



# RPEC 2023 Mortality Improvement Update



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# RPEC 2023 Mortality Improvement Update

**AUTHOR** Society of Actuaries Research Institute  
Retirement Plans Experience Committee

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# RPEC 2023 Mortality Improvement Update

## Section 1: Executive Summary

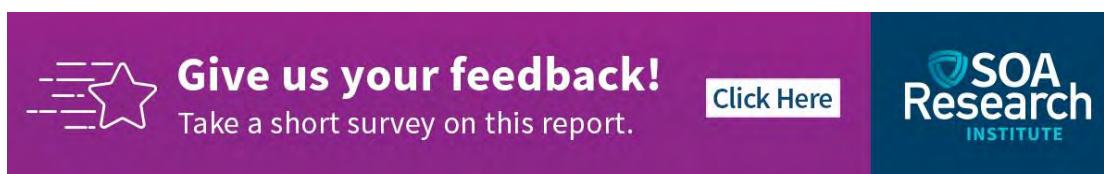
This report presents research into recent population mortality experience compiled by the Retirement Plans Experience Committee (RPEC or the Committee) of the Society of Actuaries Research Institute (SOA) as it pertains to development of mortality improvement assumptions for measuring obligations of retirement programs in the United States. Each year from 2015 through 2021, RPEC released an update to Mortality Improvement Scale MP-2014 (SOA 2014) that incorporated the latest available historical mortality data. These scales were produced by the RPEC\_2014 model which, in 2021, was incorporated into the MIM-2021 model.



In the RPEC 2022 Mortality Improvement Update released in October 2022, RPEC elected not to create a mortality improvement scale incorporating the then-emerging 2020 U.S. mortality data, as it was severely affected by the COVID-19 pandemic. The challenges with incorporating pandemic data without adjustment into the MIM-2021 model still persist with the now-available 2021 population mortality data, as described in section 2. Therefore, RPEC has not released a new mortality improvement scale for 2023.

RPEC has continued to review emerging population mortality data to understand how the pandemic has been affecting U.S. mortality rates. It was observed that excess mortality relative to pre-pandemic trends began to significantly abate after the first quarter of 2022. The first half of 2023 has shown population mortality levels that are close to pre-pandemic trends in aggregate, with significant differences by age group. While there is still considerable excess mortality among working-aged adults during this period, mortality rates for ages over 65 have been below projections based on pre-pandemic trends. Further discussion and analysis of this observation can be found in subsection 3.3.

The latest version of MIM-2021 is MIM-2021-v4. There have been no changes to the underlying mortality improvement projection model, but the Data Analysis Tool now includes additional historical data. MIM-2021-v4 still includes buttons to load the parameters used to build Scale MP-2021 and Scale O2-2021 (SOA 2023b). Users can also optionally input mortality loads by age and sex on a select basis through 2027 and an ultimate basis for 2028 and later. This functionality enables practitioners to model their selected assumption for the effects of the pandemic on mortality.

RPEC will continue to study emerging mortality experience and assess what mortality improvement scale options might be considered for implementation.



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## Section 2: 2020-2021 Mortality Data and RPEC Mortality Improvement Scales

RPEC released the Scale MP-2021 Report (SOA 2021) in October 2021, which included an improvement scale that incorporated data through December 31, 2019, according to the Committee's previously established methodology and update cadence. In October 2022, the SOA published the RPEC 2022 Mortality Improvement Update (SOA 2022a). That report summarized then-available data on the pandemic's impact on mortality rates, but did not provide a new mortality improvement scale because the additional data to be added under the previously established methodology and cadence would have been heavily influenced by the onset of the pandemic.

The RPEC 2022 Mortality Improvement Update provided statistics on excess mortality in the United States during 2020, 2021, and the first half of 2022. RPEC provided content on potential considerations for selecting a mortality load, as well as summarizing other organizations' approaches to incorporating future impacts of the pandemic on mortality and excerpting findings from the SOA expert opinion surveys on the short-term impact of COVID-19 on U.S. mortality. While the report provided data on excess mortality, RPEC did not provide committee-selected COVID-19 loads.

As stated in the RPEC 2022 Mortality Improvement Update, continuing to incorporate new data into an updated improvement scale using past timelines would result in the inclusion of data from the 2020 and 2021 calendar years, data that is severely affected by the COVID-19 pandemic. The model used by RPEC applies graduation techniques to smooth out past mortality data so, if the 2020-2021 data were incorporated without adjustment, the resulting graduated rates would be significantly affected, including those for the years leading up to the pandemic. This impact would yield the curious result of elevated mortality levels before the pandemic occurred. Furthermore, the model develops a gradual transition from current levels to assumed long-term ultimate improvement rates. Incorporating the 2020-2021 data would cause the model to generate elevated future mortality projections rather than reflect a targeted prediction of the short- and long-term effects of the pandemic. As a result, RPEC does not believe it would be appropriate to incorporate, without adjustment, the substantially higher rates of mortality experience from 2020-2021 into the graduation and projection models used by RPEC to forecast future mortality.

Furthermore, as described in subsection 3.1, mortality for nearly all causes of death was observed to be higher during 2020-2021 than in recent prior years. The Committee believes the contemporaneous elevation of nearly all causes of death cannot be completely separated from the ongoing pandemic and, consequently, that adjusting the experience data to give reduced or no weight to deaths specifically identified as caused by COVID-19, even if possible from the underlying datasets, would not completely adjust for the indirect impact of the pandemic on other causes of death nor reflect any potential mis-reporting of COVID-19 deaths as other causes.

RPEC has again decided not to produce a new projection scale in 2023. RPEC processed the 2021 data from the CDC, the Census Bureau, and the CMS according to the Committee's standard approach as described earlier in this section. RPEC used those data and information from other sources to inform an analysis of excess mortality as described in subsections 3.2 and 3.3. The resulting mortality rates were neither incorporated into the historical data included in MIM-2021-v4 nor used to develop future mortality improvement rates via the graduation and projection process described in RPEC's previous reports on mortality improvement. The underlying data from the CDC, the Census Bureau, and the CMS remain unchanged between MIM-2021-v3 (released in October 2022) and MIM-2021-v4.

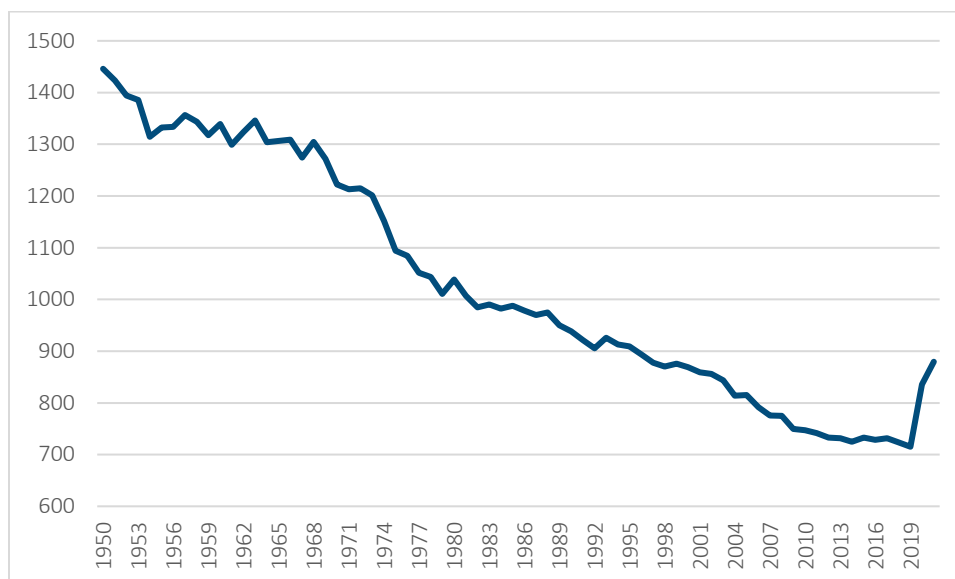
## Section 3: U.S. Mortality Experience During the COVID-19 Pandemic

### 3.1 2021 U.S. POPULATION MORTALITY EXPERIENCE

Per the National Vital Statistics System, the age-adjusted mortality rate for 2021 was 879.7 (per 100,000), an increase of 5.3% from the 835.4 rate for 2020 (NCHS 2022). Figure 3.1 shows the total (males and females combined) age-adjusted mortality rates in the U.S. for calendar years 1950 through 2021.

