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Aging and Retirement

RPEC 2022 Mortality Improvement Update

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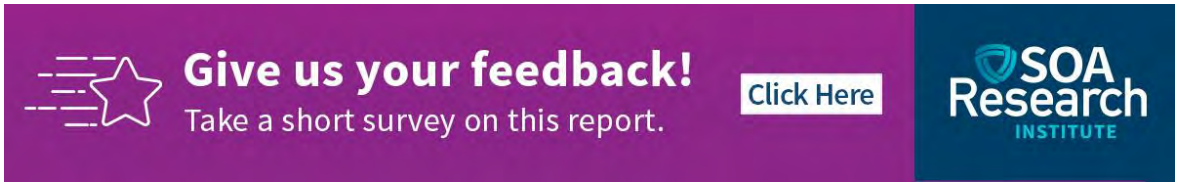

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RPEC 2022 Mortality Improvement Update

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 (SOA) Research Institute 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.

The MIM-2021 model relies upon recent population mortality experience to project future mortality trends. This year, the newest mortality data available is from 2020, which was severely affected by the COVID-19 pandemic. The Committee does not believe it would be appropriate to incorporate, without adjustment, the substantially higher rates of mortality experience from 2020 into the graduation and projection models used to forecast future mortality. Therefore, RPEC has elected to not release a new mortality improvement scale for 2022.

The newest version of MIM-2021, MIM-2021-v3, still includes buttons to load the parameters used to build Scale MP-2021 and Scale O2-2021. 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.

This report contains information to assist practitioners in selecting a mortality load assumption, including the following:

- Statistics on excess mortality in the United States during 2020, 2021, and the first half of 2022 (Section 3).
- Considerations for selecting a mortality load (subsection 5.2).
- An analysis of the sensitivity of annuity values to several illustrative sample inputs for mortality loads (subsection 5.3).
- A summary of other organizations' approaches with respect to future impacts of the COVID-19 pandemic on mortality (subsections 6.1 and 6.2).
- Details of an SOA expert opinion survey on the short-term impact of COVID-19 on U.S. mortality (subsection 6.3).

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

Section 2: 2020 Mortality Data and RPEC Mortality Improvement Scales

RPEC released the *Scale MP-2021 Report* (SOA 2021) in October 2021. That report summarized then-available data on the pandemic's impact on mortality rates while simultaneously releasing an improvement scale that incorporated data through Dec. 31, 2019, according to the Committee's previously established methodology and update cadence.

As described in subsection 2.1 of the *MP-2021 Report*, the improvement model and MP-2021 mortality improvement scale were based on historical mortality information that the Social Security Administration (SSA) published in conjunction with *The 2021 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds* (Trustees' Report). That Trustees' Report included rates that are smoothed across ages for each individual year through calendar year 2018 (SSA 2021). The data for calendar years 1950 through 2016 used in the MP-2021 study were taken directly from those SSA-published mortality rates. Rates for 2017 through 2019 were calculated using the data developed by the Centers for Disease Control and Prevention (CDC), the U.S. Census Bureau, and the Centers for Medicare and Medicaid Studies (CMS or Medicare). The data from the CDC, the Census Bureau and the CMS used for the MP-2021 study were the most recent available at the time of the report's issuance. The process used to develop the 2017 through 2019 rates follows the SSA's graduation methodology as described in Appendix B.

Continuing to incorporate new data into an updated improvement scale using past timelines would result in the inclusion of data from the 2020 calendar year, 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 data were incorporated without adjustment, the resulting graduated rates would be significantly impacted, including those for the years leading up to the pandemic. This 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 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 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 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.

Without new data deemed predictive to future mortality, RPEC decided not to produce a new projection scale in 2022. RPEC processed the 2020 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 to inform an analysis of excess mortality during 2020 as described in subsection 5.1, but the resulting mortality rates were neither incorporated into the historical data included in MIM-2021-v3 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-v2 (released in October 2021) and MIM-2021-v3.

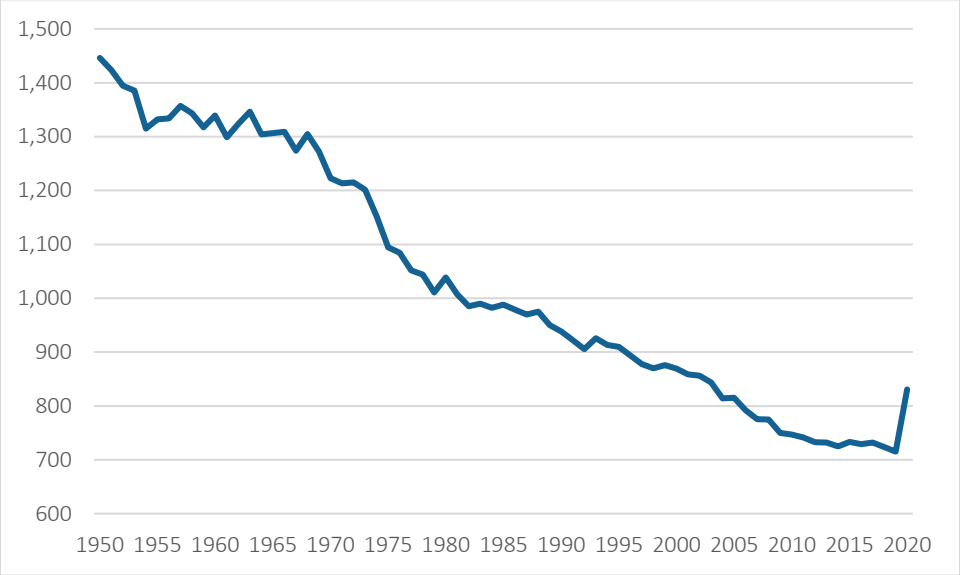
Section 3: U.S. Mortality Experience During the COVID-19 Pandemic

3.1 2020 U.S. POPULATION MORTALITY EXPERIENCE

Per the National Vital Statistics System, the age-adjusted mortality rate for 2020 was 835.4 (per 100,000), an increase of 16.8% from the 715.2 rate for 2019 (NVSS 2022). Figure 3.1 shows the total (males and females combined) age-adjusted mortality rates in the U.S. for calendar years 1950 through 2020.

