

2020-2021 Excess Deaths in the U.S. General Population by Age and Sex



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Updated August 2022

Executive Summary

This is an update of a report published originally in June 2021¹ comparing total U.S. population mortality to baseline expectations by age and sex. The report now includes U.S. population numbers through August 17, 2022, so the years 2020 and 2021 are now mostly complete.

There has been no change in the study methods, so this document includes some of the original language, but updates the tables and charts through the end of 2021. Where it makes sense, 2020 and 2021 results are shown separately.

The actual deaths used are those reported by the U.S. Centers for Disease Control and Prevention (CDC), and several different methods were considered for setting expected deaths, adjusting for the estimated mix by age, sex, and time of year (seasonality). Since the CDC provides deaths on an incurred basis, completion factors were considered based on delays in reporting, but the analysis also considered lagged actual-to-expected ratios (A/E ratios), which diminished the importance of completion.

Understanding the impact of the SARS-CoV-2 (COVID-19) pandemic provided the primary motivation for this study, but another goal was to facilitate comparisons between the U.S. general population results and the U.S. Group Life Insurance market experience, which is being captured by the SOA-sponsored COVID-19 Group Term Life Mortality Survey. The impact of COVID-19 deaths, as captured by the CDC, were measured directly, but the total mortality was also considered.

Using the five-year trended death expectations (from 2015-2019), the final nine months of 2020 completed with the total death A/E of 122%, while the full year of 2021 completed at 117%. In both years, the age group with the highest A/E was ages 35-64, with 2021 being somewhat worse than 2020.

Using the full 52 weeks of experience from 2020, the A/E ratio was 116.4%, with 13.3% excess due to COVID and 3.1% excess from causes not explicitly identified as COVID.

¹ [2020 Excess Deaths in the U.S. General Population by Age and Sex, Updated May 2021 \(soa.org\)](#)

The most recent public report based on the SOA-sponsored COVID-19 Group Term Life Mortality Survey considered the experience period from April 1, 2020 through March 2022 and used the 2017-2019 experience period to set the baseline expectations. The following tables show the results from the U.S. population at approximately the same period using the same baseline expectations. The deaths are on an incurred basis and the expectations are adjusted for seasonality.

Table 1**ACTUAL TO EXPECTED DEATHS: MARCH 22, 2020 TO JANUARY 2, 2021**

Age	Total	COVID	Excl Covid
< 15	96.5%	0.6%	95.9%
15-34	122.8%	4.5%	118.3%
35-64	123.1%	14.8%	108.3%
> 64	122.0%	19.2%	102.9%
All Ages	122.0%	17.5%	104.5%

Based on CDC data as of August 17, 2022

Table 2**ACTUAL TO EXPECTED DEATHS: JANUARY 3, 2021 TO JANUARY 1, 2022**

Age	Total	COVID	Excl Covid
< 15	102.2%	1.4%	100.8%
15-34	130.8%	9.4%	121.4%
35-64	131.1%	21.7%	109.4%
> 64	113.0%	14.2%	98.8%
All Ages	117.3%	15.5%	101.8%

Based on CDC data as of August 17, 2022

The following two tables show the U.S. population mortality experience as compared to the results of the Society of Actuaries Group Life survey, with 2020 and 2021 results as reported through April 2022. For these tables, we set the U.S. population expectation to match what is used for the Group Life survey (average death rates from 2017-2019).


Table 3**COMPARISON OF GROUP LIFE SURVEY RESULTS TO U.S. POPULATION (2020)**

	Group Life	U.S. Population	Ratio
Period	4/1/20 to 12/31/20	3/29/20 to 1/2/21	
Population (000)	131,593	330,439	39.8%
Total Deaths	375,002	2,728,042	13.7%
Annual Rates per 1,000	3.782	10.724	35.3%
COVID-19 Deaths	46,613	392,088	11.9%
Expected	312,968	2,236,248	14.0%
Excess Deaths as Percent of Expected			
Total	19.8%	22.0%	90.1%
COVID-19	14.7%	17.5%	83.8%
Exclude COVID-19	5.1%	4.5%	115.2%