**Figure 3.1**

**U.S. AGE-ADJUSTED MORTALITY RATES PER 100,000, CALENDAR YEARS 1950–2021**



Mortality rates in calendar year 2021 were higher for eight of the 10 leading causes of death in the United States, which included the leading cause of death—heart disease (3.3%). Mortality rates increased by 1.7% for cancer, 22.5% for COVID-19, 12.3% for unintentional injuries (which includes overdose-related deaths), 5.9% for stroke, 2.4% for diabetes, 9.0% for chronic liver disease and cirrhosis, and 7.1% for kidney disease. Rates decreased 4.7% for chronic lower respiratory diseases and 4.3% for Alzheimer’s disease. Influenza was no longer one of the top-ten causes of death, replaced by chronic liver disease and cirrhosis. (NCHS 2022).

Preliminary analysis by the National Vital Statistics System indicates that the average age-adjusted death rate in the United States (per 100,000 of population) was 811.2 for 2022, which was 7.8% lower than the corresponding value of 879.7 for 2021 (13.4% higher than 2019).

These mortality statistics illustrate age-adjusted mortality improvement rates for the U.S. population as a whole. The trends of mortality improvement vary significantly by gender and age group.

### 3.2 ANALYSIS OF EXCESS MORTALITY DURING THE COVID-19 PANDEMIC

COVID-19 has greatly affected mortality rates in the U.S. since March 2020. The impact of COVID-19 on mortality rates, however, has not been evenly dispersed by geography, race, sex, or socio-economic level. The excess death rates have also varied substantially from period to period with pronounced peaks and less-elevated valleys.

The SOA continues to conduct extensive research into the impact of the pandemic on mortality rates. In previous years, the SOA had published analyses by Rick Leavitt of excess deaths in the U.S. general population, the latest being “2020-2021 Excess Deaths in the U.S. General Population by Age and Sex” (Leavitt, 2022). While an updated version of this analysis addressing 2022 excess deaths has not been published by the SOA, RPEC has continued that work using Rick Leavitt’s methodology and CDC data through September 20, 2023. The results of that updated analysis are provided in Tables 3.1 through 3.3 below.

**Table 3.1**

**EXCESS MORTALITY PERCENTAGES FOR THE NINE MONTHS APRIL 1, 2020 THROUGH DECEMBER 31, 2020**

Age	Females			Males		
	Total A/E	COVID-19	Exc. COVID-19	Total A/E	COVID-19	Exc. COVID-19
15–24	119.9%	3.9%	116.0%	126.2%	2.2%	124.0%
25–34	119.2%	6.5%	112.6%	123.6%	4.8%	118.8%
35–44	125.2%	9.9%	115.3%	130.1%	10.4%	119.7%
45–54	124.3%	13.2%	111.0%	130.1%	16.5%	113.6%
55–64	117.4%	14.4%	103.0%	122.4%	16.6%	105.8%
65–74	122.0%	17.5%	104.5%	124.4%	20.2%	104.2%
75–84	122.3%	18.6%	103.6%	124.5%	21.9%	102.6%
85+	120.6%	18.1%	102.6%	120.6%	20.1%	100.5%
<b>Ages 65+</b>	<b>120.9%</b>	<b>16.9%</b>	<b>104.0%</b>	<b>123.5%</b>	<b>18.5%</b>	<b>105.1%</b>
<b>All ages</b>	<b>121.4%</b>	<b>18.1%</b>	<b>103.3%</b>	<b>123.2%</b>	<b>20.8%</b>	<b>102.4%</b>

Based on CDC data as of September 20, 2023

**Table 3.2**

**EXCESS MORTALITY PERCENTAGES FOR CALENDAR YEAR 2021**

Age	Females			Males		
	Total A/E	COVID-19	Exc. COVID-19	Total A/E	COVID-19	Exc. COVID-19
15–24	129.3%	8.6%	120.7%	129.3%	4.4%	124.8%
25–34	128.9%	14.5%	114.3%	132.4%	9.8%	122.7%
35–44	144.2%	22.4%	121.8%	148.0%	19.3%	128.7%
45–54	135.4%	24.3%	111.1%	141.3%	25.9%	115.4%
55–64	122.1%	20.4%	101.6%	124.8%	20.5%	104.3%
65–74	122.4%	18.6%	103.8%	122.8%	19.1%	103.7%
75–84	115.7%	14.1%	101.6%	116.6%	16.8%	99.8%
85+	104.1%	9.6%	94.5%	106.3%	12.3%	94.0%
<b>Ages 65+</b>	<b>111.6%</b>	<b>12.9%</b>	<b>98.7%</b>	<b>115.2%</b>	<b>16.0%</b>	<b>99.2%</b>
<b>All ages</b>	<b>114.7%</b>	<b>14.3%</b>	<b>100.4%</b>	<b>120.0%</b>	<b>16.9%</b>	<b>103.1%</b>

Based on CDC data as of September 20, 2023

**Table 3.3**

**EXCESS MORTALITY PERCENTAGES FOR CALENDAR YEAR 2022**

Age	Females			Males		
	Total A/E	COVID-19	Exc. COVID-19	Total A/E	COVID-19	Exc. COVID-19
15–24	119.4%	3.2%	116.2%	118.9%	1.8%	117.1%
25–34	115.0%	5.0%	110.0%	119.5%	3.3%	116.3%
35–44	126.6%	7.2%	119.5%	133.4%	5.5%	127.9%
45–54	116.8%	8.4%	108.3%	121.0%	7.7%	113.4%
55–64	106.0%	8.2%	97.8%	106.8%	7.5%	99.3%
65–74	110.1%	8.7%	101.4%	109.2%	8.8%	100.4%
75–84	113.9%	8.5%	105.4%	112.7%	9.9%	102.7%
85+	102.9%	7.2%	95.7%	102.6%	9.5%	93.1%
<b>Ages 65+</b>	<b>107.8%</b>	<b>7.9%</b>	<b>99.9%</b>	<b>108.2%</b>	<b>9.4%</b>	<b>98.8%</b>
<b>All ages</b>	<b>108.5%</b>	<b>7.8%</b>	<b>100.7%</b>	<b>110.1%</b>	<b>8.5%</b>	<b>101.6%</b>

Based on CDC data as of September 20, 2023

The results presented in the above tables changed from those presented in last year's report for a few reasons:

- The underlying CDC death counts were updated.
- Previous models used by RPEC relied on weekly data from the CDC, but the CDC stopped publishing data on a weekly basis in June 2023. Accordingly, RPEC had to use a model that was modified to incorporate monthly information, with modified seasonality and completion factors.
- The underlying assumed population counts were updated to incorporate the 2020 census information. This impacted the expected deaths for each year and, therefore, the A/E ratios.

Note that because "excess deaths" are assessed in the above tables by comparing actual-to-expected deaths, it is important to understand how the expected deaths were determined. Expected deaths in these tables were determined by computing the mortality trend for each age group over the five-year period from 2015 through 2019 and extending that trend through the period under study, adjusting for seasonality. In determining the mortality trend, mortality rates were calculated for each year by dividing the number of deaths for each gender and age range by the estimated population counts.

There are many other valid methods of determining expected deaths from pre-pandemic information, and those methods may yield somewhat different A/E ratios than those presented in the tables above. RPEC continued the five-year trend method used by Rick Leavitt in his work because it captures any mortality improvement (or decline) observed over the period and reflects those trends in the estimated mortality in future periods.

However, this method involves estimation, namely for the assumed population counts for each year. Generally, death counts are directly tabulated each year, but the underlying population counts are estimated from decennial census surveys conducted by the U.S. Census Bureau. The population counts used by RPEC in this analysis were updated to reflect the 2020 census information currently available (USC 2023), and 2011-2019 counts were recast by linearly interpolating between the 2010 and 2020 censuses. The resulting annual incremental change was also used to project the 2020 population counts beyond 2020.