Figure 3.1

U.S. AGE-ADJUSTED MORTALITY RATES PER 100,000, CALENDAR YEARS 1950–2020



Mortality rates in calendar year 2020 were higher for six of the 10 leading causes of death in the United States, which included the leading cause of death—heart disease (4.1%). Mortality rates increased by 16.8% for unintentional injuries (which includes overdose-related deaths), 4.9% for stroke, 8.7% for Alzheimer's disease, 14.8% for diabetes, and 5.7% for influenza and pneumonia. Rates decreased 1.4% for cancer (the second leading cause of death) and 4.7% for chronic lower respiratory diseases. COVID-19 was a new leading cause of death (third highest), and the rate for kidney disease did not change (NVSS 2022). Prior to the pandemic, the age-adjusted mortality improvement rate averaged approximately 0.5% per year over the 2010–2019 period, compared to an average of approximately 1.5% per year from 2000–2009.

Preliminary analysis by the National Vital Statistics System (NVSS 2022) indicates that the average age-adjusted death rate in the United States (per 100,000 of population) was 880.9 for 2021, which was 5.4% higher than the corresponding value of 835.4 for 2020 (23.2% 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 pandemic continues to exert significant impact on population mortality through the date of this report's authorship. 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 has conducted extensive research into the impact of the pandemic on mortality rates. In August 2022, the SOA published "2020-2021 Excess Deaths in the U.S. General Population by Age and Sex" (Leavitt 2022). That research includes an analysis of population mortality data and presents excess mortality rates by age and sex.[1] Tables 3.1 and 3.2 show the actual-to-expected (A/E) mortality ratios from that report, with the addition of average A/E ratios for ages 65 and up.

Table 3.1

EXCESS MORTALITY PERCENTAGES FOR THE 40 WEEKS MAR. 22, 2020, THROUGH DEC. 26, 2020

	Females			Males		
Age	**Total A/E**	**COVID-19**	**Exc. COVID-19**	**Total A/E**	**COVID-19**	**Exc. COVID-19**
15–24	119.3%	3.8%	115.5%	125.8%	2.2%	123.6%
25–34	119.3%	6.6%	112.7%	123.3%	4.9%	118.5%
35–44	124.7%	9.8%	114.9%	129.7%	10.5%	119.2%
45–54	123.7%	13.2%	110.5%	129.6%	16.5%	113.2%
55–64	117.1%	14.3%	102.8%	122.1%	16.5%	105.6%
65–74	121.5%	17.3%	104.1%	124.0%	20.1%	104.0%
75–84	122.2%	18.4%	103.8%	124.6%	21.8%	102.9%
85+	120.2%	17.7%	102.5%	120.3%	19.8%	100.5%
Ages 65+	**121.1%**	**17.8%**	**103.2%**	**123.0%**	**20.6%**	**102.4%**
All ages	**120.6%**	**16.7%**	**103.9%**	**123.3%**	**18.3%**	**105.0%**

Table 3.2

EXCESS MORTALITY PERCENTAGES FOR THE 52 WEEKS JAN. 3, 2021, THROUGH JAN. 1, 2022

	Females			Males		
Age	**Total A/E**	**COVID-19**	**Exc. COVID-19**	**Total A/E**	**COVID-19**	**Exc. COVID-19**
15–24	130.5%	8.7%	121.8%	130.4%	4.5%	126.0%
25–34	128.9%	14.5%	114.4%	131.8%	9.7%	122.1%
35–44	143.8%	22.4%	121.4%	146.9%	19.1%	127.8%
45–54	136.1%	24.4%	111.7%	141.8%	26.0%	115.8%
55–64	122.8%	20.5%	102.2%	125.3%	20.5%	104.8%
65–74	122.6%	18.6%	104.1%	123.0%	18.9%	104.1%
75–84	114.5%	13.8%	100.7%	115.5%	16.4%	99.0%
85+	104.1%	9.4%	94.7%	106.2%	12.1%	94.1%
Ages 65+	**111.3%**	**12.8%**	**98.6%**	**114.8%**	**15.8%**	**99.0%**
All ages	**114.6%**	**14.2%**	**100.4%**	**119.8%**	**16.8%**	**103.1%**

For each year, there was excess mortality for each combination of sex and all age groups over age 15. While total excess mortality across all age groups was relatively balanced during 2020, the underlying causes were not. Younger ages saw higher excess mortality due to causes other than COVID-19, while most of the excess mortality for older age groups was identified as due to COVID-19.

In 2021, excess mortality decreased compared to post-March 2020, primarily due to lower mortality among older age groups. For the 75–84 and 85-plus age groups, excess mortality from both COVID-19 and non-COVID-19 were significantly lower than in 2020. However, excess mortality for younger adults increased substantially in 2021, particularly due to COVID-19. For both sexes, the highest excess mortality occurred in the 35–44 age group. Finally, excess mortality for females was generally lower than that for males during both years.

Although the Leavitt report only includes excess mortality estimates through the end of 2021, data collection is ongoing, and new estimates of 2022 excess mortality are produced weekly as data become available. Table 3.3

[1] Excess mortality rates are determined as the percentage increase in observed mortality over expectations. These expectations were developed using trends for mortality rates and population counts by sex and age.

shows excess mortality for 2022 through the first half of the year, computed on a consistent basis with the Leavitt report methodology for 2020 and 2021. Note that this methodology involves seasonal adjustments to expected mortality within a calendar year. That is particularly relevant for Table 3.3, because mortality for most age groups tends to be higher in the first half of the year than the second.