Table 4
COMPARISON OF GROUP LIFE SURVEY RESULTS TO U.S. POPULATION (2021)


	Group Life	U.S. Population	Ratio
Period	1/1/21 to 12/31/21	1/3/21 to 1/1/22	
Population (000)	130,856	332,207	39.4%
Total Deaths	515,711	3,457,109	14.9%
Annual Rates per 1,000	5.231	10.399	50.3%
COVID-19 Deaths	78,357	457,777	17.1%
Expected	422,057	2,947,126	14.3%
Excess Deaths as Percent of Expected			
Total	22.2%	17.3%	128.2%
COVID-19	18.5%	15.5%	119.0%
Exclude COVID-19	3.7%	1.8%	209.0%

These results have not been adjusted for the different distributions by age and sex between the two populations. This table shows that the proportional impact of the pandemic on Group Life claims was a little less than U.S. population in 2020 and was significantly worse than the U.S. population in 2021.



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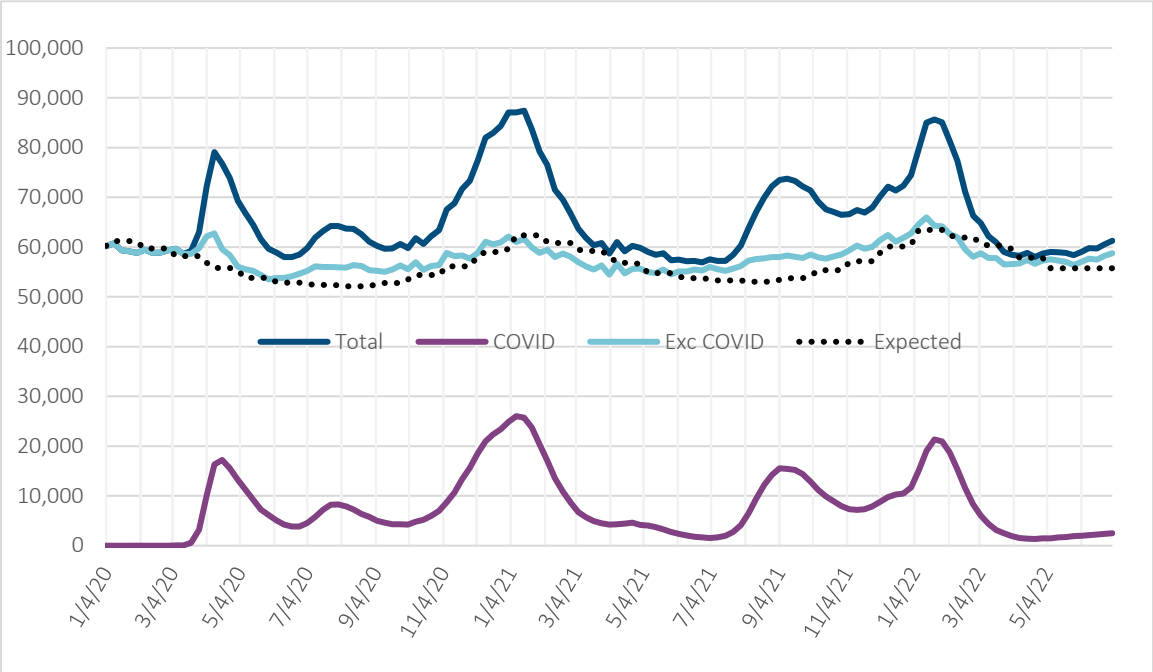
Section 1: Study Results – Mortality Observations

The following tables and figures show the results of excess deaths studied. More details on how this analysis was performed are provided in the Study Methods section below.

The data used for this analysis was provided by the CDC as of August 17, 2022 and includes incurred deaths by week, beginning on December 29, 2019 and going through July 2, 2022. For 2020, the CDC defines Week 1 as ranging from December 29, 2019 through January 4, 2020 and Week 52 as ranging from December 19, 2020 through December 26, 2020, so when reporting on 2020 results, this convention is used. The year 2021 begins on December 27, 2020 and runs through January 2, 2022. For the purposes of this analysis, the start of the COVID-19 active period is March 22, 2020.