Comparing the results in Table 3.3 to Tables 3.1 and 3.2, excess mortality in 2022 declined from that of the previous years for almost all age/sex combinations. While there remains a significant amount of excess mortality in the age bands below age 55, that excess mortality is not primarily attributed to COVID-19. In contrast, the excess mortality is primarily attributed to COVID-19 for ages 55 and older, with the 85+ age group displaying lower than expected mortality, excluding the effects of COVID-19 for the second year in a row.



### 3.3 EMERGING DATA AND PROGRESSION OF EXCESS MORTALITY

RPEC also analyzed mortality data from the CDC in 2023. Table 3.4 shows the excess mortality for the first six months of 2023, reflecting CDC data through September 20, 2023 and using the same five-year trend method described above to determine expected deaths.

**Table 3.4**

#### EXCESS MORTALITY PERCENTAGES FOR THE FIRST SIX MONTHS OF 2023

Age	Females			Males		
	Total A/E	COVID-19	Exc. COVID-19	Total A/E	COVID-19	Exc. COVID-19
15–24	114.4%	0.7%	113.7%	118.8%	0.4%	118.3%
25–34	105.1%	0.9%	104.1%	111.5%	0.7%	110.8%
35–44	119.1%	1.4%	117.6%	128.4%	1.1%	127.4%
45–54	106.1%	1.6%	104.5%	111.6%	1.4%	110.2%
55–64	94.3%	1.9%	92.4%	95.3%	1.5%	93.8%
65–74	99.3%	2.5%	96.7%	98.6%	2.4%	96.2%
75–84	106.4%	3.3%	103.1%	103.9%	3.5%	100.3%
85+	94.9%	3.2%	91.6%	94.0%	4.0%	90.0%
<b>Ages 65+</b>	<b>99.3%</b>	<b>3.1%</b>	<b>96.2%</b>	<b>98.9%</b>	<b>3.3%</b>	<b>95.6%</b>
<b>All ages</b>	<b>99.7%</b>	<b>2.8%</b>	<b>96.9%</b>	<b>100.8%</b>	<b>2.7%</b>	<b>98.0%</b>

Based on CDC data as of September 20, 2023

The above table shows a significant decline in excess mortality for the first half of 2023 relative to the prior year, especially for ages 55 and older. Of note is the fact that the average A/E ratios for those 65 and older are below 100%, even before adjusting for the deaths attributed to COVID-19. One potential explanation for this phenomenon is that, in the early years of the pandemic, COVID-19 fatalities were disproportionately high among the segment of the population with more serious health conditions<sup>1</sup>, and that segment is disproportionately higher for the older age ranges than the younger age ranges. After those fatalities, the surviving population might be “healthier” on average and, therefore, may have lower average mortality.

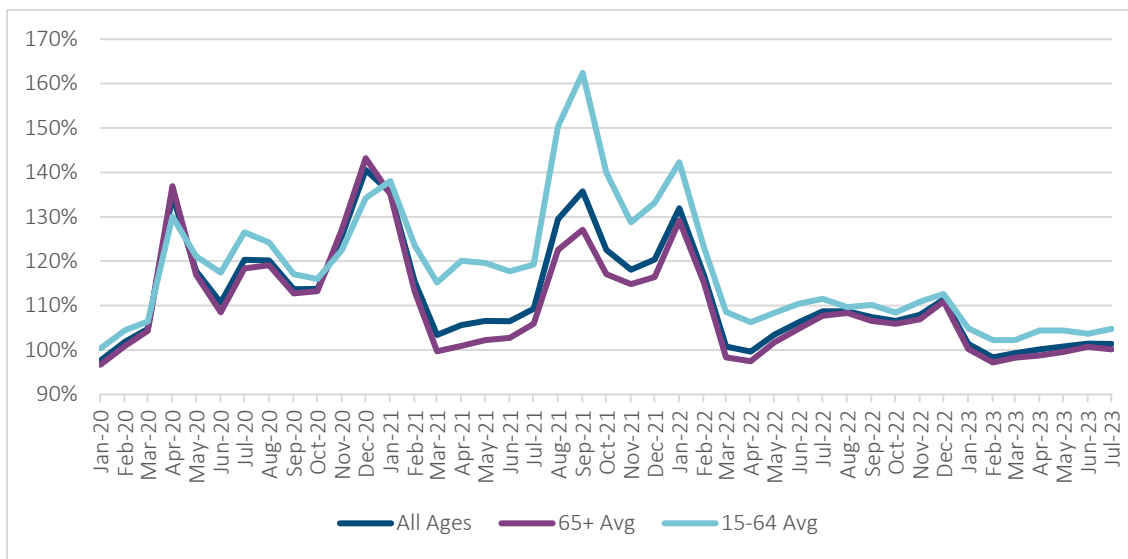
RPEC also observed that a notable exception to this phenomenon is the 75-84 age group, with significantly higher A/E ratios for both males and females than the rest of the post-age 55 population. This effect was observed to a lesser degree in 2022 as well. A likely explanation is that the oldest cohorts of the Baby Boomers are beginning to age into the 75-84 age group<sup>2</sup>, and the linear extrapolation of the 2020 census counts are likely understating the population counts and, therefore, the expected deaths for this age range. This potential effect would not significantly impact the A/E ratios for the broader age 65+ totals, however.

<sup>1</sup> The CDC lists many health conditions that have been known to increase the risk of severe illness and death from COVID-19: <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html>

<sup>2</sup> According to the Census Bureau’s 2022 Vintage estimates, there were 2,959,404 75-year-olds in the United States as of July 1, 2022, compared to 2,153,675 75-year-olds as of July 1, 2021.

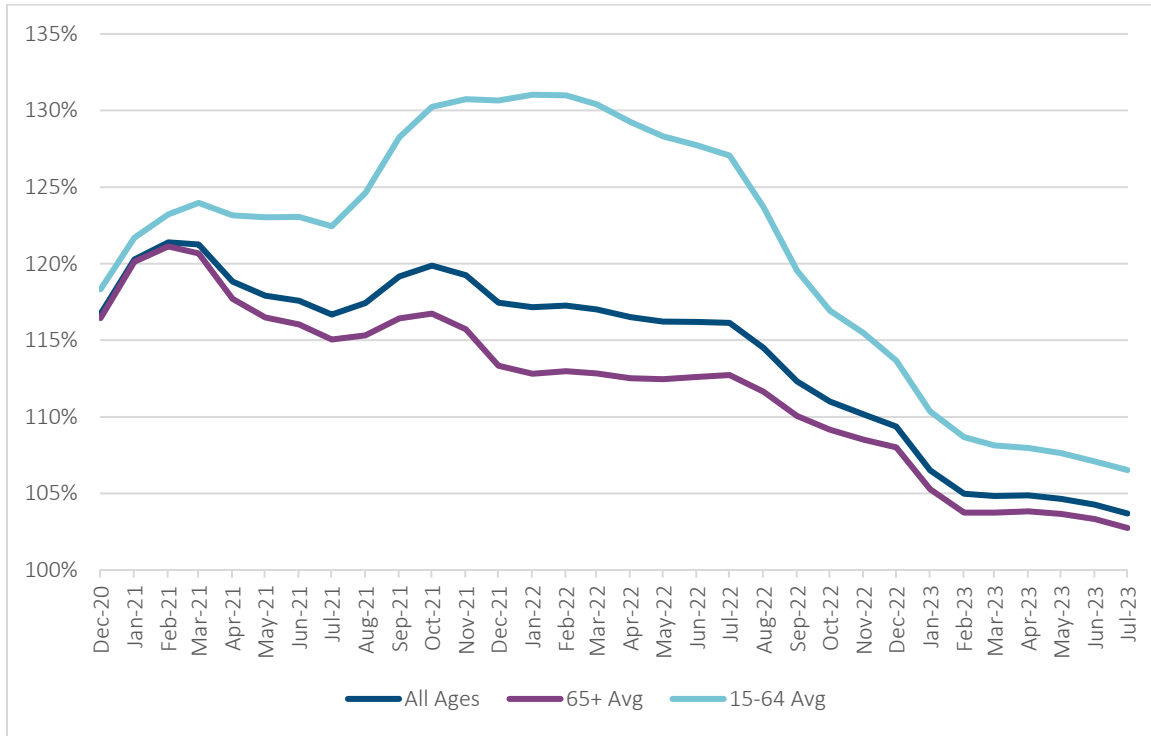
These emerging results, of course, do not necessarily mean that we’ve seen the last of COVID-19-driven excess mortality. At the time of the writing of this report, there is currently somewhat of a COVID-19 resurgence, with the onset of the EG.5 variant. We also know that COVID-19 appears in waves and may have a seasonal component, a dynamic that is hard to discern from the above tables but is captured in the below Figure 3.1 of monthly excess deaths. In the below graph, excess deaths are determined for three broad age groups (all ages, ages 15-64, and ages 65+) and aggregated across males and females.

