



Mortality and Longevity

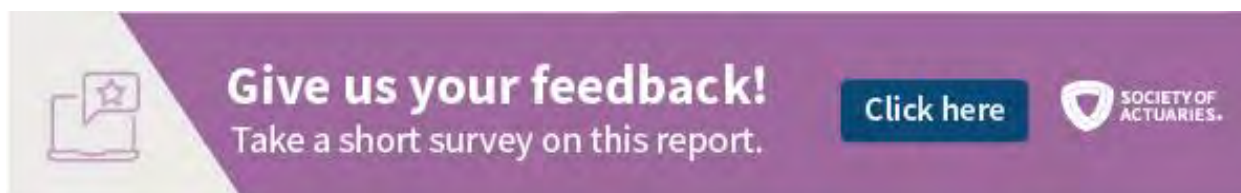
U.S. Population Mortality Rates 2000-2019






U.S. Population Mortality Rates 2000-2019

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A purple banner with a white triangle on the left side. On the left, there is an icon of a laptop with a star on a speech bubble. The text "Give us your feedback!" is in large white font, followed by "Take a short survey on this report." in smaller white font. To the right is a dark blue button with the text "Click here" in white. On the far right is the Society of Actuaries logo.

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Section 1: Purpose of the Study

This publication contains historical U.S. population mortality rates by gender and single year of age for calendar years 2000-2019. These rates represent one-year probabilities of death. This is an update to a series of such publications; the prior iteration consisting of 2000-2018 mortality rates can be found [here](#). The key updates from the previous publication are the addition of mortality rates for 2019 and true-ups of historical data from 2000-2018.

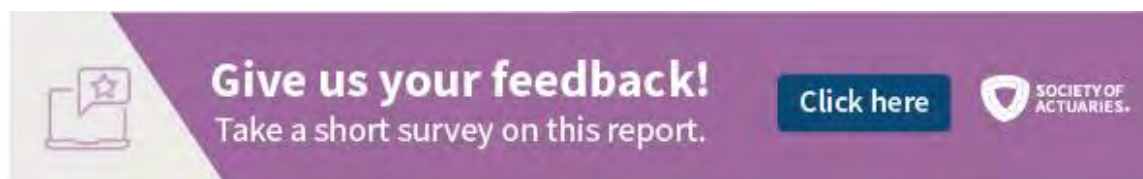
Section 2: Data Sources



The mortality rates found in this publication are based on the same data sets underlying the historical probabilities of death published by the Social Security Administration (SSA). The death counts for ages 0-64 were taken from the National Center for Health Statistics via the “Multiple Cause of Death” data published in the CDC WONDER database. The corresponding population counts for years 2000-2009 are taken from the same source. The 2010-2019 population counts were taken from the Census Bureau’s 2019 Vintage July 1 population estimates.

For ages 65 and up, the SOA requested counts of enrollments and deaths from the Centers for Medicare & Medicaid Services (CMS). The SOA chose to use this data set for the over-65 population because Medicare enrollment requires verification of date of birth, so age information can be more reliable in the CMS data than in other sources, particularly for the oldest subset of the population.

CMS provided revised estimates for 2017 and 2018 deaths and enrollments to reflect retroactive data updates. These changes resulted in some mortality rates in this publication differing from the corresponding rates in last year’s 2000-2018 historical mortality rates publication. All of the changes were increases. For ages above 65, the percentage increase in the rates by age due to these CMS data updates ranged between 0.00% and approximately 0.25%

It is important to remember that these historical mortality rates are unsmoothed rates. The SSA uses the same data sources and similar adjustments to compute their historical probabilities of death, but the SSA rates are graduated within a given calendar year per the process outlined in Actuarial Study No. 120. No such smoothing was done for this publication.



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Section 3: Analysis

Mortality improvement rates can be used to analyze how mortality changes from year-to-year. Positive mortality improvement indicates a drop in mortality rates, while negative mortality improvement indicates a year-to-year increase in mortality. Below are some observations on recent mortality improvement trends.

