



U.S. Population Mortality Rates 2000-2021

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U.S. Population Mortality Rates 2000-2021

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 2000-2021. These rates represent one-year probabilities of death. This is an update to a series of such publications; the prior iteration consisting of 2000-2020 mortality rates can be found [here](#). The key updates from the previous publication are the addition of mortality rates for 2021 and true-ups of historical data from 2010-2020.



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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 20-64 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 2020 Vintage July 1 population estimates. The 2020 and 2021 population counts were taken from the Census Bureau’s 2021 Vintage July 1 population estimates.

Note that the previous year’s publication utilized census counts for ages 20-64 from the Census Bureau’s 2020 Vintage population estimates, which used an estimates base of the 2010 census. The 2020 population counts from the 2021 Vintage used in this year’s publication uses a different estimates base developed from a blend of several sources, as described in a [documentation note on the Census Bureau web page](#). This change to the estimates base resulted in differences in mortality rates by age ranging between -2.1% and +2.9%. It is expected that the Census Bureau will continue to refine their 2020 estimates base in future years.

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 and population counts 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 2019 and 2020 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 2000-2020 historical mortality rates publication. All 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 0.15%

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 the SSA’s [Long-Range OASDI Projection Methodology documentation](#). 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 2018 and 2021 for males. Due to the COVID-19 pandemic, mortality improvement rates were significantly negative from 2019 to 2020, with varying changes by age group. From 2020 to 2021, pre-retirement males experienced a further large deterioration in mortality on top of that experienced in 2020. The Under 65 age group experienced -11.2% improvement in 2021 compared to 2020, resulting in age-adjusted mortality rates approximately 30% higher than what they were in 2019. By contrast, older Americans experienced substantial improvement in mortality in 2021. All five-year age bands above age 75 experienced lower mortality rates in 2021 than in 2020.

Table 3.1

2018-2021 MORTALITY IMPROVEMENT IN FIVE-YEAR AGE GROUPS, MALES

Age Band	2018 -> 2019	2019 -> 2020	2020 -> 2021
20-to-24	0.5%	-23.7%	-3.5%
25-to-29	1.2%	-25.5%	-9.9%
30-to-34	-1.3%	-26.9%	-14.0%
35-to-39	-1.7%	-23.3%	-16.4%
40-to-44	-3.6%	-23.5%	-18.6%
45-to-49	0.2%	-21.5%	-16.0%
50-to-54	0.6%	-17.5%	-13.1%
55-to-59	1.1%	-14.6%	-9.7%
60-to-64	0.8%	-15.8%	-7.2%
65-to-69	0.9%	-16.8%	-5.0%
70-to-74	2.1%	-16.6%	-1.0%
75-to-79	1.9%	-16.7%	0.6%
80-to-84	1.6%	-15.5%	2.5%
85-to-89	1.4%	-13.8%	3.8%
90-to-94	1.5%	-12.9%	4.9%
95-to-100	1.5%	-11.8%	5.5%
All Ages	1.1%	-16.5%	-3.3%

Table 3.2

2018-2021 MORTALITY IMPROVEMENT IN BROAD AGE GROUPS, MALES

Age Band	2018 -> 2019	2019 -> 2020	2020 -> 2021
20-to-44	-1.3%	-24.5%	-13.6%
45-to-64	0.8%	-16.6%	-10.4%
65-to-84	1.6%	-16.3%	-0.5%
85-to-100	1.5%	-13.3%	4.3%
All Ages	1.1%	-16.5%	-3.3%

Table 3.3

2018-2021 MORTALITY IMPROVEMENT UNDER/OVER AGE 65, MALES

Age Band	2018 -> 2019	2019 -> 2020	2020 -> 2021
Under 65	0.2%	-18.6%	-11.2%
65 and over	1.6%	-15.3%	1.1%
All Ages	1.1%	-16.5%	-3.3%

3.2 KEY OBSERVATIONS - FEMALES

The three tables below show annual mortality improvement rates between 2018 and 2021 for females. Similar to males, the COVID-19 pandemic resulted in significantly negative mortality improvement rates from 2019 to 2020, with varying changes by age group. Also similar to males, there was considerable further year-over-year deterioration in mortality among the working age groups, with ages 35-44 showing the highest cumulative percentage increase in mortality rates from 2019 through 2021. Substantial mortality improvement was observed for the oldest Americans in 2021, with a age-adjusted improvement rate of 6.3% for females aged 85 through 100. As was the case with males, female mortality at these advanced ages remained elevated relative to 2019, as the improvement observed in 2021 was not enough to counteract the shock experienced in 2020.