**Figure 3.1**  
**MONTHLY AVERAGE EXCESS MORTALITY FOR THE U.S. POPULATION**



To better assess how excess mortality has changed broadly over the past few years, RPEC studied excess mortality on a rolling 12-month basis using data and methodology consistent with the information above. Figure 3.2 displays excess mortality for each 12-month period by the month at the end of each 12-month period.

**Figure 3.2**  
**ROLLING 12-MONTH AVERAGE EXCESS MORTALITY FOR THE U.S. POPULATION**



The above table clearly shows an abatement of excess mortality over the past couple of years for all age groups studied. Of note is the fact that the A/E ratio for the 12-month period ending July 31, 2023 for the Age 65+ group is 102.7%. If the mortality experience in 2023 continues at the levels captured in Table 3.4, we will eventually see the 12-month rolling average dip below the 100% level for this age group as well.

## Section 4: Potential Mortality Loads for Improvement Scale Development

### 4.1 CONSIDERATIONS FOR SELECTING MORTALITY LOADS IN THE MIM-2021-V4 MODEL

RPEC acknowledges that some practitioners may decide to implement some sort of future COVID-19-related mortality loads into their mortality improvement assumption. Key matters to address are the magnitude and duration of future mortality loads. Below are some considerations that may help practitioners in this effort:

- One source of potentially relevant information is the COVID-19 and the Short-Term Impact on Future U.S. Mortality, An Expert Opinion Survey, first published by the SOA in August 2022 (SOA 2022b) and updated in August 2023 (SOA 2023a). This survey is discussed in subsection 6.3 of this report. One finding from that survey is that respondents expect the average excess mortality for the U.S. private and public pension plan population to be lower than that for the U.S. general population.
- The survey also indicated that average excess mortality was generally expected to persist until at least 2025 and be largely phased out by 2030. Excess mortality was generally expected to be larger for the younger ages than for the older ages. However, the data presented in subsection 3.2, based on CDC information, indicate lower excess mortality in 2022 compared to 2020 and 2021 and further declining excess mortality in 2023, with no excess mortality in total for ages 65 and older. This information for 2023 was not known by the survey participants at the time of the survey.
- Section 6 of this report provides some information regarding what other organizations are assuming for how COVID-19 will impact future mortality. The SSA is assuming very little future mortality impact from COVID-19, with all excess mortality phased out by 2025. In the UK, insurers and reinsurers are generally assuming no COVID impact, but many pension scheme sponsors are placing a small weight on 2020 mortality information that effectively adds a “COVID-19 load” that extends beyond 2032.
- Subsection 5.3 of the RPEC 2022 Mortality Improvement Update (SOA 2022a) illustrates the impact on annuity values for various types of mortality loads. That information may provide some useful context regarding the potential impact of a particular mortality load assumption being contemplated.
- The data used in the MIM-2021-v4 model are based on the experience of the general U.S. population. Mortality characteristics of a particular pension plan population may differ, as described in subsection 4.2.

### 4.2 PLAN-SPECIFIC CONSIDERATIONS FOR DEVELOPING MORTALITY LOADS

A few notes are worth mentioning for actuaries who might be inclined to create plan-specific excess mortality loads. An important source of information, if credible or partially credible, would be experience from the specific plan being valued. A/E ratios for active and annuitant populations can be calculated for the pandemic years and could also be compared to the excess mortality estimates shown in section 3. That information may indicate how the plan’s mortality experience compares to national excess mortality estimates.

If plan mortality experience has little or no credibility, information available on the CDC website presents results split by various geographies and demographic variables (NCHS 2023). Knowing the composition and locations of plan participants could indicate which CDC results might help predict whether plan impact would likely be lower or higher than national averages. An SOA study of CDC mortality data indicates that, in 2020 and 2021, there was a widening of the gap in mortality experience between counties in the highest socioeconomic quintile and counties in the lowest socioeconomic quintile (Holman, 2023). That may imply that the pandemic impact on blue collar plans could be higher, on average, than for white collar plans. In addition, larger actuarial firms may have data across a significant pool of pension plans or even similar plans.

## Section 5: Considerations for Use of the MIM-2021-v4 Application Tool

In April 2021, the SOA released MIM-2021 (SOA 2021), a new mortality improvement model that is a single structure for actuarial practitioners across different practice areas to create mortality improvement projections. An updated version of this model, MIM-2021-v4, is being released concurrently with this report. However, there have been no changes to the MIM-2021-v4 Application Tool compared to MIM-2021-v3. The MIM-2021-v4 Data Analysis Tool that accompanies the model is being updated to reflect actual 2020 and 2021 mortality information, so the version number of the Application Tool is being updated for consistency.

Since the release of Scale MP-2014, RPEC has relied upon releases of historical data supplied by the SSA to build mortality improvement scales. The MIM-2021-v4 Application Tool allows for selection of alternative historical datasets to use for mortality improvement projections, with the intent of allowing practitioners in various areas the latitude to choose which one they deem most appropriate for their specific purpose. For these alternative datasets, deaths are taken from the National Vital Statistics System of the National Center for Health Statistics (NCHS), and exposures are taken from the Census Bureau.

Section 3 of the Scale MP-2021 Report outlined RPEC's rationale for utilizing the historical SSA data rather than the NCHS data for constructing mortality improvement scales. After consideration of the data available from the Census Bureau at the time of this writing, RPEC concluded that the rationale for using the historical data furnished by the SSA for mortality improvement projections from the Scale MP-2021 Report still applies.

Other considerations for use of the MIM-2021-v4 Application Tool can be found in the Scale MP-2021 Report and the RPEC 2022 Mortality Improvement Update.

## Section 6: Other Sources of Information

### 6.1 SOCIAL SECURITY ADMINISTRATION APPROACH TO REFLECTING PANDEMIC MORTALITY

The 2023 SSA Trustees' Report contains information regarding the mortality impact of COVID-19 and the projection of future effects used by the SSA in its modeling for the system (SSA 2023). Note that this material is focused on the broader U.S. population, and post-65 is specifically reflective of people enrolled in the Social Security system as recorded by Medicare.

A high-level description of the COVID-19-related mortality impact reflected in the 2023 Trustees' Report begins with, "Now, more than 3 years after the start of the COVID-19 pandemic, the acute stage of the pandemic appears to be over, but the Trustees expect there will be residual effects on the population and the economy for years to come."<sup>3</sup> A further note states, "Historical death rates were calculated for years 1900 through 2020 for ages below 65 ... For ages 65 and over, final Medicare data on deaths for years 1968 through 2019 and preliminary data for 2020 and 2021 were used. Death rates by cause of death were produced for all ages for years 1979-2020 using data from the NCHS. Note, however, that regressions used for the model projections do not include data for 2020 and 2021 due to the elevated death rates caused by COVID-19."<sup>4</sup>

Additional information is provided under Long-Range Demographic Assumptions, Mortality, page 2, "the Trustees assume a set of factors (representing the multiplicative factors that are applied to the death probabilities that would have been assumed in the absence of the pandemic) that vary by broad age group." Tables 6.1 and 6.2 reproduce the SSA tables of multiplicative factors used in the 2022 and 2023 Trustees Reports.

