Mortality and Longevity

U.S. Population Mortality Rates 2000-2018

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Caveat and Disclaimer

CONTENTS

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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 2000-2018. These rates represent one-year probabilities of death. This is an update to a series of such publications; the prior iteration consisting of 2000-2017 mortality rates can be found here. The key updates from the previous publication are the addition of mortality rates for 2018 and true-ups of historical data from 2000-2017.

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 2010-2018 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.

Each year, the Census Bureau provides an updated estimate of historical population by sex and single year of age for years since 2010. In addition, CMS provided revised estimates for 2016 and 2017 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 2000-2017 historical mortality rates publication. All of the changes were increases. For ages below 65, the Census Bureau updates caused some mortality rates to increase by no more than 0.00001. 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.

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 2015 and 2018 for males[1]. Mortality improvement was positive in the aggregate from 2017 to 2018, with varying changes by age group. After multiple years of significant negative mortality improvement, the young adult group aged 20-44 reversed this trend in 2018 with a mortality improvement rate over 2%. The improvement rates for both the 65-to-84 and 85-to-100 age groups were 1.0%, which is above the annual arithmetic average for each of these groups since 2010 (0.7% and 0.3%, respectively). The aggregate mortality improvement of 0.9% for 2018 was the highest for males since 2012 (also 0.9%).

Table 3.1
2015-2018 MORTALITY IMPROVEMENT IN FIVE-YEAR AGE GROUPS, MALES

Age Band	2015 -> 2016	2016 -> 2017	2017 -> 2018
20-to-24	-8.7%	2.4%	5.3%
25-to-29	-11.0%	-2.6%	4.9%
30-to-34	-10.4%	-4.1%	3.2%
35-to-39	-10.3%	-3.4%	-0.2%
40-to-44	-6.1%	-1.8%	-0.1%
45-to-49	-1.8%	-0.9%	-0.1%
50-to-54	0.4%	0.7%	1.9%
55-to-59	-0.4%	0.4%	0.1%
60-to-64	-0.4%	-0.1%	-0.3%
65-to-69	1.1%	-0.8%	-0.2%
70-to-74	0.9%	1.3%	0.8%
75-to-79	1.2%	0.1%	1.2%
80-to-84	2.6%	-1.1%	1.8%
85-to-89	2.1%	-1.2%	1.2%
90-to-94	1.8%	-0.9%	0.7%
95-to-100	2.7%	-2.2%	0.9%
All Ages	**0.3%**	**-0.5%**	**0.9%**

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[1] The mortality improvement percentages from 2015 to 2016 and from 2016 to 2017 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

2015-2018 MORTALITY IMPROVEMENT IN BROAD AGE GROUPS, MALES

Age Band	2015 -> 2016	2016 -> 2017	2017 -> 2018
20-to-44	-9.0%	-2.1%	2.2%
45-to-64	-0.4%	0.1%	0.3%
65-to-84	1.5%	-0.2%	1.0%
85-to-100	2.1%	-1.2%	1.0%
All Ages	**0.3%**	**-0.5%**	**0.9%**

Table 3.3

2015-2018 MORTALITY IMPROVEMENT UNDER/OVER AGE 65, MALES

Age Band	2015 -> 2016	2016 -> 2017	2017 -> 2018
Under 65	-2.4%	-0.4%	0.8%
65 and Over	1.7%	-0.5%	1.0%
All Ages	**0.3%**	**-0.5%**	**0.9%**

3.2 KEY OBSERVATIONS - FEMALES

The three tables below show annual mortality improvement rates between 2015 and 2018 for females. Female mortality improvement rates were positive for all five-year age groups in 2018 except for the 35-to-39 age group. Similar to males, the positive mortality improvement of 1.5% for the age 20-to-44 young adult group reversed the recent trend of multiple years of large increases in mortality rates. The 1.5% mortality improvement for the 45-to-64 age group was the highest since 2010 (2.4%) and the 1.6% mortality improvement for the 65-to-84 age group was the second-highest since 2009 (3.9%), trailing only 2016 (1.8%). The aggregate improvement of 1.2% is also the second-highest for females since 2009 (3.7%), behind 2016 (1.3%).

Table 3.4
2015-2018 MORTALITY IMPROVEMENT IN FIVE-YEAR AGE GROUPS, FEMALES

Age Band	2015 -> 2016	2016 -> 2017	2017 -> 2018
20-to-24	-7.3%	-2.0%	5.5%
25-to-29	-9.1%	-3.0%	1.4%
30-to-34	-8.6%	-3.0%	0.8%
35-to-39	-8.5%	-0.7%	-0.8%
40-to-44	-2.0%	-1.5%	2.2%
45-to-49	-0.4%	1.6%	1.9%
50-to-54	-0.2%	2.1%	2.5%
55-to-59	-0.8%	-0.2%	1.5%
60-to-64	-1.2%	-0.5%	0.8%
65-to-69	1.9%	-0.7%	2.2%
70-to-74	1.4%	1.0%	1.6%
75-to-79	1.7%	0.0%	1.3%
80-to-84	2.0%	-0.7%	1.6%
85-to-89	2.3%	-0.8%	0.2%
90-to-94	2.7%	-1.5%	0.9%
95-to-100	2.6%	-2.6%	0.2%
All Ages	**1.3%**	**-0.6%**	**1.2%**

Table 3.5
2015-2018 MORTALITY IMPROVEMENT IN BROAD AGE GROUPS, FEMALES

Age Band	2015 -> 2016	2016 -> 2017	2017 -> 2018
20-to-44	-6.2%	-1.9%	1.5%
45-to-64	-0.8%	0.4%	1.5%
65-to-84	1.8%	-0.2%	1.6%
85-to-100	2.5%	-1.4%	0.5%
All Ages	**1.3%**	**-0.6%**	**1.2%**

Table 3.6
2015-2018 MORTALITY IMPROVEMENT UNDER/OVER AGE 65, FEMALES

Age Band	2015 -> 2016	2016 -> 2017	2017 -> 2018
Under 65	-1.8%	0.0%	1.5%
65 and Over	2.1%	-0.8%	1.1%
All Ages	**1.3%**	**-0.6%**	**1.2%**

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.

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