Table 3.4

2018-2021 MORTALITY IMPROVEMENT IN FIVE-YEAR AGE GROUPS, FEMALES

Age Band	2018 -> 2019	2019 -> 2020	2020 -> 2021
20-to-24	0.0%	-18.7%	-11.2%
25-to-29	3.5%	-24.2%	-9.1%
30-to-34	-0.2%	-19.2%	-15.3%
35-to-39	-1.0%	-18.2%	-17.7%
40-to-44	-0.4%	-20.5%	-19.7%
45-to-49	0.9%	-17.8%	-16.1%
50-to-54	2.4%	-15.8%	-11.9%
55-to-59	1.9%	-13.7%	-10.4%
60-to-64	-0.8%	-15.5%	-9.0%
65-to-69	1.9%	-15.9%	-6.6%
70-to-74	2.2%	-13.5%	-1.2%
75-to-79	2.1%	-14.1%	-0.4%
80-to-84	2.0%	-13.9%	3.2%
85-to-89	1.6%	-14.4%	5.7%
90-to-94	1.4%	-13.7%	6.6%
95-to-100	2.5%	-13.2%	7.4%
All Ages	1.6%	-14.6%	-0.4%

Table 3.5

2018-2021 MORTALITY IMPROVEMENT IN BROAD AGE GROUPS, FEMALES

Age Band	2018 -> 2019	2019 -> 2020	2020 -> 2021
20-to-44	0.1%	-20.0%	-16.0%
45-to-64	0.9%	-15.3%	-11.0%
65-to-84	2.0%	-14.2%	-0.4%
85-to-100	1.7%	-13.9%	6.3%
All Ages	1.6%	-14.6%	-0.4%

Table 3.6

2018-2021 MORTALITY IMPROVEMENT UNDER/OVER AGE 65, FEMALES

Age Band	2018 -> 2019	2019 -> 2020	2020 -> 2021
Under 65	0.7%	-16.3%	-12.0%
65 and over	1.9%	-14.1%	2.9%
All Ages	1.6%	-14.6%	-0.4%

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: 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.

About The Society of Actuaries Research Institute

Serving as the research arm of the Society of Actuaries (SOA), the SOA Research Institute provides objective, data-driven research bringing together tried and true practices and future-focused approaches to address societal challenges and your business needs. The Institute provides trusted knowledge, extensive experience and new technologies to help effectively identify, predict and manage risks.

Representing the thousands of actuaries who help conduct critical research, the SOA Research Institute provides clarity and solutions on risks and societal challenges. The Institute connects actuaries, academics, employers, the insurance industry, regulators, research partners, foundations and research institutions, sponsors and non-governmental organizations, building an effective network which provides support, knowledge and expertise regarding the management of risk to benefit the industry and the public.

Managed by experienced actuaries and research experts from a broad range of industries, the SOA Research Institute creates, funds, develops and distributes research to elevate actuaries as leaders in measuring and managing risk. These efforts include studies, essay collections, webcasts, research papers, survey reports, and original research on topics impacting society.

Harnessing its peer-reviewed research, leading-edge technologies, new data tools and innovative practices, the Institute seeks to understand the underlying causes of risk and the possible outcomes. The Institute develops objective research spanning a variety of topics with its [strategic research programs](#): aging and retirement; actuarial innovation and technology; mortality and longevity; diversity, equity and inclusion; health care cost trends; and catastrophe and climate risk. The Institute has a large volume of [topical research available](#), including an expanding collection of international and market-specific research, experience studies, models and timely research.

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