**Table 6.1**

**SSA MULTIPLICATIVE FACTORS APPLIED TO PROBABILITIES OF DEATH (SSA 2023)**

Year	Age 0	Ages 1–14	Ages 15–64	Ages 65–84	Ages 85+
2020	0.980*	1.010*	1.190*	1.160*	1.150*
2021	1.000	1.080	1.330	1.180*	1.080*
2022	1.000	1.050	1.110	1.120	1.050
2023	1.000	1.010	1.030	1.030	1.010
2024	1.000	1.000	1.010	1.010	1.000
2025	1.000	1.000	1.000	1.000	1.000

\* Based on actual data

**Table 6.2**

**SSA MULTIPLICATIVE FACTORS APPLIED TO PROBABILITIES OF DEATH (SSA 2022)**

Year	Age 0	Ages 1–14	Ages 15–64	Ages 65–84	Ages 85+
2020	0.890	1.000	1.161	1.161	1.161
2021	0.960	1.040	1.195	1.175	1.175
2022	0.990	1.010	1.059	1.047	1.047
2023	1.000	1.000	1.012	1.009	1.009
2024	1.000	1.000	1.000	1.000	1.000

<sup>3</sup> 2023 SSA, page 2.

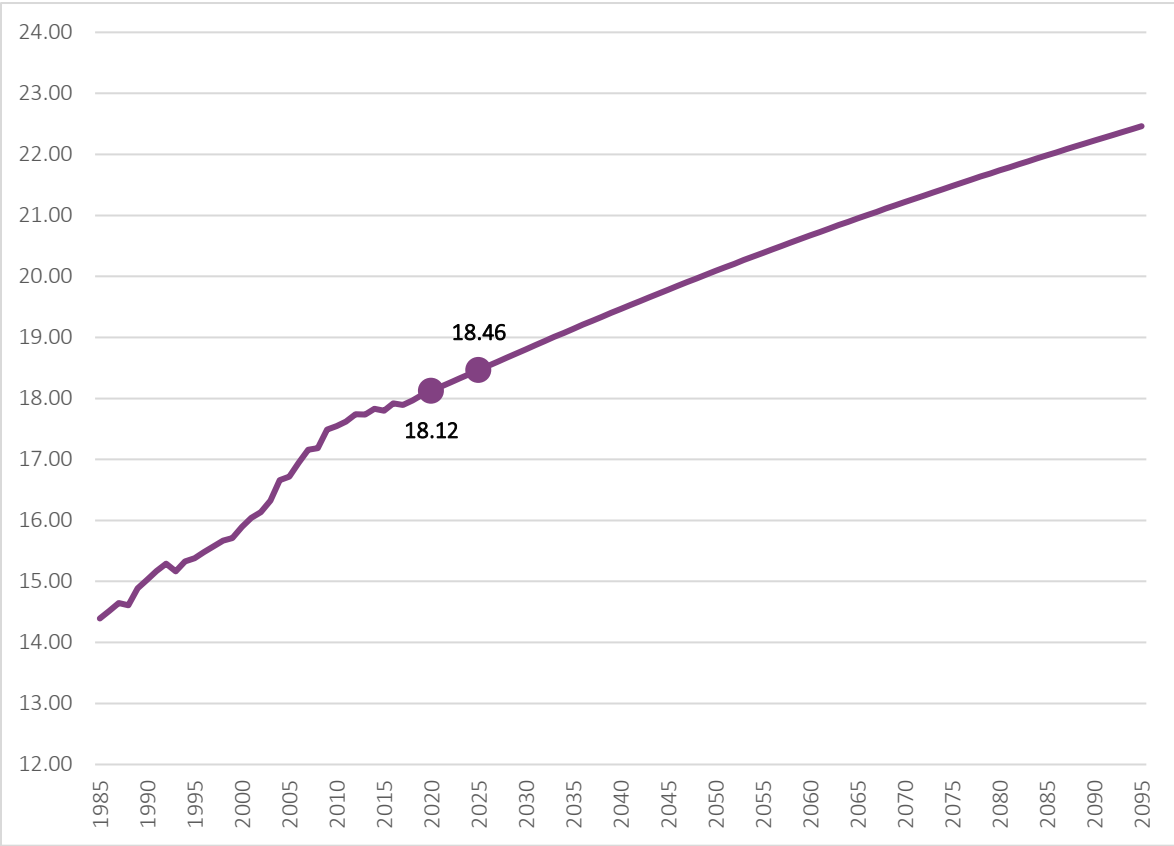
<sup>4</sup> 2023 SSA, pages 85-86

Perhaps the most relevant characteristic is that mortality in 2025 does not reflect continued adjustment for COVID-19-related impact. The magnitude of adjustment noted above for the years 2023 and 2024 would not likely have a significant impact on pension liabilities. However, other approaches discussed in this report do anticipate some COVID-19 effects lasting to 2025 and beyond.

Along with each Trustees’ Report, the SSA provides mortality rates by sex and age under “Alternative 2” (a.k.a. “Intermediate Alternative”) as used for system projections. Figures 6.1 and 6.2 compare period life expectancy for a male age 65 using mortality rates published with the 2023 Trustees’ Report (reflecting actual data through 2020 and Alternative 2 projections thereafter) to period life expectancy using rates published with the 2020 Trustees’ Report (reflecting actual data through 2017 and Alternative 2 projections thereafter *without reflecting COVID-19*).

Note that period life expectancy is based solely on mortality rates by age for a given year assuming the rates do not change in future years. It is a simple single number that captures the overall level of mortality in that year for comparison to other years. It is not the life expectancy for any cohort of the population.