Due to the delay in reporting, the actual deaths have been completed based on factors that vary by age and sex. These are shown below along with the expectations that are based on the five-year trend after adjusting for seasonality.

Figure 1
COMPLETED ACTUAL AND EXPECTED DEATHS BY WEEK: ALL AGES AND SEXES



These data are as of August 17, 2022 and exclude deaths that occurred after July 2, 2022. Figure 1 shows that, for most months, the total A/E ratio is much greater than 100%, while the A/E ratio excluding COVID-19 deaths is also greater than 100% by a few percent.

Tables 5 and 6 below show the total results for the COVID-19 active period up through December 26, 2020 and for all of 2021.

Table 5

ACTUAL TO EXPECTED DEATHS: MARCH 22, 2020 TO JANUARY 2, 2021

Age	Female			Male		
	Total	COVID	Excl COVID	Total	COVID	Excl COVID
LT 1	96.4%	0.3%	96.1%	94.4%	0.4%	94.0%
1-4	91.8%	0.9%	90.9%	96.1%	0.8%	95.3%
5-14	96.8%	1.7%	95.1%	107.0%	1.5%	105.5%
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%
GE 85	120.2%	17.7%	102.5%	120.3%	19.8%	100.5%
All Ages	120.6%	16.7%	103.9%	123.3%	18.3%	105.0%

Based on CDC data as of August 17, 2022

Table 6

ACTUAL TO EXPECTED DEATHS: JANUARY 3, 2021 TO JANUARY 1, 2022

Age	Female			Male		
	Total	COVID	Excl COVID	Total	COVID	Excl COVID
LT 1	103.3%	0.9%	102.3%	97.3%	0.7%	96.5%
1-4	108.6%	2.1%	106.6%	103.2%	1.7%	101.5%
5-14	105.7%	3.5%	102.2%	110.7%	3.2%	107.5%
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%
GE 85	104.1%	9.4%	94.7%	106.2%	12.1%	94.1%
All Ages	114.6%	14.2%	100.4%	119.8%	16.8%	103.1%

Based on CDC data as of August 17, 2022

It is interesting to note that the highest overall A/E ratios occurred for ages 35-54 for both sexes in both years and that the highest excess death percentage when COVID-19 is excluded was in ages 15-24 for females for both years, and for males in 2020. When COVID-19 is excluded, the highest percentage for males was for ages 35-44 in 2021.

Figures 2-5 show the history of actual-to-expected deaths by week, sex, and age group. Generally, the deaths are low for ages under 15, and elevated for ages over 15, even excluding COVID-19. These figures exclude deaths incurred after July 2, 2022.