Table 3.3

EXCESS MORTALITY PERCENTAGES FOR THE 26 WEEKS JAN. 2, 2022, THROUGH JUL. 2, 2022

	Females			Males		
Age	**Total A/E**	**COVID-19**	**Exc. COVID-19**	**Total A/E**	**COVID-19**	**Exc. COVID-19**
15–24	122.8%	4.6%	118.2%	122.9%	2.6%	120.3%
25–34	119.2%	7.5%	111.7%	121.4%	4.8%	116.6%
35–44	129.8%	10.7%	119.0%	134.8%	8.4%	126.4%
45–54	121.6%	12.9%	108.6%	125.6%	12.3%	113.3%
55–64	111.8%	12.7%	99.2%	113.0%	12.1%	101.0%
65–74	114.0%	12.7%	101.3%	114.3%	13.1%	101.2%
75–84	111.8%	11.0%	100.8%	112.8%	13.3%	99.5%
85+	102.8%	8.5%	94.3%	104.0%	11.6%	92.4%
Ages 65+	**108.0%**	**10.2%**	**97.8%**	**110.4%**	**12.7%**	**97.7%**
All ages	**109.6%**	**10.4%**	**99.2%**	**113.0%**	**12.0%**	**101.0%**

During the first half of 2022, excess mortality was lower than in either of the two previous years of the pandemic. Excess mortality due to COVID-19 decreased compared to the two prior years, while the average A/E ratio for all ages for males and females excluding COVID-19 was very close to 100%. While there was still substantial excess mortality in younger age groups, it was notably less pronounced than it was during 2021.

The "actual" deaths include an assumption for completion that varies by age group and sex to account for deaths that have occurred but have not yet been reported to the CDC. Those completion factors were estimated from analysis of historical data. For example, it is estimated that the data used to develop Table 3.3 were approximately 98.0% complete. The closer a particular week is to the date of the data refresh, the more material the completion factors are to the death estimates. Further detail can be found in the Leavitt report.

The above data were refreshed as of Aug. 17, 2022 and are subject to change as the data become more complete.

Section 4: Considerations for Use of the MIM-2021-v3 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-v3, is being released concurrently with this report.

The new version of the model contains some enhancements to MIM-2021-v2, which was made available in October 2021. Those additions are as follows:

- An interactive flow chart to give practitioners a clearer sense of where key parameters are to be entered, including helpful information regarding the selection and potential interactions of model parameters.
- Expansion of the select period for the select-and-ultimate period for COVID-19 load inputs, with the ability to enter mortality loads by age and sex for individual years 2020 through 2027 and a single load applying for years 2028 and beyond. Detailed information on how to use this input section can be found in the *Scale MP-2021 Report*.
- Addition of a pre-selected parameter set designed for individual life insurance and individual annuity practitioners. The SOA Research Institute's Longevity Advisory Group developed the assumption set and reviewed it for reasonability compared to:
    - RPEC's committee-selected assumptions.
    - The development of MI assumptions from other SOA and industry mortality improvement committees.
    - Recent SOA surveys of insurance company MI practices derived from both direct insurers and reinsurers.

  More information regarding this assumption set can be found in the *MIM-2021-v3* report (SOA 2022a).

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-v3 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. The population estimates available from the Census Bureau for calendar years through 2020 are still based on extrapolations from the 2010 census and do not yet reflect the 2020 census.

Section 5: Potential Mortality Loads for Improvement Scale Development

5.1 COMMITTEE-DEVELOPED EXCESS MORTALITY ESTIMATES BY AGE AND SEX FOR 2020

As mentioned in Section 2, the Committee did not believe it was appropriate to incorporate the 2020 mortality data in an updated improvement scale. However, RPEC did develop detailed estimates of the 2020 excess mortality by age and sex for informational purposes, as compared to projections consistent with Scale MP-2021. Those estimates are provided in a separate Excel file posted on the SOA website along with this report.

To develop those estimates, in accordance with the process described in Appendix B, RPEC developed estimates of SSA-style mortality rates for calendar year 2020 for each combination of age and sex. To form an expected basis, the Committee chose to use the two-dimensional Whittaker-Henderson graduated historical mortality rates for calendar year 2017 (the last year of historical improvement data in Scale MP-2021), projected to 2020 using Scale MP-2021. The excess mortality estimates the Committee developed are the percentage differences between the SSA-style rates and the rates developed using the aforementioned expected basis.

It should be noted that those excess mortality estimates differ from those presented in Table 3.1 for the following reasons:

1. The Committee-developed excess mortality estimates are for the full year of 2020 rather than the 40-week period described in the Table 3.1 header. Accordingly, the Committee-developed excess mortality estimates are lower because they include the pre-pandemic portion of 2020.

2. The SSA-style rates for 2020 are based on data from the CMS for ages over 65, whereas the actual deaths tabulated for Table 3.1 come from the CDC data at all ages.

3. The basis for expected mortality described above is not the same as that used for the figures in Table 3.1. Details on the expected basis used for Table 3.1 can be found in the Leavitt report.

5.2 CONSIDERATIONS FOR SELECTING MORTALITY LOADS IN THE MIM-2021-V3 MODEL

The previous section discussed the Committee's analysis that yielded a schedule of excess mortality based on SSA-style mortality rates for 2020. That schedule, however, should not be misconstrued as a Committee-selected set of mortality loads for use in pension plan mortality improvement projections. In fact, RPEC chose not to publish a set of "Committee-selected loads" for the following reasons:

- COVID-19 impact on mortality, both direct and indirect, has been very uneven across different geographies, demographics, socio-economic statuses, and time periods.

- There are structural inconsistencies between excess mortality data available from the CDC and information that the SSA utilized, and only CDC information is currently available for time periods beyond 2020.

- The "MP" improvement scales are intended for use in valuing liabilities where it is assumed that past experience is already reflected in the participant or member data at the measurement date. There does not appear to be consensus within the actuarial community on the extent of the near and long-term future impacts, direct or indirect, of the pandemic on pensioner mortality.