3.1 KEY OBSERVATIONS - MALES

The three tables below show annual mortality improvement rates between 2016 and 2019 for males. Mortality improvement was positive in the aggregate from 2018 to 2019, with varying changes by age group. This was the second consecutive year of aggregate mortality improvement close to 1.0% for the age ranges studied.

Improvement in 2019 was generally higher than the previous year for ages above 45 and in aggregate. Young adults ages 20-to-44 experienced positive mortality improvement in 2018 for the first time since 2012, but mortality increased once again for this group in 2019. The aggregate mortality improvement of 1.2% for 2018 was the highest for males since 2010 (also 1.2%).

Table 3.1

2016-2019 MORTALITY IMPROVEMENT IN FIVE-YEAR AGE GROUPS, MALES

Age Band	2016 -> 2017	2017 -> 2018	2018 -> 2019
20-to-24	2.4%	5.3%	0.7%
25-to-29	-2.6%	4.9%	1.1%
30-to-34	-4.1%	3.2%	-1.3%
35-to-39	-3.4%	-0.2%	-1.6%
40-to-44	-1.8%	-0.1%	-3.6%
45-to-49	-0.9%	-0.1%	0.2%
50-to-54	0.7%	1.9%	0.6%
55-to-59	0.4%	0.1%	1.1%
60-to-64	-0.1%	-0.3%	0.8%
65-to-69	-0.9%	-0.2%	1.0%
70-to-74	1.3%	0.8%	2.1%
75-to-79	0.1%	1.2%	1.9%
80-to-84	-1.2%	1.7%	1.7%
85-to-89	-1.2%	1.2%	1.5%
90-to-94	-0.9%	0.7%	1.5%
95-to-100	-2.3%	0.8%	1.5%
All Ages	-0.5%	0.9%	1.2%

Table 3.2

2016-2019 MORTALITY IMPROVEMENT IN BROAD AGE GROUPS, MALES

Age Band	2016 -> 2017	2017 -> 2018	2018 -> 2019
20-to-44	-2.1%	2.2%	-1.3%
45-to-64	0.1%	0.3%	0.8%
65-to-84	-0.2%	0.9%	1.7%
85-to-100	-1.2%	1.0%	1.5%
All Ages	-0.5%	0.9%	1.2%

Table 3.3

2016-2019 MORTALITY IMPROVEMENT UNDER/OVER AGE 65, MALES

Age Band	2016 -> 2017	2017 -> 2018	2018 -> 2019
Under 65	-0.4%	0.8%	0.3%
65 and Over	-0.5%	1.0%	1.6%
All Ages	-0.5%	0.9%	1.2%

3.2 KEY OBSERVATIONS - FEMALES

The three tables below show annual mortality improvement rates between 2016 and 2019 for females. Similar to 2018, mortality improvement for females in 2019 was positive for all four broad age groups shown below. 65-to-84 year-old females experienced 2.1% improvement, which was the highest of all age groups and the highest for the 65-to-84 age group since 2009. Unlike males, females in the 20-to-44 age group did not show an aggregate increase in mortality in 2019. Improvement was greater for females aged 65 and over than for females under the age of 65; the reverse was true in 2018. The aggregate improvement of 1.6% is the highest mark for females since 2009 (3.7%).