Figure 2
FEMALES: COMPLETED ACTUAL-TO-EXPECTED DEATHS BY WEEK, SEX, AND BROAD AGE GROUP

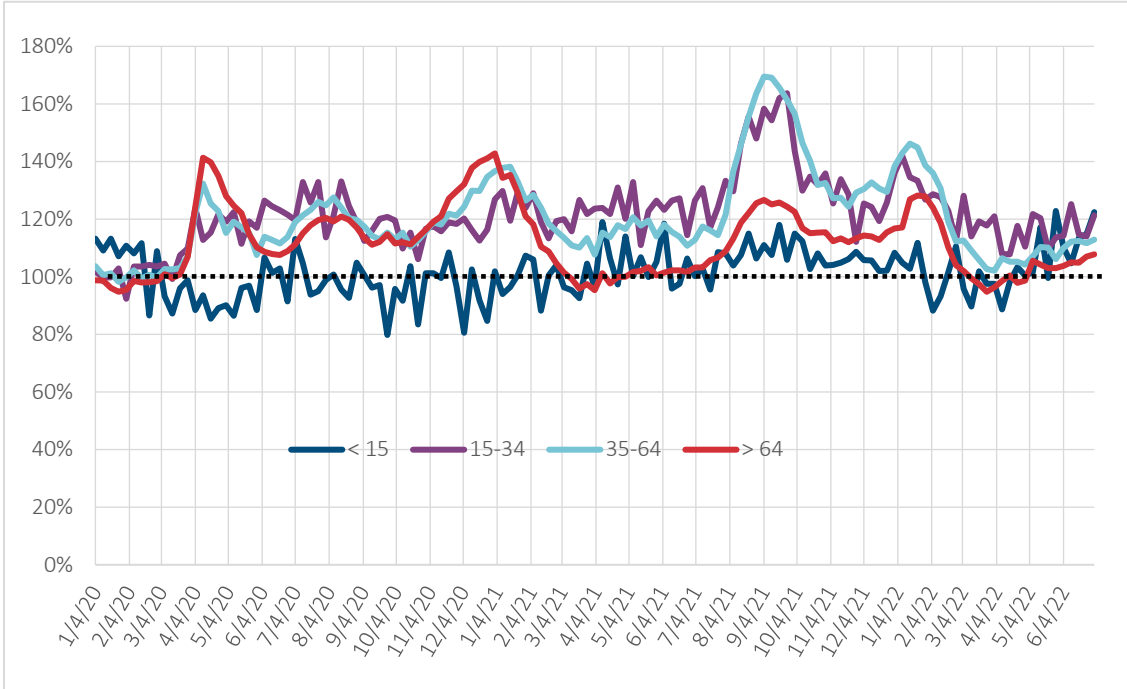


Figure 3
MALES: COMPLETED ACTUAL-TO-EXPECTED DEATHS BY WEEK, SEX, AND BROAD AGE GROUP