**Figure 6.1**  
**SSA INTERMEDIATE PROJECTION MALE AGE-65 PERIOD LIFE EXPECTANCY, PRIOR TO THE COVID-19 PANDEMIC**

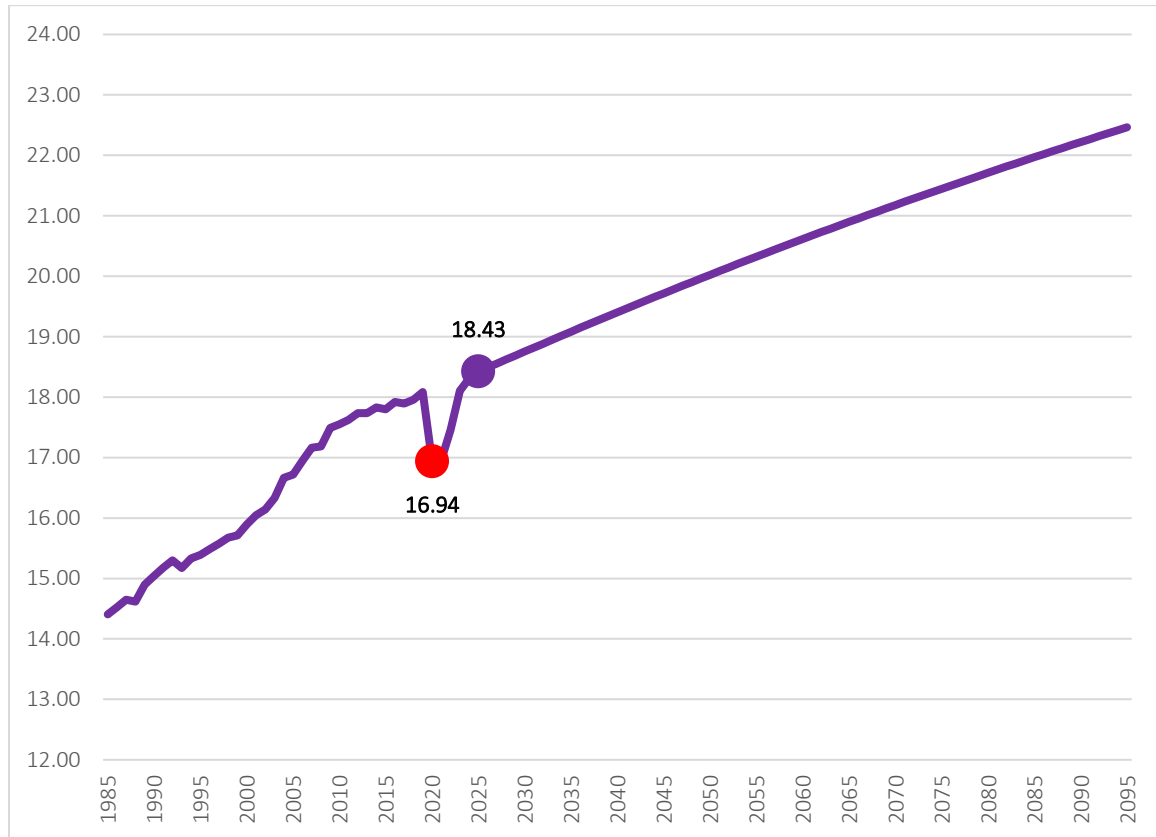




Life expectancy figures above for years 2020 and 2025, before COVID-19 reflection, were projected to be 18.12 years and 18.46 years, respectively. Reflecting the COVID-19 impacts projected in the 2023 Trustees' Report, period life expectancies for 2020 and 2025 are 16.94 years and 18.43 years, respectively.

**Figure 6.2**

**SSA INTERMEDIATE PROJECTION MALE AGE-65 PERIOD LIFE EXPECTANCY, REFLECTING COVID-19 IMPACT**



The impact on cohort life expectancy (which includes projections for mortality rates for future years) for a 65-year-old, however, is not nearly as significant. The figures in Tables 6.3 and 6.4 are extracted from Table V.A5.—Cohort Life Expectancy in the 2023 Trustees Report<sup>5</sup>. Each year’s life expectancies in these tables take into account the estimated COVID-19 impacts reflected in the 2020–2024 rates.

**Table 6.3**  
**2023 TRUSTEES’ REPORT TABLE V.A5.—COHORT LIFE EXPECTANCY**

Year	At Birth		At Age 65	
	Male	Female	Male	Female
2017	81.7	86.2	18.6	21.3
2018	81.8	86.3	18.6	21.3
2019	81.9	86.3	18.7	21.4
2020	82.0	86.4	18.8	21.5
2021	82.1	86.5	18.9	21.6
2022	82.2	86.5	19.0	21.7
2025	82.4	86.8	19.3	21.9
2030	82.9	87.1	19.6	22.2
2035	83.3	87.5	19.9	22.5
2040	83.7	87.8	20.2	22.7
2045	84.1	88.1	20.5	23.0

Comparable figures extracted from the 2020 Trustees’ Report (without COVID-19 impact) are shown below (SSA 2020).

**Table 6.4**  
**2020 TRUSTEES’ REPORT TABLE V.A5.—COHORT LIFE EXPECTANCY**

Year	At Birth		At Age 65	
	Male	Female	Male	Female
2017	82.2	86.3	18.8	21.3
2018	82.3	86.4	18.8	21.4
2019	82.4	86.5	18.9	21.5
2020	82.5	86.5	19.0	21.5
2025	82.9	86.9	19.3	21.8
2030	83.4	87.3	19.6	22.1
2035	83.8	87.6	20.0	22.4
2040	84.2	87.9	20.3	22.7
2045	84.6	88.2	20.6	23.0

Note that the COVID-19 impact on an age-85 cohort (for example) would be more significant because mortality rates are higher at advanced ages.

## 6.2 CONTINUOUS MORTALITY INVESTIGATION APPROACH TO REFLECTING PANDEMIC MORTALITY

The United Kingdom’s Continuous Mortality Investigation (CMI), supported by the Institute and Faculty of Actuaries, has a long history of providing authoritative and independent mortality and sickness rate tables for UK life insurers and pension funds. The CMI updates its Mortality Projections Model regularly, typically annually. The newest version of the CMI Mortality Projection Model, CMI\_2022, includes mortality data for 1982 to 2022 (which also reflected the UK 2021 Census updates), and the standard version of the model (which the CMI refers to as “Core”) uses a weight of 0% for 2020 and 2021 data, a weight of 25% for 2022

<sup>5</sup> SSA 2023, page 101.

data and weights of 100% for other years (IFoA 2023a). The 25% weight for 2022 represents the first time that the CMI placed weight on post-pandemic data.

After the publication of CMI\_2022, the CMI surveyed insurers and reinsurers on their use of the CMI model, including the following results for responses to aspects relating to the COVID-19 pandemic (IFoA 2023b):

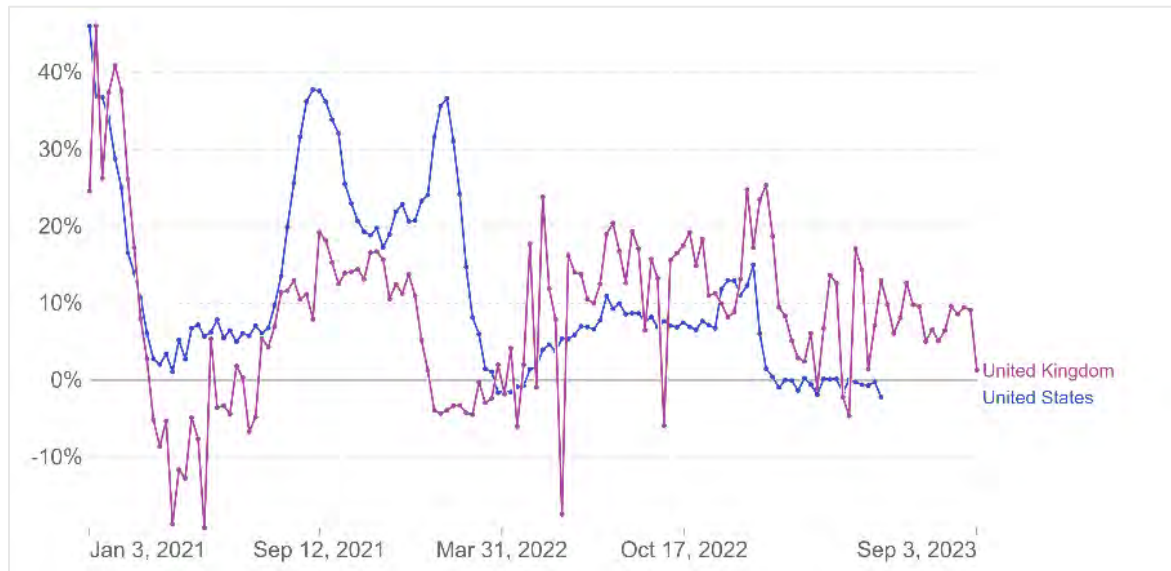
- The survey results indicate that around half of the respondents intend to adopt CMI\_2022, with the majority of other respondents using either CMI\_2019 or CMI\_2021.
- The use of weights for 2020-2022 data: of the CMI models at year-end 2023, all but one indicated that they would use the Core weight of 0% for 2020 and 2021 data; the use of 2022 data for those who plan to use CMI\_2022 varies, with the “Core” setting of 25% as the most common response.
- Respondents’ best estimate view of the specific impact of the pandemic on the trend component of life expectancy: Just under half of respondents indicated no change, while the other responses were split roughly evenly between cohort life expectancy reductions of 0.5% to 3.5%. The liability-weighted average impact of responses was a 1.7% reduction.

Similar to RPEC’s approach, the CMI provides the flexibility for practitioners to adjust the model to reflect their own views of the COVID-19 pandemic if they so choose.

It is worth noting that, although most insurers and reinsurers do not currently intend to place any weight on 2020 and 2021 data in the CMI model, there are varying opinions among respondents in terms of whether to place weight and the degree of weight to place on 2022 data. Some private sector pension advisors have recently increased their allowances beyond the “core” value of 25% for 2022 data to reflect the fact that 2023 mortality rates continue to be elevated. Placing weights on 2020 - 2022 data in the CMI model has the effect of lowering initial mortality improvements from what they would otherwise have been without any weight, with a decreasing but sustained difference that extends beyond 2030.