RPEC acknowledges that some practitioners may decide to implement some sort of future COVID-19-related mortality loads into their mortality improvement assumption, and those practitioners may consider the 2020–2022 excess mortality information provided in Section 3 to be a starting point for developing a mortality load assumption

that extends beyond the census date in their pension valuations. 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*, published by the SOA in August 2022 (SOA 2022b). This survey is discussed in subsection 6.3 of this report. One finding from that survey is that survey 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.

- The data presented in subsection 3.2 based on CDC information indicate somewhat declining excess mortality over the period from March 2020 through June 2022. However, the trend has been far from monotonic, varying significantly between months and seasons.

- As the tables in subsection 3.2 show, there has been a significant amount of excess mortality even when deaths specifically attributed to COVID-19 are excluded[2]. Practitioners may want to decide whether only the COVID-19 portion is relevant in developing a "COVID-19 load" or if the load should reflect all excess mortality. That matter may be somewhat moot for pension valuations, given that for older ages COVID-19 is the primary driver of excess mortality.

- 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 almost no future mortality impact from COVID-19. In the U.K., 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. In the Netherlands, increased mortality due to COVID-19 is reflected in standard mortality projections but is assumed to quickly phase out and have a negligible impact on pension obligations.

- Subsection 5.3 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.

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. 2020 A/E ratios for active and annuitant populations can be calculated and could also be compared to the loads derived from SSA-style data presented in subsection 5.1 above. 2021 A/E ratios could be compared to those detailed in Table 3.2. 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 2022). Knowing the composition/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, there was a widening of

[2] The criteria for deaths reported as "COVID" may not be uniform across locations or over time.

the gap in mortality experience between counties in the highest socioeconomic quintile and counties in the lowest socioeconomic quintile (SOA 2022c). 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.

5.3 IMPACT OF MORTALITY LOAD SELECTION ON ANNUITY VALUES

This subsection contains information regarding the impact on annuity values of various mortality load assumptions. RPEC has included this information to give practitioners some context for the mortality load assumptions they may be contemplating, because the impact on annuity values may be used to estimate the potential impact on pension obligations.

Table 5.1 outlines the load inputs that will be used to illustrate the sensitivity of the model to various COVID-19 mortality load patterns using a measurement date of Jan. 1, 2022, and a baseline scale of MP-2021. While users can vary loads by age and sex in the MIM-2021-v3 Application Tool, for illustration purposes, the load percentages shown apply to all age/sex combinations in these sample scenarios.

The below loads are illustrative only and should not be considered as a recommendation by the Committee.

Table 5.1

MORTALITY LOAD INPUTS FOR SAMPLE MP-2021 MODIFICATION SCENARIOS

Year	Scale MP-2021	Short-Term Shock	Gradual Wear-Off	Long-Term Deterioration
2022	0.00%	10.00%	10.00%	10.00%
2023	0.00%	5.00%	8.00%	8.00%
2024	0.00%	0.00%	6.00%	6.00%
2025	0.00%	0.00%	4.00%	4.00%
2026	0.00%	0.00%	2.00%	2.00%
2027	0.00%	0.00%	1.00%	1.00%
2028+	0.00%	0.00%	0.00%	1.00%

Table 5.2 displays the annuity factors produced by the resultant mortality improvement scales for these scenarios and a base table of Pri-2012 Total Dataset.

Table 5.2

IMPACT OF MORTALITY LOAD INPUTS ON ANNUITY FACTORS AT 4.0% AS OF JANUARY 1, 2022

	Age	MP-2021	Short Term Shock	Gradual Wear-Off	Long-Term Deterioration	Short Term Shock	Gradual Wear-Off	Long-Term Deterioration
Females	25	3.7466	3.7465	3.7464	3.7393	−0.00%	−0.01%	−0.19%
	35	5.4554	5.4551	5.4547	5.4440	−0.01%	−0.01%	−0.21%
	45	7.9547	7.9539	7.9530	7.9369	−0.01%	−0.02%	−0.22%
	55	11.6349	11.6323	11.6290	11.6058	−0.02%	−0.05%	−0.25%
	65	14.2831	14.2662	14.2488	14.2226	−0.12%	−0.24%	−0.42%
	75	10.2881	10.2576	10.2246	10.2004	−0.30%	−0.62%	−0.85%
	85	6.2159	6.1552	6.0994	6.0862	−0.98%	−1.87%	−2.09%
	95	3.3670	3.2739	3.2161	3.2128	−2.77%	−4.48%	−4.58%
Males	25	3.5139	3.5135	3.5131	3.5052	−0.01%	−0.02%	−0.25%
	35	5.1135	5.1128	5.1120	5.1001	−0.01%	−0.03%	−0.26%
	45	7.4588	7.4576	7.4561	7.4384	−0.02%	−0.04%	−0.27%
	55	10.9238	10.9200	10.9149	10.8900	−0.03%	−0.08%	−0.31%
	65	13.4081	13.3866	13.3640	13.3376	−0.16%	−0.33%	−0.53%
	75	9.4825	9.4461	9.4083	9.3860	−0.38%	−0.78%	−1.02%
	85	5.5055	5.4390	5.3807	5.3701	−1.21%	−2.27%	−2.46%
	95	2.8964	2.7983	2.7445	2.7424	−3.39%	−5.24%	−5.32%

Annuity values at the youngest ages are relatively unaffected by short-term loads on mortality. However, annuity values at older ages, where mortality rates are higher, exhibit sensitivity to mortality loads applied for the first several years of projection.

Note that mortality loads input into the MIM-2021-v3 Application Tool for years prior to a particular measurement date will have no impact on annuity values computed using the resultant mortality improvement scale at that measurement date. For example, annuity values computed as of Jan. 1, 2022, will be unaffected by mortality loads input into the tool for years 2020 and 2021.

