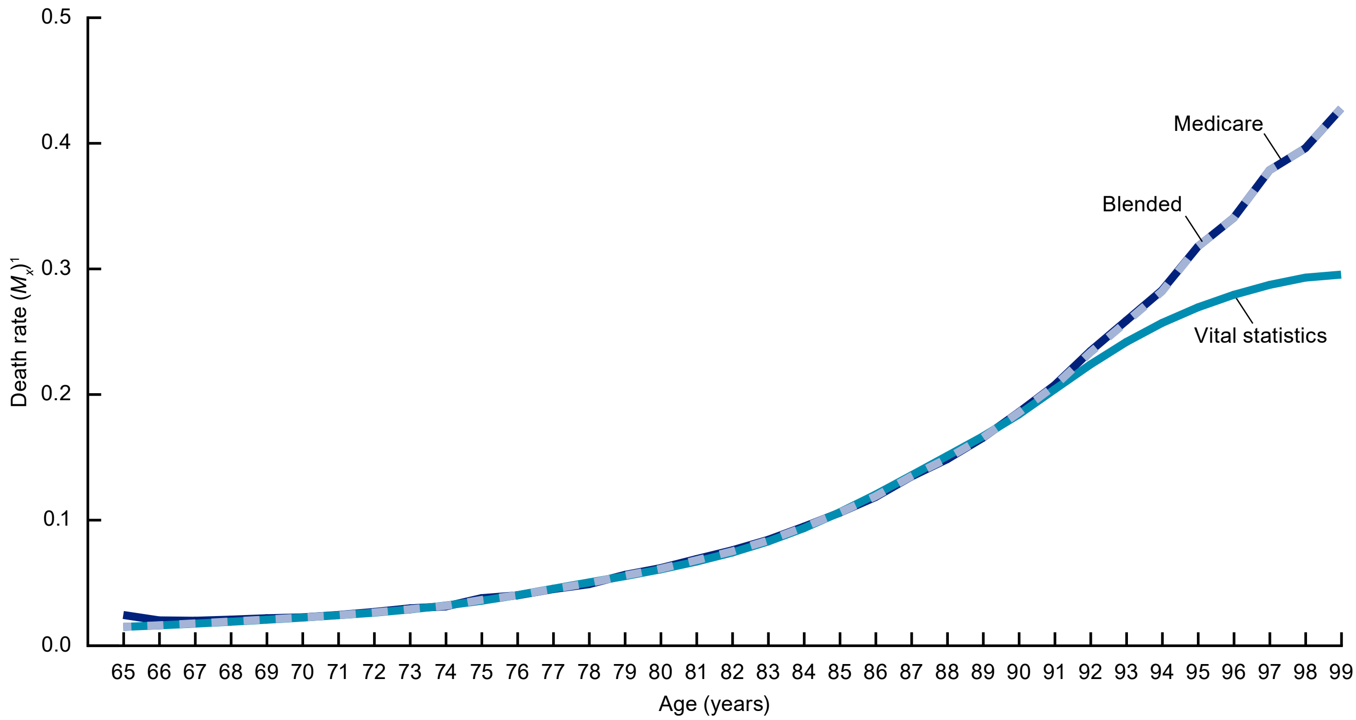
$$\overline{M}_x = \frac{e^a e^{bx}}{1+e^a e^{bx}} \text{ or, equivalently, } \overline{M}_x = \frac{e^{a+bx}}{1+e^{a+bx}} \quad [9]$$

Figure I. Age-specific vital statistics, Medicare, and blended death rates for total population: United States, 2021



