2021 Provisional U.S. Population Mortality
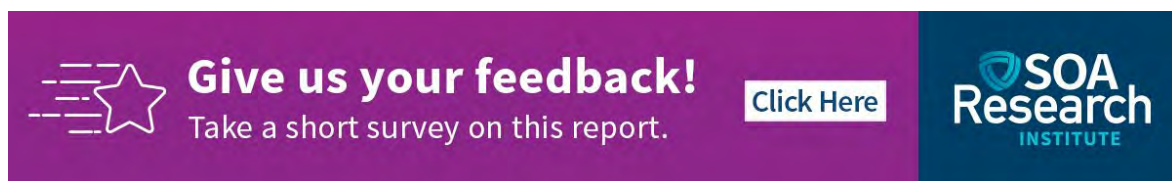
Key Observations

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2021 Provisional U.S. Population Mortality

Key Observations

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2021 Provisional U.S. Mortality

Key Observations
Observations for Whole Population, by Sex and Age

In the following, we consider high-level results from provisional mortality data released from the U.S. Centers for Disease Control and Prevention (CDC) for 2021, including looking at changes by sex and age group.[1]

Executive Summary

- In provisional data for 2021, general population mortality for the United States was worse than seen in 2020 along multiple dimensions, though a few groups saw improvement compared to 2020.
- The crude death rate increased 2.4% in 2021, and the age-adjusted death rate increased 2.8%. The period life expectancy decreased 0.9 years in 2021. These three mortality metrics demonstrated the continuing effects of pandemic (and non-pandemic) excess mortality in 2021, after larger effects in 2020.
- Males had a 3.5% increase in age-adjusted death rate in 2021, while females saw a 1.8% increase. Males saw higher mortality increases in 2020 and 2021, reversing some of the relative mortality improvements seen in pre-pandemic times.
- By age groups, the worst relative experience during 2019-2021 was seen by those in working ages, especially the age 35-44 group, which had a cumulative 49% increase in death rate over the period. Adults in retirement age had a less relative increase in mortality, with the age 65-74 group with the greatest cumulative effect, at 26% increase in death rates from 2019 to 2021. Children under age 15 did not have much mortality increases over the period, with the age 5-14 group showing only a 9% cumulative increase from 2019 to 2021.

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Section 1: Mortality Metrics

There are multiple measures for mortality that can be used in investigating trends. In this paper, we will be using crude death rates, age-adjusted death rates, and period life expectancy. The three metrics are defined and discussed below.

All of these metrics will be stated for full years, and this paper is most focused on the experience of 2021 in relation to recent experience as well as longer-term U.S. mortality experience.

1.1 CRUDE DEATH RATES AND AGE-ADJUSTED DEATH RATES

Crude death rates are the easiest to understand as it calculates the number of people who died during the year divided by the total number of people in the population. To make the numbers easier to deal with, the standard rates are quoted in units of per 100,000 people.

However, crude death rates can give a distorted picture of mortality effects as it is influenced by the age distribution of the underlying population. A population with more old people, for example, will generally have a higher crude death rate than a population with more children, all else held equal. When we wish to compare mortality rates, we're generally not interested in simply comparing the age distributions of the underlying populations.

To have a better idea of changing mortality severity by cause of death at different ages, age-adjusted death rates are used. This is a standardized weighted average, where death rates at different ages are averaged as if the population had a specific age distribution. The current standardized population for U.S. mortality statistics is based on something close to the 2000 U.S. population age distribution.

Figure 1 shows how the death rate metrics have diverged over two decades, and the most recent behavior during the pandemic. Table 1 also shows the percentage changes year-over-year. To better highlight year-over-year changes, positive changes in each metric, in which mortality increased by that measure, are bolded and in red.