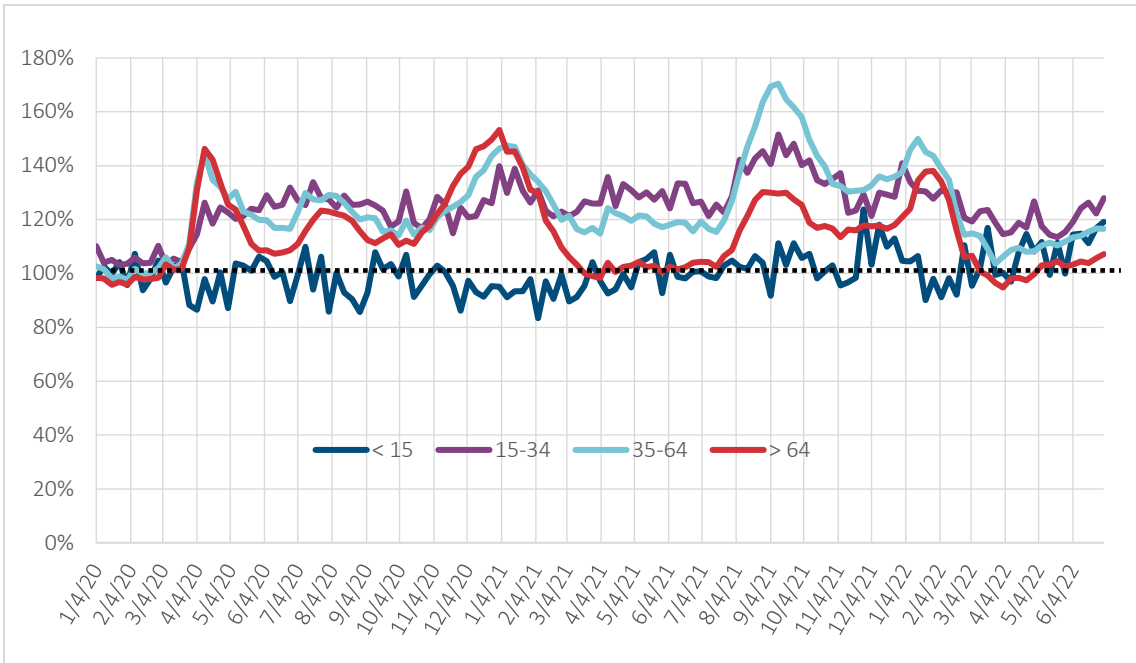


Figure 4
FEMALES: COMPLETED ACTUAL-TO-EXPECTED DEATHS, EXCLUDING COVID, BY WEEK, SEX, AND BROAD AGE GROUP

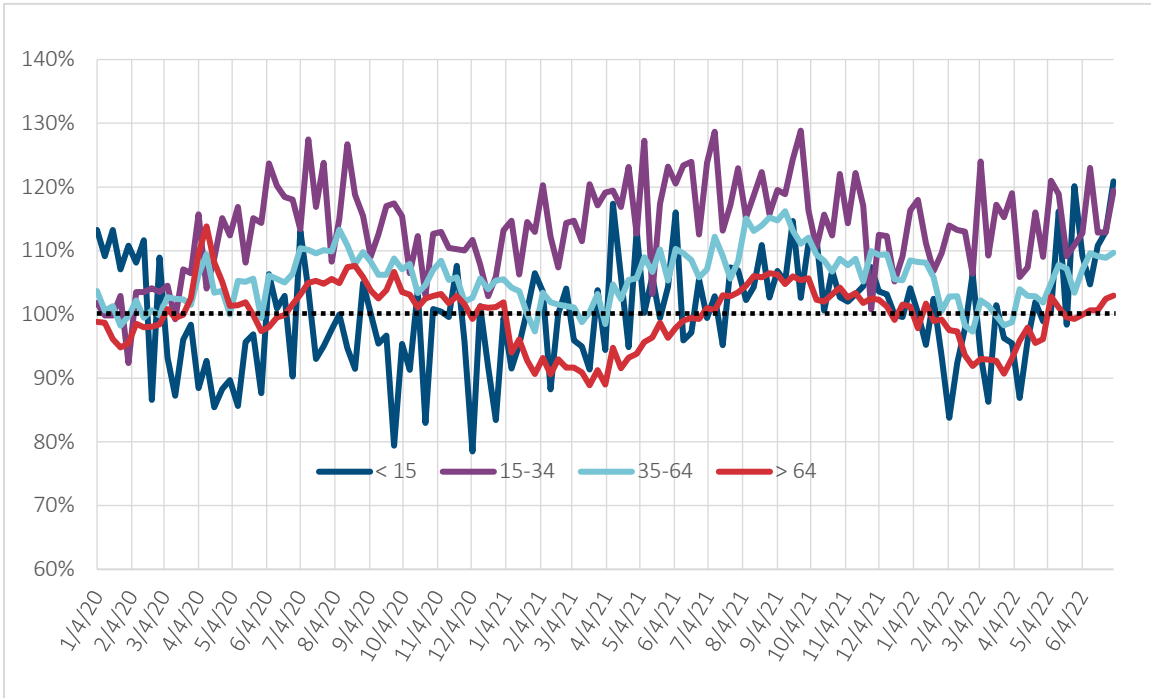
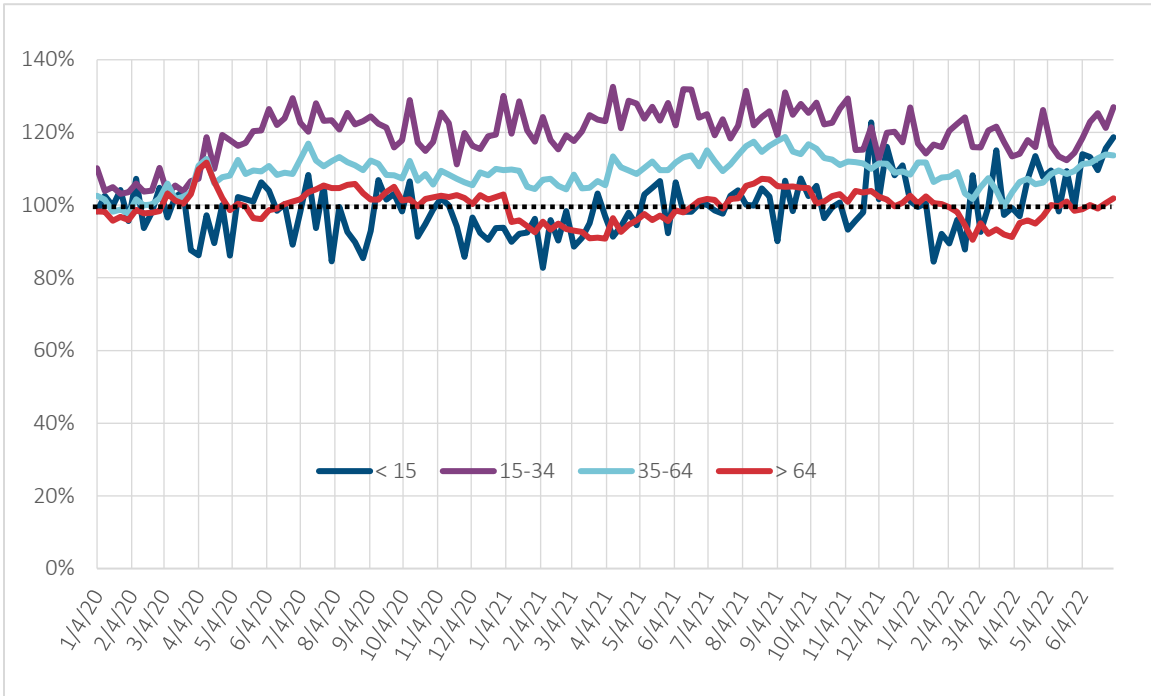