Section 6: Other Sources of Information

6.1 SOCIAL SECURITY ADMINISTRATION APPROACH TO REFLECTING PANDEMIC MORTALITY

The annual Trustees' Report that the SSA published in June 2022 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 2022). Note that this material is focused on the broader U.S. population, and post-65 is specifically targeting 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 2022 Trustees' Report begins with, "*Preliminary data for 2020 show that while the effects of the pandemic led to significantly higher death rates for those aged 15 and older, the death rates for those aged 1-14 were generally unaffected, and death rates for those age 0 (children in their first year of life) were significantly lower. The table below shows the multiplicative factors that were applied to the probabilities of death that would have been projected in the absence of the pandemic.*"[3] The cited table is shown below:

Table 6.1

SSA MULTIPLICATIVE FACTORS APPLIED TO PROBABILITIES OF DEATH

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

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

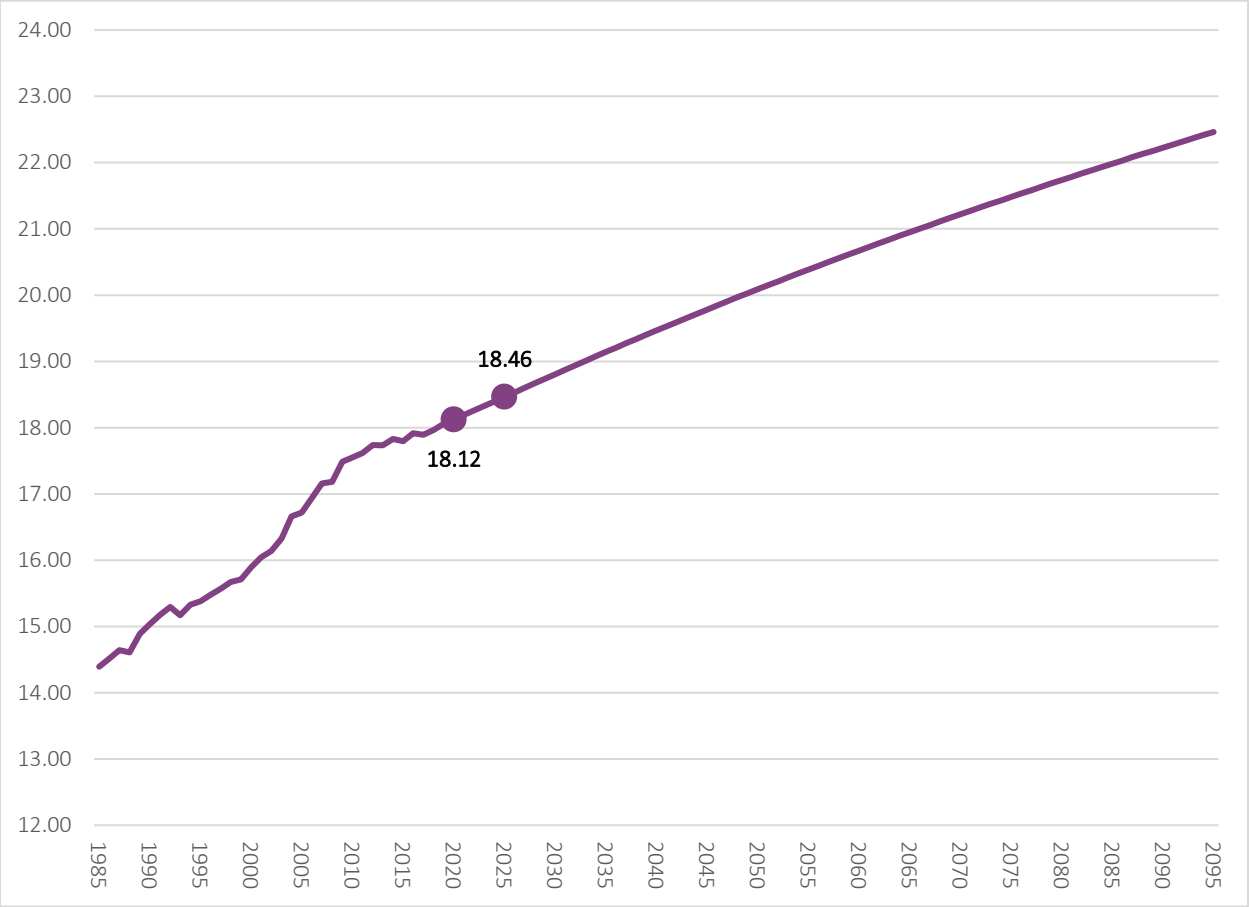
Along with each Trustees' Report, the SSA provides mortality rates by sex and age under "Alternative 2" (a.k.a. "Intermediate Alternative") as used for system projections. Figures 6.1 and 6.2 compare period life expectancy for a male age 65 using mortality rates published with the 2022 Trustees' Report (reflecting actual data through 2019 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.

[3] 2022 Trustees Report, page 85.