Figure 1
U.S. DEATH RATE TRENDS, 1999-2021 (PROVISIONAL)
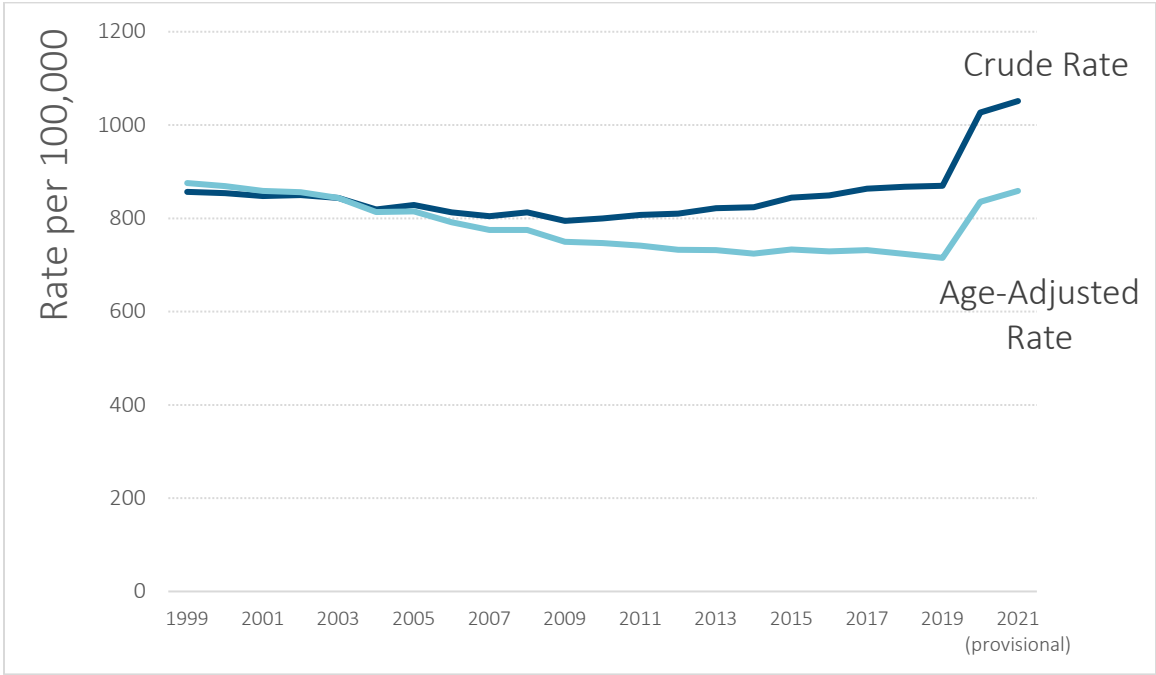
Data source: CDC WONDER

Table 1
U.S. DEATH RATE TRENDS, 1999-2021 (PROVISIONAL)

	Crude Rate	Year-over-year percentage change		Age-adjusted rate	Year-over-year percentage change
1999	857.0			875.6	
2000	854.0	-0.4%		869.0	-0.8%
2001	848.0	-0.7%		858.8	-1.2%
2002	849.5	0.2%		855.9	-0.3%
2003	843.9	-0.7%		843.5	-1.4%
2004	818.8	-3.0%		813.7	-3.5%
2005	828.4	1.2%		815.0	0.2%
2006	813.1	-1.8%		791.8	-2.8%
2007	804.6	-1.0%		775.3	-2.1%
2008	812.9	1.0%		774.9	-0.1%
2009	794.5	-2.3%		749.6	-3.3%
2010	799.5	0.6%		747.0	-0.3%
2011	807.3	1.0%		741.3	-0.8%
2012	810.2	0.4%		732.8	-1.1%
2013	821.5	1.4%		731.9	-0.1%
2014	823.7	0.3%		724.6	-1.0%
2015	844.0	2.5%		733.1	1.2%
2016	849.3	0.6%		728.8	-0.6%
2017	863.8	1.7%		731.9	0.4%
2018	867.8	0.5%		723.6	-1.1%
2019	869.7	0.2%		715.2	-1.2%
2020	1027.0	18.1%		835.4	16.8%
2021 (provisional)	1051.4	2.4%		858.5	2.8%

Data Source: CDC WONDER

1.1.1 OBSERVATIONS ON 2021 OVERALL DEATH RATE CHANGES

For both metrics, mortality in 2021 increased compared to 2020.

Given that there had been a historically large mortality increase in 2020, the additional increase in 2021 showed additional strain but there was an odd pattern: the percentage increase was larger for the age-adjusted rate than for the crude rate. This is not usual if one looks at the 1999-2019 history, or even the result in 2020.

Indeed, for all the years 1999-2020, the crude rate showed a larger increase (or less of a decrease when both rates decreased) than for the age-adjusted death rate. This was to be expected as the population was generally aging – the crude rate increases in most years, even as the age-adjusted death rate decreased, reflected that aging population.

Though we will not be discussing the causes in this paper, note that the age-adjusted death rates indicate a pre-pandemic increase in mortality in 2005, 2015, and 2017.

The larger increase in the age-adjusted rate in 2021 is reflecting that some younger ages were harder-hit with respect to mortality in a relative sense than older ages were. We shall see better detail in a later section. This had some repercussions in insurance products that covered working-age Americans, such as group life insurance, in 2021.

Note that the crude death rate is well above any of the rates seen in the history going back to 1999.

However, in looking at the age-adjusted death rate, we see that these rates are at the same level as the rates seen in the early 2000s. This disparity in the behavior of these two rates reflects the aging population, as well as the differing death rates by age groups in 2021.

1.2 PERIOD LIFE EXPECTANCY

Period life expectancy is another metric often used to compare mortality trends between groups and periods. Period life expectancy is developed by developing a life table with mortality rates at each age for the period in question (such as calendar year 2021), and calculating a life expectancy from birth as if a person were living through that life table.