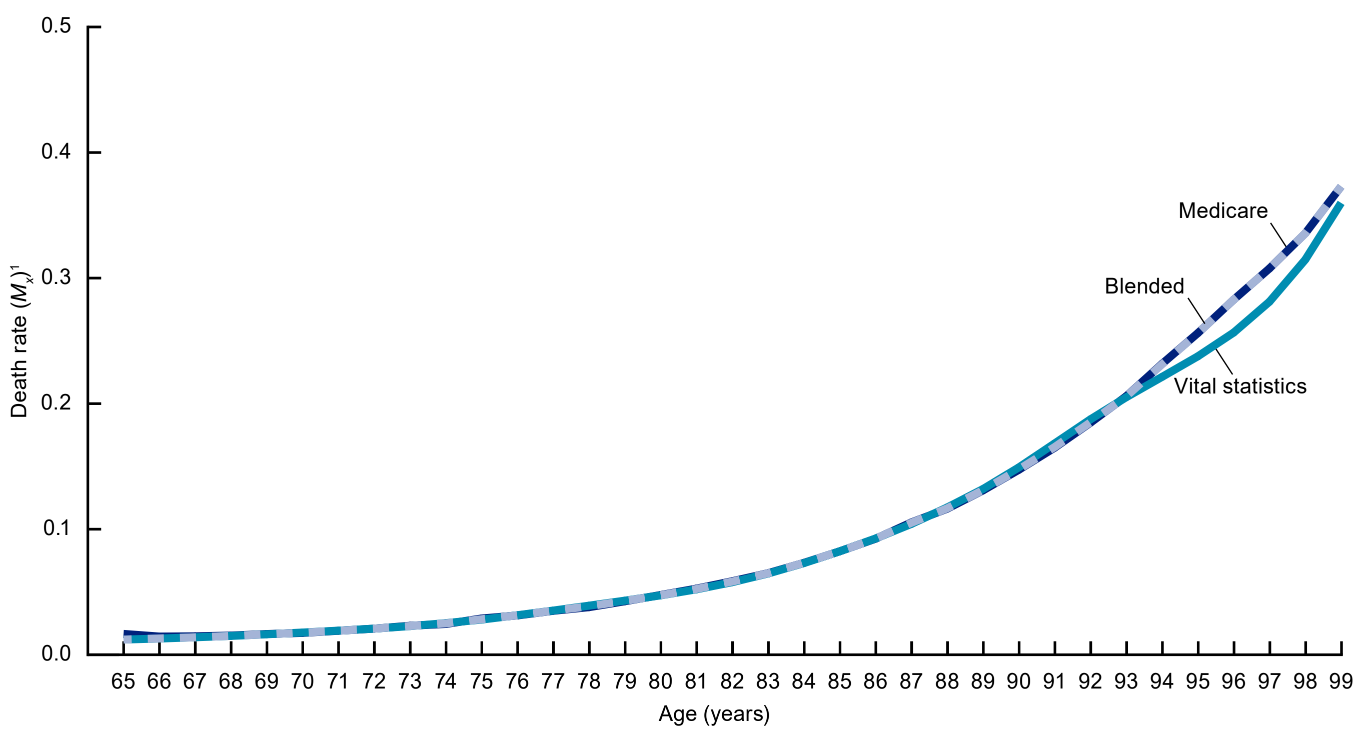
[1]Rate (M_x) is defined as the number of deaths during the year divided by the midyear population (D_x/P_x).
SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

Figure II. Age-specific vital statistics, Medicare, and blended death rates for male population: United States, 2021



[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 data file.

Figure III. Age-specific vital statistics, Medicare, and blended death rates for female population: United States, 2021



[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 data file.

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

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

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

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 older, 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 2021. 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 older than 0, the number of survivors remaining at exact age *x* is calculated as:

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

Decrement function (d_x)

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

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

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:

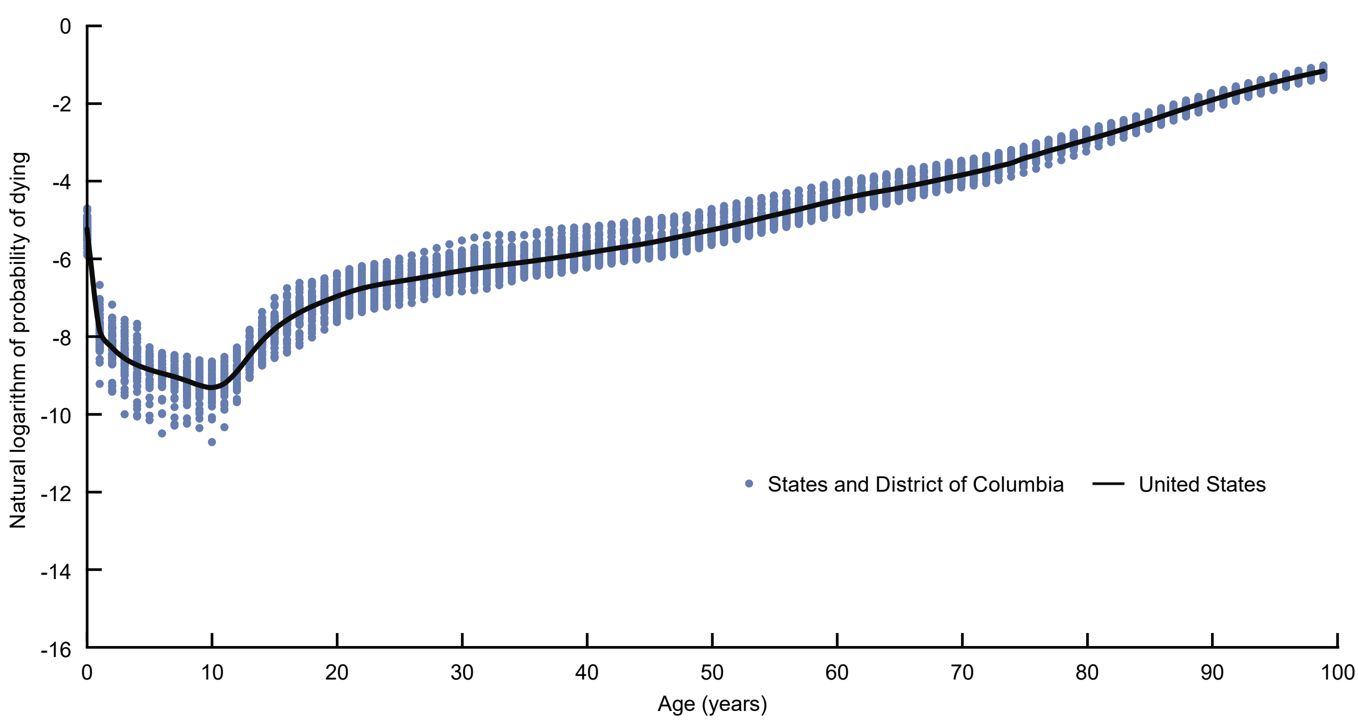
$$L_x = \frac{1}{2}(l_x + l_{x+1}) = l_x - \frac{1}{2}d_x \qquad [13]$$

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

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

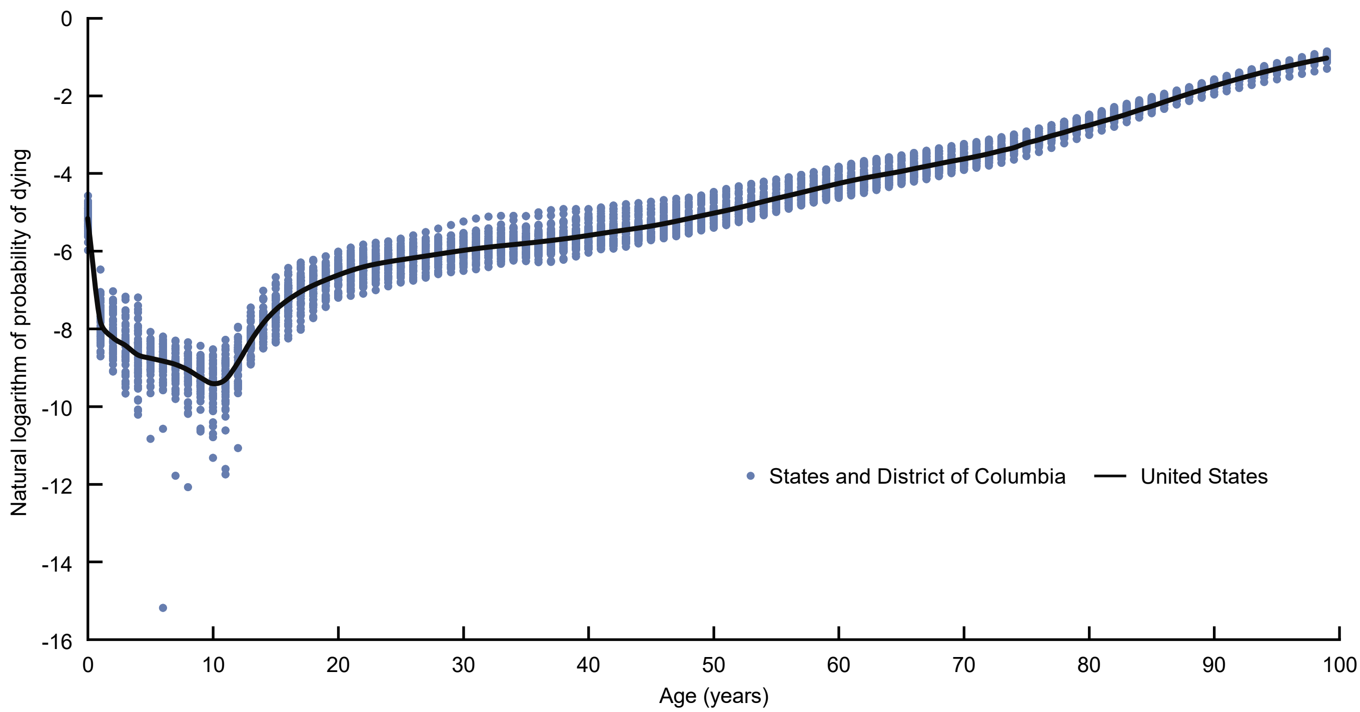
Finally, ${}_{\infty}L_{100}$ is estimated as the sum of the extrapolated L_x values for ages 100–120.