Table 3.4
2016-2019 MORTALITY IMPROVEMENT IN FIVE-YEAR AGE GROUPS, FEMALES

Age Band	2016 -> 2017	2017 -> 2018	2018 -> 2019
20-to-24	-2.0%	5.5%	0.0%
25-to-29	-3.0%	1.4%	3.8%
30-to-34	-3.0%	0.8%	-0.2%
35-to-39	-0.7%	-0.8%	-1.0%
40-to-44	-1.5%	2.2%	-0.4%
45-to-49	1.6%	1.9%	0.9%
50-to-54	2.1%	2.5%	2.5%
55-to-59	-0.2%	1.5%	2.0%
60-to-64	-0.5%	0.8%	-0.8%
65-to-69	-0.7%	2.1%	1.9%
70-to-74	1.0%	1.6%	2.2%
75-to-79	0.0%	1.3%	2.1%
80-to-84	-0.7%	1.5%	2.0%
85-to-89	-0.9%	0.2%	1.6%
90-to-94	-1.6%	0.9%	1.4%
95-to-100	-2.6%	0.2%	2.6%
All Ages	-0.6%	1.1%	1.6%

Table 3.5
2016-2019 MORTALITY IMPROVEMENT IN BROAD AGE GROUPS, FEMALES

Age Band	2016 -> 2017	2017 -> 2018	2018 -> 2019
20-to-44	-1.9%	1.5%	0.2%
45-to-64	0.4%	1.5%	0.9%
65-to-84	-0.2%	1.6%	2.1%
85-to-100	-1.4%	0.5%	1.7%
All Ages	-0.6%	1.1%	1.6%

Table 3.6
2016-2019 MORTALITY IMPROVEMENT UNDER/OVER AGE 65, FEMALES

Age Band	2016 -> 2017	2017 -> 2018	2018 -> 2019
Under 65	0.0%	1.5%	0.8%
65 and Over	-0.8%	1.0%	1.9%
All Ages	-0.6%	1.1%	1.6%

Section 4: Mortality Improvement Calculation Methodology

The SOA computed the above mortality improvement rates by calculating the age-adjusted death rates (ADRs) for each age group within each year. This methodology is described in the following paper published by the Centers for Disease Control and Prevention and written by Lester R. Curtin, Ph.D. and Richard J. Klein, M.P.H.:

<https://www.cdc.gov/nchs/data/statnt/statnt06rv.pdf>

The SOA applied the direct standardization method described on pages 2-3 of the paper using 2012 population counts (as described above under “Data Sources”) as the reference population. 2012 was selected to ensure consistency with previous iterations of this study. The unrounded mortality rates for each age band were weighted by 2012 population counts. For each age band ‘x’ and calendar year ‘y’, the mortality improvement rate $f_{(x,y)}$ was calculated from the weighted mortality rates $q_{(x,y)}$:


$$f_{(x,y)} = 1 - \frac{q_{(x,y)}}{q_{(x,y-1)}}$$

Section 5: Questions

If you have any questions on these historical U.S. population mortality rates, please contact Patrick Nolan at (847) 273-8860 or pnolan@soa.org.


Section 6: Reliance and Limitations

In producing this report, the SOA relied upon data furnished by CMS, the CDC, and the U.S. Census Bureau. These data may be trued up in future years.



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About The Society of Actuaries

With roots dating back to 1889, the [Society of Actuaries](#) (SOA) is the world's largest actuarial professional organization with more than 31,000 members. Through research and education, the SOA's mission is to advance actuarial knowledge and to enhance the ability of actuaries to provide expert advice and relevant solutions for financial, business and societal challenges. The SOA's vision is for actuaries to be the leading professionals in the measurement and management of risk.

The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

Objectivity: The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

Quality: The SOA aspires to the highest ethical and quality standards in all of its research and analysis. Our research process is overseen by experienced actuaries and nonactuaries from a range of industry sectors and organizations. A rigorous peer-review process ensures the quality and integrity of our work.

Relevance: The SOA provides timely research on public policy issues. Our research advances actuarial knowledge while providing critical insights on key policy issues, and thereby provides value to stakeholders and decision makers.

Quantification: The SOA leverages the diverse skill sets of actuaries to provide research and findings that are driven by the best available data and methods. Actuaries use detailed modeling to analyze financial risk and provide distinct insight and quantification. Further, actuarial standards require transparency and the disclosure of the assumptions and analytic approach underlying the work.

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