Period life expectancy is an artificial construct, as nobody actually lives through such a mortality environment through their lifetime. Many people confuse period life expectancy with cohort life expectancy, which is life expectancy based on life tables for when someone was born, tracking through the various years from birth through death through multiple years as opposed to the mortality experience of the population in a single calendar year.

Period life expectancy behaves similar to an inverse of an age-adjusted death rate, in that it increases when age-adjusted death rate decreases, and vice-versa. In general, it can be used to track trends and compare the mortality experience of different populations. However, it can be difficult to interpret in terms of percentage changes.

In Figure 2, the period life expectancy for the U.S. population is graphed. In Table 2, the year-over-year change is given for 2000-2021 (provisional), which decreases in period life expectancy bolded and in red to highlight increases in mortality.

Figure 2
U.S. PERIOD LIFE EXPECTANCY, 2000-2021 (PROVISIONAL)
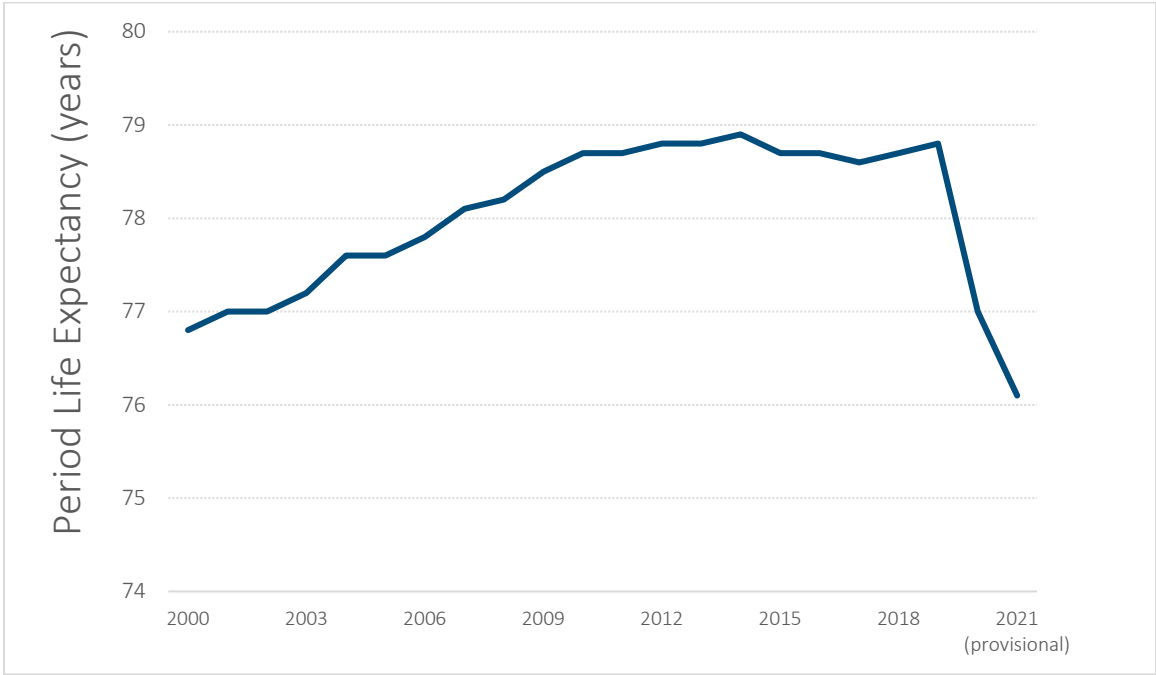
SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality

Table 2
U.S. PERIOD LIFE EXPECTANCY, 2000-2021 (PROVISIONAL)

	Period life expectancy (years)	Year-over-year change in years
2000	76.8	
2001	77.0	0.2
2002	77.0	0.0
2003	77.2	0.2
2004	77.6	0.4
2005	77.6	0.0
2006	77.8	0.2
2007	78.1	0.3
2008	78.2	0.1
2009	78.5	0.3
2010	78.7	0.2
2011	78.7	0.0
2012	78.8	0.1
2013	78.8	0.0
2014	78.9	0.1
2015	78.7	-0.2
2016	78.7	0.0
2017	78.6	-0.1
2018	78.7	0.1
2019	78.8	0.1
2020	77.0	-1.8
2021 (provisional)	76.1	-0.9

SOURCE: National Center for Health Statistics, National Vital Statistics System, Mortality

1.2.1 OBSERVATIONS ON 2021 LIFE EXPECTANCY CHANGES

As with the death rate changes, there was an additional change in period life expectancy in 2021, just not as severe as that seen in 2020.

After a nearly 2-year decrease in period life expectancy from 2019 to 2020, an additional almost 1-year decrease in 2021 brings the period life expectancy to below the level seen in 2000.