Figure IV. Age patterns of mortality for states and District of Columbia compared with United States, 2021



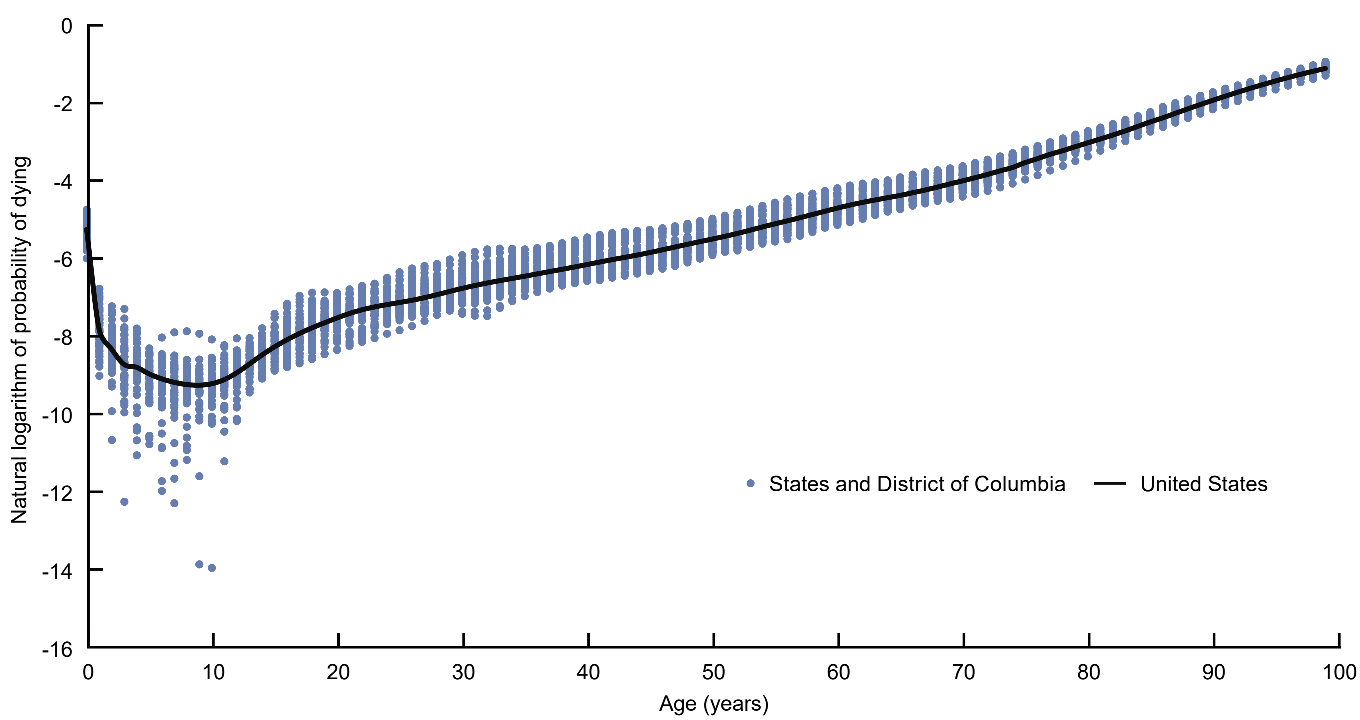
SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

Figure V. Male age patterns of mortality for states and District of Columbia compared with United States, 2021



SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

Figure VI. Female age patterns of mortality for states and District of Columbia compared with United States, 2021



SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality data file.

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

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

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

Life expectancy at age *x* (e_x)

Life expectancy at exact age x is calculated as:

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

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:

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

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 younger than 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 older, 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 (11):

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

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

Standard error of q_x

The standard error of q_x is calculated as:

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

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

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

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 (12):

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

Standard error of e_x

The standard error of e_x is calculated as:

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

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