



U.S. Population Mortality Rates 2000-2017





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Section 1: Purpose of the Study

This report contains historical U.S. population mortality rates by gender and single year of age for calendar years 2000-2017. These rates represent 1-year probabilities of death. This is an update to a series of such publications; the prior iteration consisting of 2000-2016 mortality rates can be found [here](#). The key updates from the previous publication are the finalization of 2016 mortality rates and addition of mortality rates for 2017.

Section 2: Data Sources

These mortality rates 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 2010-2017 population counts were taken from the [Census Bureau’s 2018 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 that for other sources, particularly for the oldest subset of the population.

In previous iterations of this report, there were several required adjustments to the CMS data to ensure that it was on a consistent basis with the CDC data. CMS has recently changed their tabulation methodology such that these are no longer required. Furthermore, in previous publications, the most recent year of data was known to be preliminary, as it was known that the CMS regularly performed true-ups on the preliminary data before release of final numbers in the following year. It is not currently expected that there will be substantial changes to the 2017 numbers next year.

Changes to this tabulation methodology have led to differences in historical mortality rates compared to the previous iteration of this study. For ages 65 and up, most of the mortality rates have changed for the years 2006-2016 compared to those shown in last year’s publication, and a majority of these rates show an increase. This observation is consistent with changes found when comparing the graduated SSA mortality rates released in 2018 and 2019 for years 2006 and later.

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.

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 2014 and 2017 for males¹. In aggregate, mortality improvement was slightly negative from 2016 to 2017, though there were varying changes by age group. The young adult group from ages 20-44 experienced the largest increase in mortality, though this increase was significantly less pronounced than it was in the previous two years. Unlike from 2015 to 2016, when the over-65 population experienced positive mortality improvement, the death rates for these retirement-aged individuals generally increased from 2016 to 2017, particularly those over age 80.

Table 3.1

2014-2017 MORTALITY IMPROVEMENT IN FIVE-YEAR AGE GROUPS, MALES

Age Band	2014 -> 2015	2015 -> 2016	2016 -> 2017
20-to-24	-6.9%	-8.7%	2.4%
25-to-29	-7.7%	-11.0%	-2.6%
30-to-34	-7.9%	-10.5%	-4.0%
35-to-39	-6.6%	-10.4%	-3.4%
40-to-44	-3.2%	-6.2%	-1.7%
45-to-49	0.5%	-1.8%	-0.9%
50-to-54	-0.6%	0.4%	0.8%
55-to-59	0.1%	-0.4%	0.4%
60-to-64	-1.1%	-0.3%	-0.1%
65-to-69	-0.5%	1.1%	-0.8%
70-to-74	0.4%	0.9%	1.4%
75-to-79	-0.1%	1.2%	0.2%
80-to-84	-0.5%	2.6%	-1.1%
85-to-89	-0.7%	2.1%	-1.2%
90-to-94	-1.7%	1.8%	-0.8%
95-to-100	-2.4%	2.7%	-2.2%
All Ages	-0.9%	0.3%	-0.4%

¹ The mortality improvement percentages from 2014 to 2015 and from 2015 to 2016 do not exactly equal those found in the previous iteration of this publication. This is because the Census Bureau updates its intercensal population estimates each year and because of the CMS tabulation updates.

Table 3.2
2014-2017 MORTALITY IMPROVEMENT IN BROAD AGE GROUPS, MALES

Age Band	2014 -> 2015	2015 -> 2016	2016 -> 2017
20-to-44	-6.1%	-9.1%	-2.0%
45-to-64	-0.4%	-0.4%	0.1%
65-to-84	-0.2%	1.5%	-0.1%
85-to-100	-1.2%	2.1%	-1.2%
All Ages	-0.9%	0.3%	-0.4%

Table 3.3
2014-2017 MORTALITY IMPROVEMENT UNDER/OVER AGE 65, MALES

Age Band	2014 -> 2015	2015 -> 2016	2016 -> 2017
Under 65	-1.7%	-2.4%	-0.4%
65 and Over	-0.5%	1.7%	-0.5%
All Ages	-0.9%	0.3%	-0.4%

3.2 Key Observations – Females

The three tables below show annual mortality improvement rates between 2014 and 2017 for females. Female mortality rates generally increased across most age groups between 2016 and 2017. Similar to males, the rise in mortality for young adult females aged 20-44 was not as significant as it was in previous years. Also similar to males, there was a general increase in mortality among females over the age of 65, with the group over age 80 seeing the largest rises in mortality. Aggregate mortality improvement for females was -0.6% from 2016-2017, which represents a slightly higher rise in mortality than the aggregate -0.4% improvement for males.

Table 3.4
2014-2017 MORTALITY IMPROVEMENT IN FIVE-YEAR AGE GROUPS, FEMALES

Age Band	2014 -> 2015	2015 -> 2016	2016 -> 2017
20-to-24	-5.8%	-7.3%	-2.0%
25-to-29	-5.2%	-9.2%	-3.3%
30-to-34	-9.5%	-8.4%	-3.2%
35-to-39	-1.6%	-8.7%	-0.7%
40-to-44	-0.2%	-2.1%	-1.5%
45-to-49	-0.2%	-0.2%	1.4%
50-to-54	-0.2%	-0.1%	2.1%
55-to-59	-0.8%	-0.7%	-0.3%
60-to-64	-0.5%	-1.2%	-0.5%
65-to-69	0.5%	1.9%	-0.6%
70-to-74	-0.4%	1.4%	1.0%
75-to-79	-0.7%	1.7%	0.0%
80-to-84	-1.0%	2.0%	-0.7%
85-to-89	-2.5%	2.3%	-0.8%
90-to-94	-2.4%	2.7%	-1.5%
95-to-100	-3.4%	2.6%	-2.5%
All Ages	-1.4%	1.3%	-0.6%

Table 3.5
2014-2017 MORTALITY IMPROVEMENT IN BROAD AGE GROUPS, FEMALES

Age Band	2014 -> 2015	2015 -> 2016	2016 -> 2017
20-to-44	-3.4%	-6.2%	-1.9%
45-to-64	-0.5%	-0.7%	0.4%
65-to-84	-0.5%	1.8%	-0.1%
85-to-100	-2.6%	2.5%	-1.4%
All Ages	-1.4%	1.3%	-0.6%

Table 3.6
2014-2017 MORTALITY IMPROVEMENT UNDER/OVER AGE 65, FEMALES

Age Band	2014 -> 2015	2015 -> 2016	2016 -> 2017
Under 65	-1.0%	-1.7%	-0.1%
65 and Over	-1.5%	2.1%	-0.7%
All Ages	-1.4%	1.3%	-0.6%

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.

About the Society of Actuaries

The Society of Actuaries (SOA), formed in 1949, is one of the largest actuarial professional organizations in the world dedicated to serving 32,000 actuarial members and the public in the United States, Canada and worldwide. In line with the SOA Vision Statement, actuaries act as business leaders who develop and use mathematical models to measure and manage risk in support of financial security for individuals, organizations and the public.

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 non-actuaries 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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