As we can see from the historical trajectory though, the period life expectancy had been improving from 2000 to about 2014, after which there had been some years of decreases. These years of decreases (2015 and 2017) match the years in which the age-adjusted death rates increased.

It is difficult to interpret changes in life expectancy in years into impact on lines of business in insurance, unlike potential percentage differences in age-adjusted death rates or even crude death rates. While the change in life expectancy in 2020 was twice that of 2021, in terms of number of years, the percentage change in death rates in 2020, whether crude death rate or age-adjusted death rate, was larger than the changes in 2021 by several times.

Period life expectancy tends to be best in doing comparisons between groups in which one cares rank order of results, but not as much when one is trying to determine the magnitude of effect.

For the remainder of this paper, we will not be looking at period life expectancy comparisons, but only death rates.

Section 2: Demographic Differences

The largest demographic splits are by sex and age in terms of mortality impacts. Age-adjusted death rates can be calculated by sex, but for age groups, one must calculate a crude rate for each grouping.

2.1 SEX

The trends for the age-adjusted death rate by sex are shown in Figure 3, with the year-over-year percentage changes shown in Table 3.

Figure 3
U.S. AGE-ADJUSTED DEATH RATES BY SEX, 1999-2021 (PROVISIONAL)
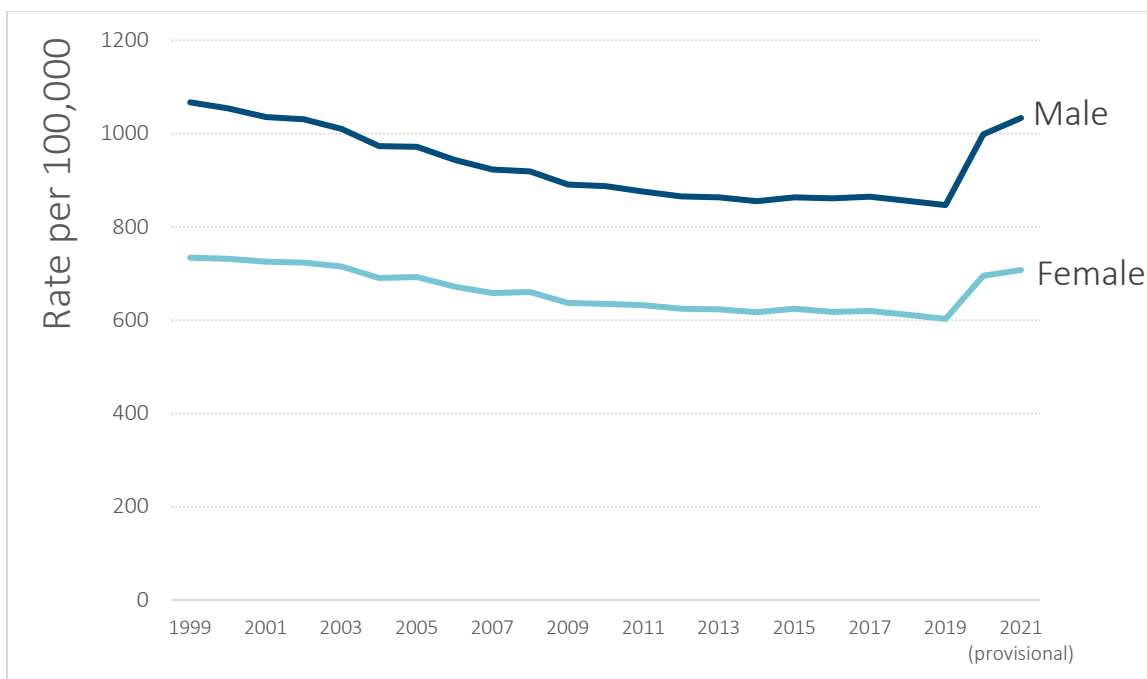
Data source: CDC WONDER

Table 3
U.S. DEATH RATE TRENDS BY SEX, 1999-2021 (PROVISIONAL)

	Male Age-adjusted death rate	Year-over-year percentage change		Female Age-adjusted death rate	Year-over-year percentage change
1999	1067			734	
2000	1053.8	-1.2%		731.4	-0.4%
2001	1035.4	-1.7%		725.6	-0.8%
2002	1030.6	-0.5%		723.6	-0.3%
2003	1010.3	-2.0%		715.2	-1.2%
2004	973.3	-3.7%		690.5	-3.5%
2005	971.9	-0.1%		692.3	0.3%
2006	943.5	-2.9%		672.2	-2.9%
2007	922.9	-2.2%		658.1	-2.1%
2008	918.8	-0.4%		659.9	0.3%
2009	890.9	-3.0%		636.8	-3.5%
2010	887.1	-0.4%		634.9	-0.3%
2011	875.3	-1.3%		632.4	-0.4%
2012	865.1	-1.2%		624.7	-1.2%
2013	863.6	-0.2%		623.5	-0.2%
2014	855.1	-1.0%		616.7	-1.1%
2015	863.2	0.9%		624.2	1.2%
2016	861	-0.3%		617.5	-1.1%
2017	864.5	0.4%		619.7	0.4%
2018	855.5	-1.0%		611.3	-1.4%
2019	846.7	-1.0%		602.7	-1.4%
2020	998.3	17.9%		695.1	15.3%
2021 (provisional)	1033.6	3.5%		707.7	1.8%

Data Source: CDC WONDER

2.1.1 OBSERVATIONS ON 2021 DIFFERENCES BY SEX

In both 2020 and 2021, male mortality increases were higher than for females.