The emerging prevalence of mortality assumptions in the UK that incorporate elevated levels due to COVID-19 is in contrast with the current situation in the U.S. That may be partly because the excess mortality levels have been quite different between the two countries during 2023. This is illustrated in the below graph, reproduced from the Our World in Data website (OWD 2023). Note the graph does not show excess mortality levels in the U.S. beyond May 21, 2023. This may be because the U.S. data underlying the graph is on a weekly basis, and the CDC stopped publishing weekly data in June 2023.

**Figure 6.3**  
**COMPARISON OF EXCESS MORTALITY – UNITED STATES VS. UNITED KINGDOM**



### 6.3 SOA EXPERT OPINION SURVEY

The SOA has recently updated a survey of experts offering opinions on the potential extent of excess future mortality with and without the effects of COVID-19. Findings are summarized in a report published in August 2023 entitled “Impact of COVID-19 on Future U.S. Mortality: Expert Opinion Survey 2” (SOA 2023a).

#### Background

To help actuaries and others model future mortality and mortality improvement, the SOA Research Institute’s Mortality and Longevity Strategic Research Program Steering Committee (MLPSC) surveyed a panel of experts to document and gather opinions and insights into the pandemic’s possible future course, its impact on future mortality, and how the experts’ views may change over time. The MLPSC conducted the original survey in March 2022, with a follow-up survey conducted in February and March 2023.

The number of responses decreased from 59 to 39 between 2022 and 2023. Of those who responded, 27 were actuaries (down from 47) and 12 (no change) were other practitioner types, which included academics, demographers, medical professionals, epidemiologists, underwriters and data scientists.

The survey asked participants to provide their opinions on future excess mortality with and without COVID-19 as a cause of death for ages 25, 45, 65 and 85 for years 2022, 2023, 2025 and 2030. It also asked them to provide responses for the following four populations:

- U.S. general population
- U.S. life insurance industry insured population
- U.S. annuity industry annuitant population
- U.S. private and public pension plan population

## Key Survey Results

Table 6.5 below summarizes the respondents' average expectations from the current and prior surveys regarding excess mortality from all causes for ages 25, 45, 65 and 85 and years 2022, 2023, 2025 and 2030. This table was compiled from a combination of Table 2a and Table 5 in the survey report. The three sections in the table capture the expectations of all respondents for the U.S. general population, the expectations among just the actuary respondents for the U.S. general population, and the expectations among all respondents for the U.S. private and public plan population, respectively. The numbers in parentheses below the population indicator at left indicate the number of respondents (2023 Survey / 2022 Survey), with actuary respondents and respondents for the pension plan populations being a subset of the total.

**Table 6.5**  
**AVERAGE ALL-CAUSE EXCESS MORTALITY ESTIMATES WITH COVID-19 BY POPULATION AND AGE**

Population (No. of Responses)	Current Age	2023 (%)	2025 (%)	2030 (%)
<b>Total Respondents, 2023 Survey / 2022 Survey</b>				
U.S. General Population (N = 39 / 56)	25	13% / 9%	9% / 6%	6% / 2%
	45	13 / 9	9 / 5	6 / 2
	65	10 / 7	6 / 5	4 / 2
	85	8 / 6	7 / 3	3 / 1
<b>Actuaries Only, 2023 Survey / 2022 Survey</b>				
U.S. General Population (N = 27 / 45)	25	13% / 9%	8% / 5%	4% / 1%
	45	12 / 8	6 / 4	3 / 1
	65	9 / 5	4 / 3	2 / 0
	85	7 / 5	4 / 2	1 / -1
U.S. Private and Public Pension Plan Participants (N = 7 / 15)	25	11% / 5%	6% / 2%	1% / -1%
	45	11 / 5	6 / 2	2 / -1
	65	8 / 4	4 / 1	1 / -3
	85	5 / 4	3 / 0	1 / -3

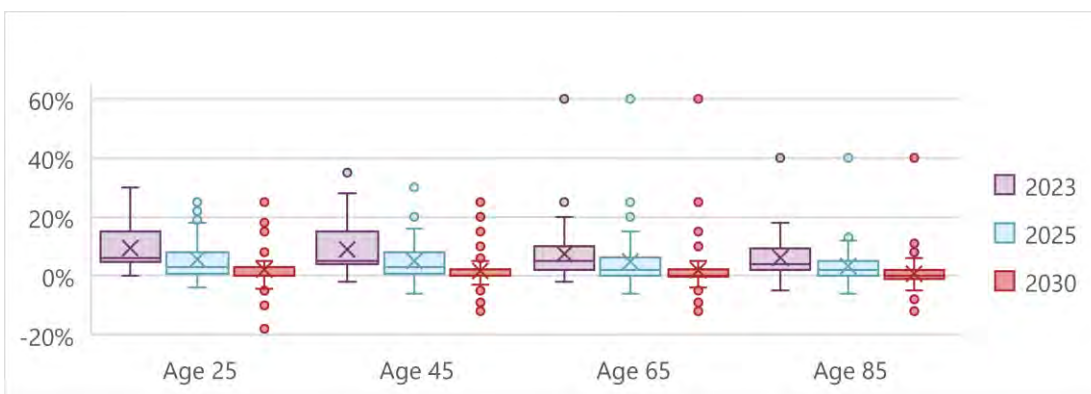
The following are some observations gleaned from the information in this table:

- In the 2023 survey, expectations for excess mortality tended to be higher and persist longer than estimated in the 2022 survey. It is not clear if this change, in particular amongst actuaries, is a result of a different composition of respondents continuing on the panel or a more uniform change in opinions.
- Based on the average of all respondents, the U.S. general population is expected to experience excess mortality for all years studied with amounts varying by year and age. The excess mortality generally declines the further into the future, as well as the older the age considered, in a particular year.
- Average excess mortality for the U.S. private and public pension plan population is expected to be lower than the expectation for the U.S. general population. While not captured in the above table, the survey report notes the same is true for both the U.S. life insurance industry insured population and the U.S. annuity industry annuitant population.
- For the U.S. private and public pension plan population, the average excess mortality is no longer expected to be negative in 2030. This may seem contradictory to the observations of emerging

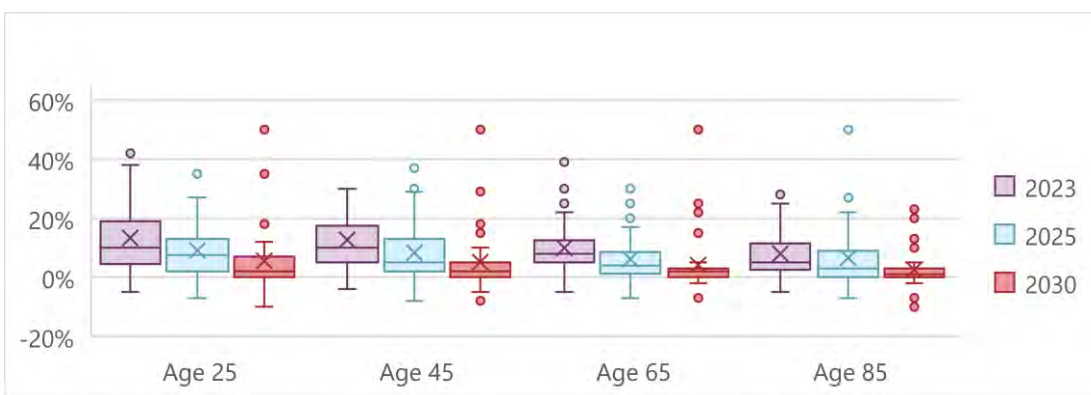
mortality data for 2023 presented in subsection 3.3. However, this year’s survey was conducted before this more recent information became available.