Figure 6.1

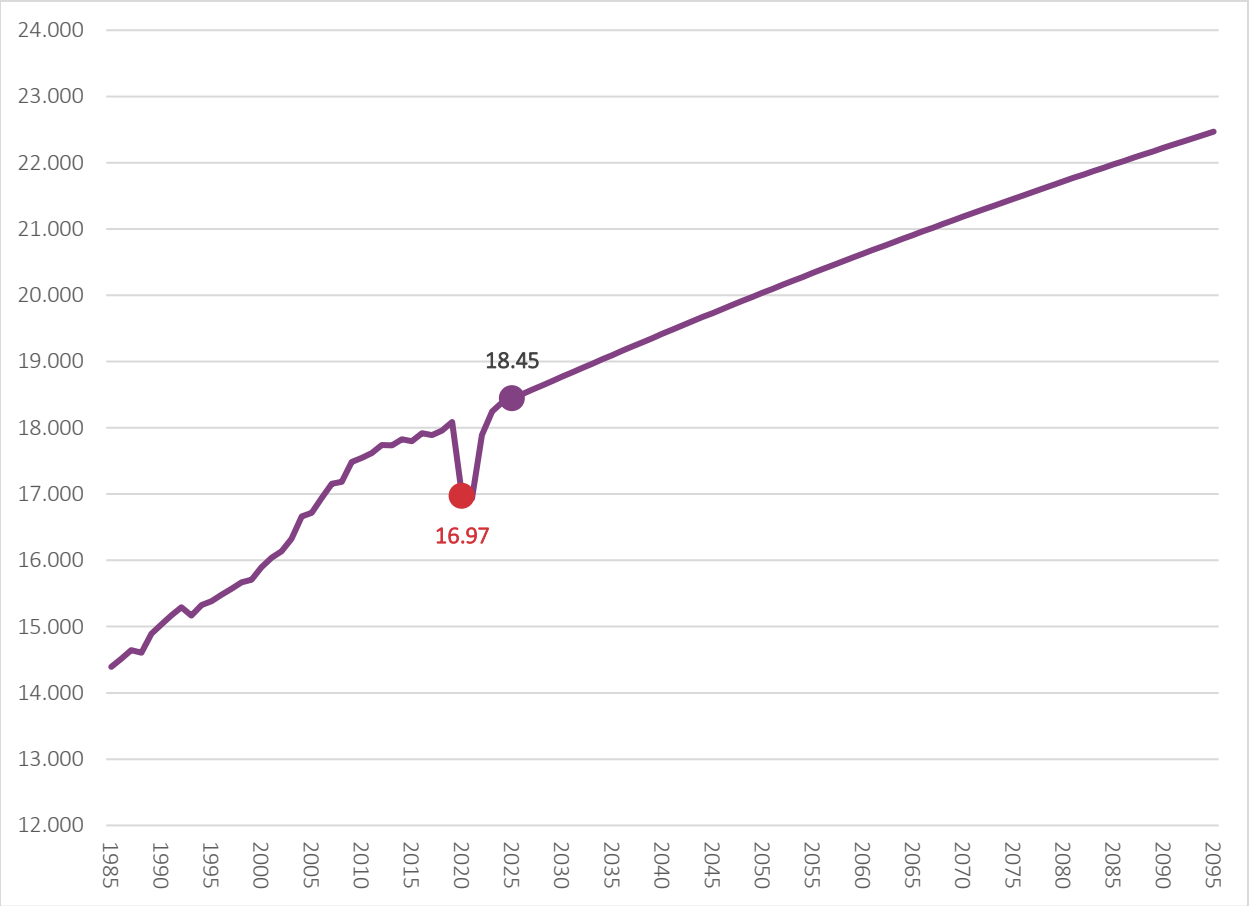
SSA INTERMEDIATE PROJECTION MALE AGE-65 PERIOD LIFE EXPECTANCY, PRIOR TO THE COVID-19 PANDEMIC



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 2022 TR, period life expectancies for 2020 and 2025 are 16.97 years and 18.45 years respectively.

Figure 6.2

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



The impact on *cohort* life expectancy for a 65-year-old, however, is not nearly as significant. The figures in Tables 6.2 and 6.3 are extracted from Table V.A5.—Cohort Life Expectancy in the 2022 Trustees Report.[4] Each year's life expectancies take into account the estimated COVID-19 impacts reflected in the 2020–2023 rates.

Table 6.2
2022 TRUSTEES' REPORT TABLE V.A5.—COHORT LIFE EXPECTANCY

	At Birth		At Age 65	
Year	Male	Female	Male	Female
2017	81.7	86.2	18.7	21.3
2018	81.8	86.3	18.7	21.4
2019	81.9	86.4	18.8	21.5
2020	82.0	86.5	18.9	21.5
2021	82.1	86.5	19.0	21.6
2025	82.5	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	83.8	87.8	20.3	22.8
2045	84.2	88.1	20.6	23.0

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

Table 6.3
2020 TRUSTEES' REPORT TABLE V.A5.—COHORT LIFE EXPECTANCY

	At Birth		At Age 65	
Year	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 would be more significant because mortality rates are higher at advanced ages.

6.2 OTHER COUNTRIES' APPROACH TO REFLECTING PANDEMIC MORTALITY

6.2.1 CONTINUOUS MORTALITY INVESTIGATION

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 U.K. 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_2021, includes mortality data for 1981 to 2021, but the standard version of the model (which the CMI refers to as "Core") uses a weight of 0% for 2020 and 2021 data and weights of 100% for other years (CMI 2022a).

[4] 2022 Trustees Report, page 101.

After the publication of CMI_2021, the CMI surveyed insurers and reinsurers on their use of the CMI model, including the following aspects relating to the COVID-19 pandemic (CMI 2022b):

- The use of weights for 2020 and 2021 data: The survey results indicate that for those who intend to adopt newer versions of the CMI model at year-end 2022, all but one indicated that they would use the Core weight of 0% for 2020 and 2021 data, and the other indicated a small weight for 2021 data.

- Their best estimate view of the specific impact of the pandemic on the trend component of life expectancy: Around half of respondents indicated no change, while the other responses were split broadly evenly between cohort life expectancy reductions of 0.5% and 1%. For those who indicated that the pandemic would change their view of life expectancy, none are reflecting this through the CMI model's weight parameters, and only one intends to do so for year-end 2022.

The CMI's approach to place no weight on the 2020 and 2021 mortality data in its Core model is consistent with RPEC's decision to not incorporate 2020 mortality information in its improvement model. 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 intend to place any weight on 2020 and 2021 data in the CMI model, many pension scheme sponsors in the U.K. have taken a different approach. While no formal survey has been conducted, some RPEC members have observed within their organizations that many U.K. pension scheme sponsors are placing small (<25%) weights on 2020 and/or 2021 data in the CMI model. Placing a small weight on 2020 or 2021 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.