The age-adjusted death rate for males was about the same in 2021 as in 2001 or 2002.

For females, their age-adjusted death rate was about the same level as 2003 in 2021.

Though not shown in the table or graph, the ratio of male-to-female age-adjusted death rates has varied over this period, starting at 1.45 in 1999, reaching a low of 1.38 in 2011-2012, and then coming up to 1.40 in 2019. With the higher male mortality increases in 2020 and 2021, the male-to-female mortality rate ratio was 1.46 in 2021.

We are not showing the sex breakout by age group in the sections below, but the disparity in mortality risk by sex is one of the larger demographic gaps for mortality in the U.S. and has been persistent in history. Males have higher mortality rates at all ages than females.

Note that females had a year where their mortality slightly worsened overall, in 2008, where the overall population did not due to the improvement seen by males.

So note that one can see different trajectories of mortality improvement and worsening by subgroups, which we will definitely see when we break out trends by age groups.

2.2 AGE GROUPS

For age groups, age-adjusted death rates are not available, but crude death rates are. If the age groups are small enough in age range, the difference in mortality between the youngest and the oldest are not much, and tracking the crude death rates are fair approaches.

For the following, we will be using the standard "10-year age groups", which differ at the extreme ends. For children, there are age groups of under 1 year old (infant mortality), age 1-4, and then standard 10-year groupings start. At the oldest end, the highest age grouping is age 85 and over.

One may wish to be careful in investigating the experience seen in the 85+ years grouping, though obviously most of the people seen in this population will be on the younger end.

In Table 4, one can see the year-over-year percentage change in the crude death rates for each of these age groups, covering 2018-2021. The pre-pandemic years are included so that one can see the "normal" kind of small fluctuations that were usual in those years.

Table 4
YEAR-OVER-YEAR PERCENTAGE CHANGE IN CRUDE DEATH RATES BY AGE GROUP

	<1 year	1-4 years	5-14 years	15-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-84 years	85+ years
2018	-2%	-1%	-2%	-5%	-3%	0%	-1%	0%	0%	-2%	-1%
2019	-1%	-3%	1%	-1%	0%	2%	-1%	0%	-1%	-2%	-2%
2020	-5%	-3%	2%	21%	24%	24%	21%	18%	17%	16%	15%
2021 (provisional)	2%	8%	7%	7%	12%	20%	13%	9%	7%	1%	-7%
Two-year cumulative change from 2019 to 2021	-4%	5%	9%	29%	39%	49%	36%	28%	26%	17%	7%

Data Source: CDC WONDER

In the final row of Table 4, we see the crude death rates for each group in 2021 compared against their level in 2019. This shows where the relative effect of pandemic mortality as well as non-pandemic causes of death have made an impact, with working age adults from age 25 – 54 seeing the highest effects. We will discuss these relative impacts in the subsections below.