Practitioners may also find it useful to consider the distribution of the responses from those surveyed. This is provided in the box and whisker plots in Figures 6.4 and 6.5, which can be found in Appendix B of the survey report. Figures 6.4 and 6.5 correspond to the top section of Table 6.4. In this plot, the bottom, middle and top lines of the boxes represent the 25th percentile, median and 75th percentile, respectively. The “X” indicates the averages from Table 2a from the survey report, and data points that are “outliers” are also shown. While certain responses were identified as outliers, they were not excluded from the averages shown in Table 6.4.

**Figure 6.4**  
 U.S. GENERAL POPULATION FUTURE EXCESS MORTALITY ESTIMATES WITH COVID-19 BY AGE - 2022 SURVEY (N = 56)



**Figure 6.5**  
 U.S. GENERAL POPULATION FUTURE EXCESS MORTALITY ESTIMATES WITH COVID-19 BY AGE – 2023 SURVEY(N = 39)



Practitioners are encouraged to look through the full survey, because there are additional areas and details not addressed in this summary. Examples include drivers of excess mortality and respondents’ level of confidence.

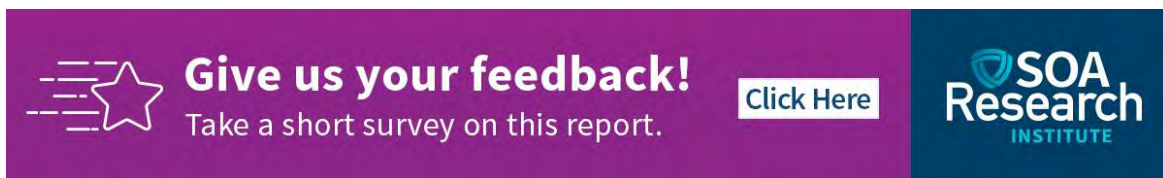
## Section 7: Online Tools


The SOA has made available the following resources, which users may find helpful:

- The MIM-2021-v4 Application Tool can be used to reconstruct Scale MP-2021 or construct alternative mortality improvement scales using the MIM-2021 framework. The MIM-2021-v4 Data Analysis Tool can be used to analyze the historical datasets included in the MIM-2021-v4 Application Tool. These tools can be downloaded here: <https://www.soa.org/resources/research-reports/2023/mortality-improvement-model/>.


## Section 8: Reliance and Limitations

The information in this report has been developed from data from other sources and has been presented for the purpose of valuing U.S. pension and other post-employment benefit obligations. No assessment has been made concerning the applicability of the information to other purposes.



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## Section 9: Acknowledgments

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- Brent A. Banister, FSA, MAAA, EA, FCA
- James G. Berberian, ASA, EA, MAAA, FCA\*
- Robert A. Blough, FSA, MAAA, EA, FCA
- James Chakan, FSA, EA\*
- Mei Du, FSA, MAAA, CERA\*
- Douglas J. Fiddler, ASA, MAAA, EA, FCA
- Timothy J. Geddes, FSA, EA, MAAA, FCA\*
- Martin W. Hill, FSA, MAAA, FCA, Mortality Improvement Subcommittee chairperson\*
- Piotr Krekora, ASA, MAAA, FCA, EA\*
- Sergey Peters, ASA, EA\*
- John R. Popiolek, FSA, MAAA, EA
- Scott F. Porter, FSA, MAAA, EA
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- Paul B. Zeisler, ASA, EA, MAAA

At the SOA:

- Patrick D. Nolan, FSA, MAAA, Senior Experience Studies Actuary
- Erika Schulty, Research Administrator

## References

- (Holman, 2023)** Holman, R. J. 2023. U.S. Population Mortality Observations-Updated with 2021 Experience. Society of Actuaries. <https://www.soa.org/resources/research-reports/2023/us-population-mortality/> (accessed Oct. 10, 2023).
- (IFoA 2023a)** Institute and Faculty of Actuaries. 2023. CMI Working Paper 177 – The CMI Mortality Projections Model, CMI\_2021. <https://www.actuaries.org.uk/learn-and-develop/continuous-mortality-investigation/cmi-working-papers/mortality-projections/cmi-working-paper-177> (accessed Oct. 10, 2023).
- (IFoA 2023b)** Institute and Faculty of Actuaries. 2023. CMI Working Paper 179 – CMI Model benchmarking survey results. <https://www.actuaries.org.uk/learn-and-develop/continuous-mortality-investigation/cmi-working-papers/mortality-projections/cmi-working-paper-179> (accessed Oct. 10, 2023).
- (Leavitt, 2022)** Leavitt, Rick. 2022. 2020-2021 Excess Deaths in the U.S. General Population by Age and Sex. <https://www.soa.org/resources/research-reports/2022/excess-death-us/> (accessed Oct. 10, 2023).
- (NCHS 2022)** National Center for Health Statistics. 2022. NCHS Data Brief No. 456: Mortality in the United States, 2021. <https://www.cdc.gov/nchs/data/databriefs/db456.pdf> (accessed Oct. 10, 2023).
- (NCHS 2023)** National Center for Health Statistics. 2023. [https://data.cdc.gov/browse?category=NCHS&sortBy=last\\_modified](https://data.cdc.gov/browse?category=NCHS&sortBy=last_modified) (accessed Oct. 10, 2023).
- (OWD 2023)** Our World in Data. 2023. Coronavirus (COVID-19) Deaths. <https://ourworldindata.org/covid-deaths> (accessed Oct. 10, 2023).
- (SOA 2014)** Society of Actuaries. 2014. Mortality Improvement Scale MP-2014. Schaumburg: Society of Actuaries. <https://www.soa.org/globalassets/assets/files/research/exp-study/research-2014-mp-report.pdf> (accessed Oct. 10, 2023).
- (SOA 2021)** Society of Actuaries. 2021. Mortality Improvement Scale MP-2021. <https://www.soa.org/resources/experience-studies/2021/mortality-improvement-scale-mp-2021> (accessed Oct. 10, 2023).
- (SOA 2022a)** Society of Actuaries. 2022. RPEC 2022 Mortality Improvement Update. <https://www.soa.org/resources/research-reports/2022/rpec-mortality-improvement/> (accessed Oct. 10, 2023).
- (SOA 2022b)** Society of Actuaries. 2022. COVID-19 and the Short-Term Impact on Future U.S. Mortality. <https://www.soa.org/resources/research-reports/2022/covid-19-short-term-impact-us-mort/> (accessed Oct. 10, 2023).
- (SOA 2023a)** Society of Actuaries. 2023. Impact of COVID-19 on Future U.S. Mortality: Expert Opinion Survey 2. <https://www.soa.org/resources/research-reports/2023/covid-impact-future-mortality-us/> (accessed Oct. 10, 2023).
- (SOA 2023b)** Society of Actuaries. 2023. The Mortality Improvement Model, MIM-2021. Schaumburg: Society of Actuaries. <https://www.soa.org/resources/research-reports/2023/mortality-improvement-model/> (accessed Oct. 23, 2023).
- (SSA 2020)** Social Security Administration. 2020. 2020 OASDI Trustees Report Table V.A5 – Cohort Life Expectancy. [https://www.ssa.gov/OACT/TR/2020/V\\_A\\_demo.html#221776](https://www.ssa.gov/OACT/TR/2020/V_A_demo.html#221776) (accessed Oct. 10, 2023).

**(SSA 2021)** Social Security Administration. 2021. Historical and Projected Probabilities of Death by Single Year of Age, Gender and Year for the Period 1900 through 2095. SSA tables.

<https://www.ssa.gov/oact/HistEst/Death/2021/DeathProbabilities2021.html> (accessed Oct. 10, 2023).

**(SSA 2022)** Social Security Administration (SSA). 2022. The 2022 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds.

<https://www.ssa.gov/OACT/TR/2022/tr2022.pdf> (accessed Oct. 10, 2023).

**(SSA 2023)** Social Security Administration. 2023. The 2023 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds.

<https://www.ssa.gov/OACT/TR/2023/tr2023.pdf> (accessed Oct. 10, 2023).

**(USC 2023)** United States Census Bureau. 2023. Age and Sex Composition: 2020.

<https://www2.census.gov/library/publications/decennial/2020/census-briefs/c2020br-06.pdf> (accessed Oct. 10, 2023).

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