6.2.2 DUTCH ACTUARIAL ASSOCIATION MORTALITY FORECAST

On Sept. 13, 2022, the Dutch Actuarial Association (the Association) published its new forecast for Dutch population mortality rates, which nearly all insurance companies and pension funds in the Netherlands have historically used (AG 2022). The mortality data the Association used reflects mortality experience from the Netherlands as well as 14 other European countries whose Gross Domestic Product is above the European average. The updated forecast includes future short-term adjustments related to COVID-19, which were calibrated using recent weekly observations of excess mortality. The Association assumed the projected impact of COVID-19 on future mortality would rapidly decrease over time, being largely phased out by around 2028. The Association modeled the impact of those COVID-19 adjustments on pension obligations and noted that they were negligible.

6.3 SOA EXPERT OPINION SURVEY

One significant source of information regarding the potential extent of excess future mortality, with and without the effects of COVID-19, is *COVID-19 and the Short-Term Impact on Future U.S. Mortality, An Expert Opinion Survey*, which the SOA published in August 2022 (SOA 2022b).

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 survey in March 2022.

Ultimately, 59 individuals submitted responses to the survey. Of those who responded, 47 were actuaries and 12 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 and 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 6.4 below summarizes the respondents' average expectations 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 4a and Table 8 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 number in parentheses below the population indicator at left indicates the number of respondents, with actuary respondents and respondents for the pension plan populations being a subset of the total.

Table 6.4
AVERAGE ALL-CAUSE EXCESS MORTALITY ESTIMATES WITH COVID-19 BY POPULATION AND AGE

U.S. Population (No. of Responses)	Current Age	2022 (%)	2023 (%)	2025 (%)	2030 (%)
Total Respondents					
General (*N* = 56)	25	14	9	6	2
	45	13	9	5	2
	65	10	7	5	2
	85	9	6	3	1
Actuaries Only					
General (*N* = 45)	25	13	9	5	1
	45	13	8	4	1
	65	10	5	3	0
	85	9	5	2	−1
Private and Public Pension Plan (*N* =15)	25	8	5	2	−1
	45	7	5	2	−1
	65	6	4	1	−3
	85	6	4	0	−3

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

- Among all respondents, the average excess mortality for the U.S. general population is expected to occur 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.

- When the respondents are restricted to actuaries, the average expected excess mortality is equal to or lower than among all respondents, with age 85 in 2030 being slightly negative.

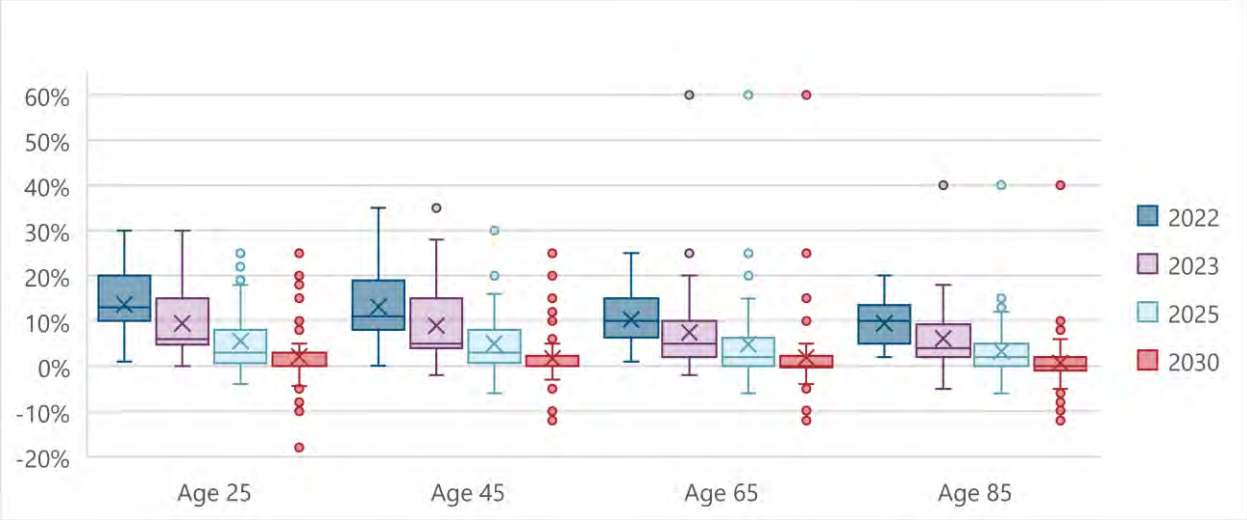
- Average excess mortality for the U.S. private and public pension plan population is expected to be lower than the expectation for the U.S. general population. While not captured in the above table, the survey report notes the same is true for both the U.S. life insurance industry insured population and the U.S. annuity industry annuitant population.

- For the U.S. private and public pension plan population, the average excess mortality is expected to be negative in 2030 for all ages. Such a sentiment is consistent with the notion of continued positive mortality improvement if it is also assumed that the excess mortality experienced so far since the onset of COVID-19 disappears by 2030.

Practitioners may also find it useful to consider the distribution of the responses from those surveyed. This is provided in the Figure 6.3 box and whisker plot below, which can be found as Figure 4 in Appendix B of the survey report. Figure 6.3 corresponds 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 Tables 4a and 4b 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 6.3

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



The following are some observations and comments regarding the information in Figure 6.3:

- There is a significant amount of variance in the respondents' expectations in the later years of the survey, most notably in 2030.

- There was one response that was a significant outlier, predicting 60% excess mortality at age 65 and 40% excess mortality at age 85 for 2023, 2025, and 2030. While most of the rounded percentages shown in Table 6.4 do not change when that response is excluded from the determination of the averages, excluding that response lowers the average expected excess mortality for age 85 in 2030 from 1% to 0%.