2.2.1 INFANT

Figure 4
U.S. CRUDE DEATH RATES BY 10-YEAR AGE GROUP, 1999-2021 (PROVISIONAL), AGES UNDER 1 (INFANT MORTALITY)
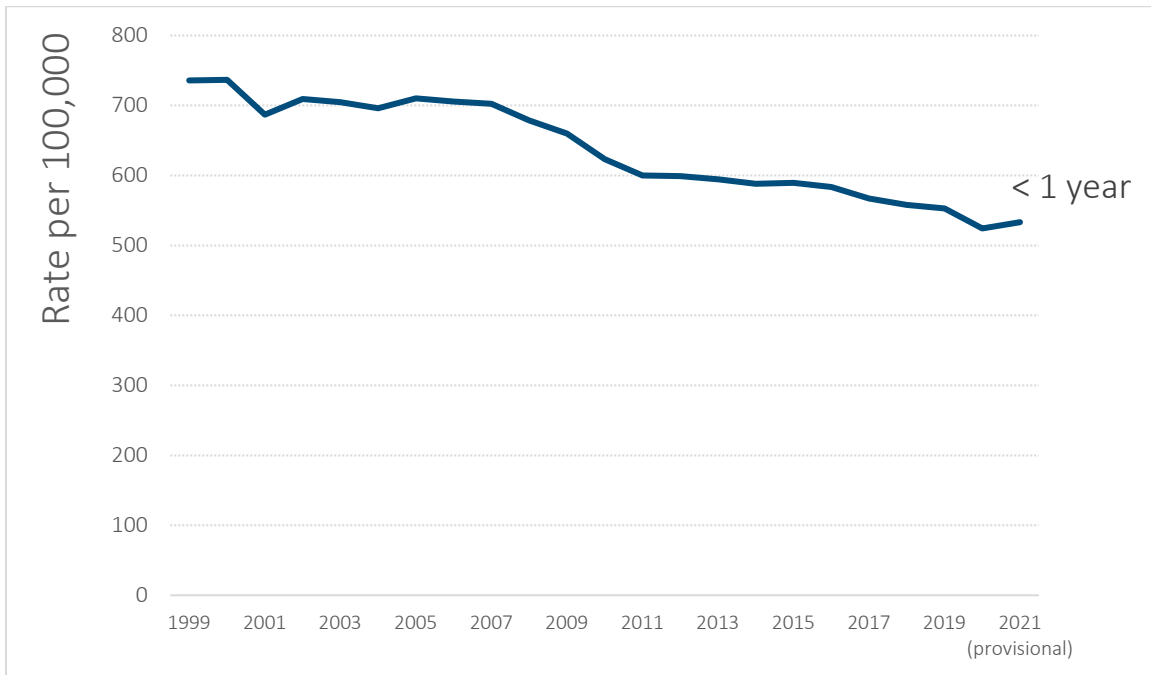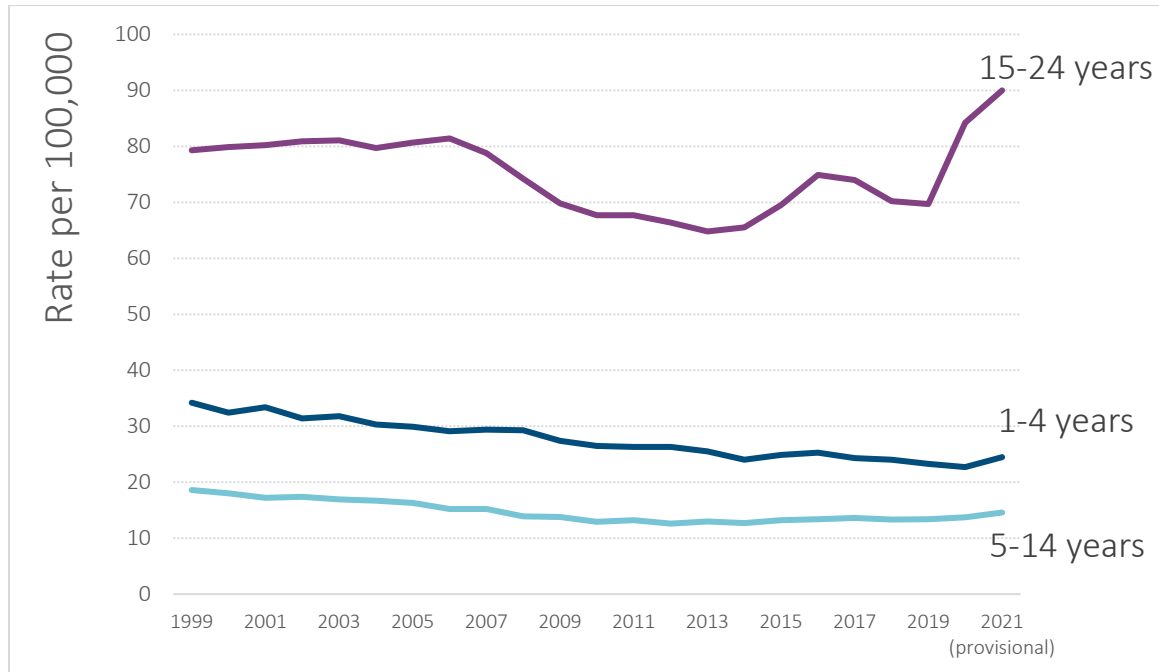

Data source: CDC WONDER

For 2021, infant mortality was slightly higher than for 2020.

However, note that infant mortality in 2020 was lower than for 2019. Indeed, even with the slight increase in 2021, infant mortality in 2021 was 4% lower than in 2019.

There had been some bad infant mortality trends in the early 2000s, but trends have been good more recently, and the pandemic seems not to have affected that much.

2.2.2 YOUTH

Figure 5
U.S. CRUDE DEATH RATES BY 10-YEAR AGE GROUP, 1999-2021 (PROVISIONAL), AGES 1 - 24

Data source: CDC WONDER

For ages 1 – 4, there has been an 8% increase in mortality in 2021 compared to 2020. This is relatively large for this age group, but very slight compared to the adult age groups. There had been some decrease in mortality in 2020, so the cumulative change in mortality from 2019 to 2021 was 5% for ages 1 – 4 years old.

For ages 5-14, the 2021 death rate increase was 7% over 2020, after a slight increase of 2% in 2020 itself. The cumulative change from 2019 to 2021 was 9% for ages 5-14 years old.

 In general, minors under age 15 have seen their mortality rates little affected during the pandemic.

However, older teens and young adults have seen significant increases in death rates. In 2020, the 15 – 24 year-old age group saw death rates increase 21% over 2019, and then increased an additional 7% in 2021. This led to a cumulative increase of 29% in crude rate from 2019 to 2021 for the 15-24 years old age group.

2.2.3 WORKING AGE

Figure 6

U.S. CRUDE DEATH RATES BY 10-YEAR AGE GROUP, 1999-2021 (PROVISIONAL), AGE 25-64
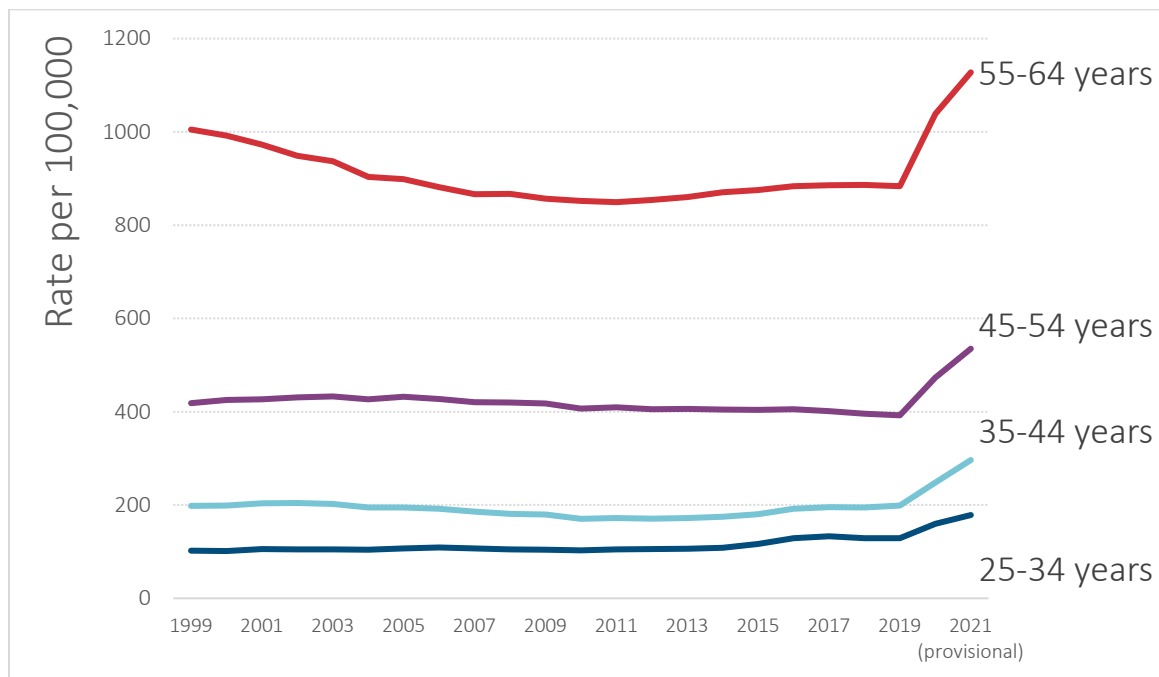
Data source: CDC WONDER

This range of ages, which we are defining as age 25-64, saw large increases in mortality cumulatively over 2020 and 2021. The larger change for each group was seen in 2020, but large changes also occurred in 2021, leading to historically large cumulative changes in mortality.

The age group with the worst relative increase was ages 35-44, which saw a cumulative increase of 49% in death rates from 2019 to 2021.

Other age groups in this range also saw large increases from 2019 to 2021:

- Age 25 – 34 had a cumulative 39% increase in death rates

- Age 45-54 had a cumulative 36% increase

- Age 55-64 had a 28% increase

For life insurance, having such large relative increases in mortality levels can have outsize effects. Group life insurance, which generally is covered in employee benefits, saw large effects in 2021 due to this relatively large increase in working age mortality. Individual life insurance can also have relative large effects in actual-to-expected ratios.
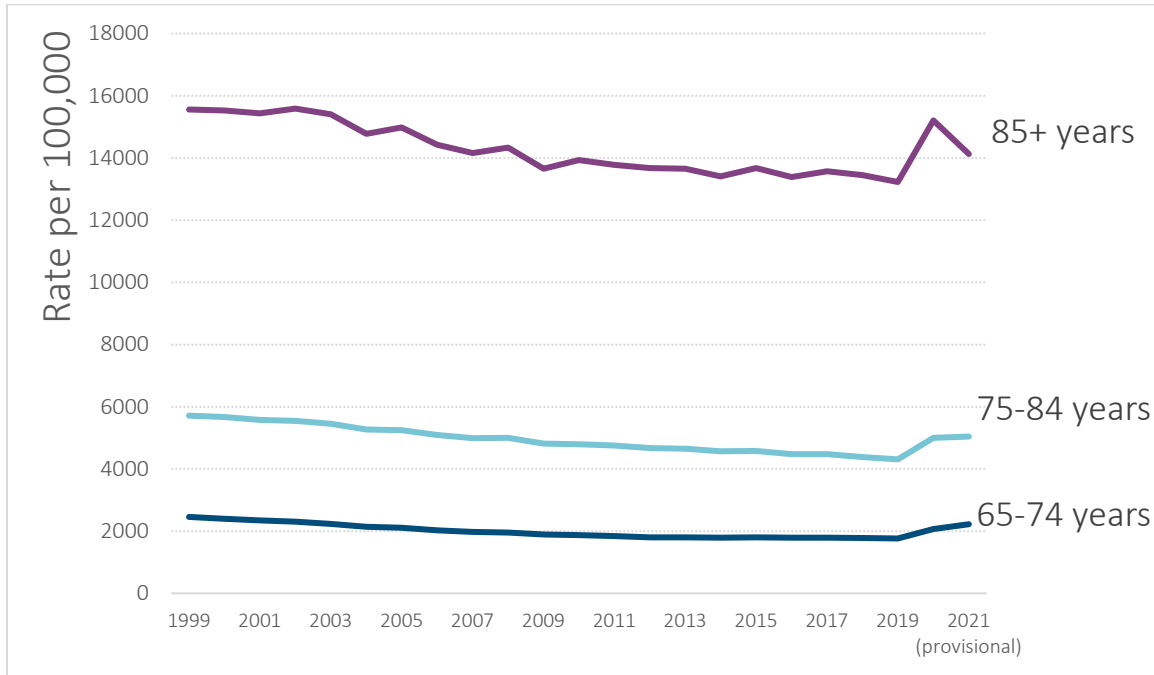
In general, at these ages, life insurance reserves compared to face amount of life insurance is low, so early death has a larger financial effect on life insurers than does the death of older policyholders.

2.2.3 RETIREMENT AGE

Figure 7

U.S. CRUDE DEATH RATES BY 10-YEAR AGE GROUP, 1999-2021 (PROVISIONAL), AGE 65 AND OVER

Data source: CDC WONDER

For retirement age adults, increases in mortality was less drastic compared to working age adults in 2021, and in the case of those over age 85, death rates actually decreased.

The 65 – 74 year old age range saw a 7% increase in death rates from 2020 to 2021, and a cumulative increase of 26% from 2019 to 2021. This is very close to the cumulative increase of 28% seen by the 55-64 year old age group.

For ages 75 – 84, death rates increased only 1% from 2020 to 2021, with mortality being essentially at the same level. The cumulative increase in crude death rates from 2019 to 2021 was 17%, much less than all the working age groups.

For those over age 85, death rates actually decreased in 2021 compared to 2020. This may be in response to vaccination prioritization for the oldest, but it may also be due to the most vulnerable dying in 2020. The death rate for this oldest age group in 2021 was still higher than the 2019 rate, with a cumulative increase of 7% over the period. This is a relative increase similar to that of the age 5-14 years old group.

Appendix A: Methodology

Death rates are in units of per 100,000 people per year.

Crude death rate and age-adjusted death rate data for 1999-2020 are from the following source, and are completed data for the year:

> Centers for Disease Control and Prevention, National Center for Health Statistics. National Vital Statistics System, Mortality 1999-2020 on CDC WONDER Online Database, released in 2021. Data are from the Multiple Cause of Death Files, 1999-2020, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program.

Crude death rate and age-adjusted death rate data for 2021 are from the following source, and are provisional for the year:

> Centers for Disease Control and Prevention, National Center for Health Statistics. National Vital Statistics System, Provisional Mortality on CDC WONDER Online Database. Data are from the final Multiple Cause of Death Files, 2018-2020, and from provisional data for years 2021-2022, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/mcd-icd10-provisional.html on Oct 7, 2022.

Period life expectancy, for 2000-2020, final, and for 2021, provisional, is from the following source:

> Arias E, Tejada-Vera B, Kochanek KD, Ahmad FB. Provisional life expectancy estimates for 2021. Vital Statistics Rapid Release; no 23. Hyattsville, MD: National Center for Health Statistics. August 2022. DOI: https://dx.doi.org/10.15620/cdc:118999.
>
> Url: https://www.cdc.gov/nchs/data/vsrr/vsrr023.pdf
>
> Supplemental tables: https://www.cdc.gov/nchs/data/vsrr/vsrr023-tables.pdf

All data are available in accompanying spreadsheet which accompany this report.

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