- With two exceptions, the median expected excess mortality is 1%–4% lower than the average. The two exceptions are in 2022, where the median is the same for age 65 and 1% higher for age 85.

The survey also provides extensive information regarding the respondents' expectations on future mortality excluding COVID-19 as a cause of death. It is worth noting that that is not necessarily the same thing as capturing

their expectations had the COVID-19 pandemic never occurred, because a person may argue that a substantial portion of the excess death is due to the significant societal changes associated with the pandemic.

The detailed expectations excluding COVID-19 are not summarized in this report. However, the Committee notes a key finding from the survey is that non-COVID-19 causes of death are expected to contribute more to the total excess mortality than COVID-19 for younger ages, while for older ages COVID-19 is the main driver of expected excess mortality. That finding is consistent with the historical excess mortality information provided in Tables 3.1-3.3 of subsection 3.2 of this report.

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

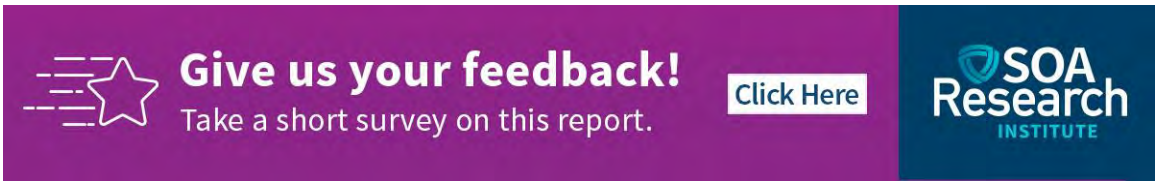
Section 7: Online Tools

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

- The MIM-2021-v3 Application Tool can be used to reconstruct Scale MP-2021 or construct alternative mortality improvement scales using the MIM-2021 framework. The MIM-2021-v3 Data Analysis Tool can be used to analyze the historical datasets included in the MIM-2021-v3 Application Tool. These tools can be downloaded here: *https://www.soa.org/resources/research-reports/2022/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.



Section 9: Acknowledgments

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RPEC members (members of the Mortality Improvement Subcommittee are denoted with an asterisk) are:

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At the SOA:

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- Erika Schulty, SOA Research Associate

Appendix A: Annuity Factors and Life Expectancy Values

Table A.1 presents a comparison of monthly deferred-to-62 annuity-due values using various SOA mortality tables, all calculated generationally as of 2022 ("Generational @ 2022") using Scale MP-2021. These annuity values were computed using the following specifications:

- Employee rates for ages below 62 and retiree rates for ages 62 and older.
- A discount rate of 4.0%.

For the "Pri-2012" column, the Total Dataset version of Pri-2012 is used.

Table A.1

MONTHLY DEFERRED-TO-62 ANNUITY-DUE VALUES AT 4.0% AS OF JAN. 1, 2022
SOA MORTALITY TABLES PROJECTED WITH SCALE MP-2021

	Age	Pri-2012	PubG-2010	PubT-2010	PubS-2010
Females	25	3.7466	3.8681	3.9722	3.7819
	35	5.4554	5.6438	5.809	5.5154
	45	7.9547	8.2476	8.5063	8.0557
	55	11.6349	12.0846	12.4862	11.7853
	65	14.2831	14.8531	15.404	14.4119
	75	10.2881	10.8316	11.3345	10.4495
	85	6.2159	6.5591	6.9211	6.4166
	95	3.3670	3.4972	3.5475	3.4889
Males	25	3.5139	3.6055	3.7769	3.5975
	35	5.1135	5.2444	5.5081	5.2396
	45	7.4588	7.6562	8.0518	7.6464
	55	10.9238	11.2338	11.8234	11.1916
	65	13.4081	13.7783	14.5269	13.621
	75	9.4825	9.7792	10.3982	9.5481
	85	5.5055	5.7563	6.1136	5.5468
	95	2.8964	3.0768	3.1072	3.0242

Table A.2 presents a comparison of 2022 cohort life expectancy values at the indicated ages, calculated assuming:

- Base mortality rates equal to headcount-weighted Pri.H-2012 employee rates for ages below 62 and headcount-weighted Pri.H-2012 retiree rates for ages 62 and older.
- Mortality projection starting in 2012 using Scale MP-2021.

Table A.2
COHORT LIFE EXPECTANCIES AS OF JAN. 1, 2022
PRI.H-2012 PROJECTED GENERATIONALLY WITH SCALE MP-2021

	Age	MP-2021
Females	25	63.54
	35	52.95
	45	42.44
	55	32.00
	65	22.29
	75	14.00
	85	7.50
	95	3.73
Males	25	60.15
	35	49.67
	45	39.33
	55	29.04
	65	19.65
	75	12.10
	85	6.31
	95	3.14

Appendix B: Development of SSA-Style Mortality Rates

RPEC followed the methodology described in the SSA's Actuarial Study No. 120 (Bell and Miller 2005) in its development of estimated mortality rates. The deaths for ages below 65 were taken from the CDC Wide-ranging Online Data for Epidemiologic Research WONDER database (CDC 2022), and the exposures for ages below 65 were taken from the most recent population estimates published by the U.S. Census Bureau (USC 2020). Deaths and exposures for ages 65 and above were made available to RPEC by the CMS.

Appendix B1.3 of the *Scale MP-2016 Report* (SOA 2016) detailed multiple adjustments made to the Medicare data, including averaging adjacent Jan. 1 populations to approximate a July 1 population count and estimating a forthcoming true-up to preliminary death counts for ages 65–69. Those adjustments are no longer made due to an update to the manner in which the CMS data has been provided. The CMS exposures are now presented as of mid-year, removing the need for averaging, and there are no longer predictable and significant true-ups of data that take place after the initial release.

Once the raw sex/age-specific death and exposure databases for each calendar year had been developed, RPEC used the iterative process described in Actuarial Study No. 120 (Bell and Miller 2005) to develop graduated SSA-style mortality rates.

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