Figure 5
MALES: COMPLETED ACTUAL-TO-EXPECTED DEATHS, EXCLUDING COVID, BY WEEK, SEX, AND BROAD AGE GROUP



Section 2: Study Methods

There are several components to the calculation of expected deaths and this section will document the methods and assumptions made. Since some of the selections are subjective, several different approaches were included to get a feel for the potential impact of these assumptions. Broadly, the steps are as follows:

Step 1: Create Expected Deaths for 2020-2022 by Age and Sex:

These expectations are based on U.S. CDC death information and U.S. Census Bureau population information from 2015 to 2019. These numbers are used to create prior year death rates. The projected death rates in 2020 to 2022 are multiplied by population estimates to determine expected deaths. The population estimates from 2020 forward are based on applying a five-year linear trend to the populations from 2015 to 2019 by sex and age group. We have elected to use the trend method, rather than the CDC 2020 and 2021 population estimates, since population is only used as a base to develop death expectations, and we felt it important to use the same basis as what was used to develop the death expectations.

Step 2: Collect Actual Deaths and Determine Completion Factors

In 2020, the CDC provided deaths by week on an incurred basis. There is some delay in reporting, so these figures need to be completed for the more recent weeks to estimate total incurred deaths. This is done by examining week-over-week completion in 2020 and then accumulating these factors to arrive at a total completion factor by the number of weeks of lag. This is done separately for total deaths and COVID-19 deaths, which tend to complete more slowly. The completion rates do vary by sex and age, so the factors are developed by sex and age group. There is some volatility in the completion, so before determining the ratios, the weeks with the lowest and highest two factors are excluded.

Step 3: Adjust for Seasonality:

Death rates vary by time of the year, age, and sex. Seasonality factors were developed by analyzing the CDC deaths by month for 2010 through 2019 and measuring the death rate in each month relative to the average for the year. When determining monthly adjustment factors, the lowest and highest ratios are excluded to dampen volatility. These adjustments are done by sex and age, both with detailed age buckets and more broad age buckets.

These are the three components of the excess death percentage calculations. Below, the calculations are described in more detail and some observations are provided.

2.1 STEP 1: CREATE EXPECTED DEATHS FOR 2020 AND 2021 BY AGE AND SEX

2.1.1 HISTORY OF U.S. DEATHS

The U.S. deaths were taken from the CDC data retrieval site² after selecting “Underlying Cause of Death” and then “1999-2019: Underlying Cause of Death by Bridged-Race Categories.” The downloaded data were segmented by single year of age, sex, year, and month.

2.1.2 U.S. POPULATION ESTIMATES

U.S. population estimates were taken from the U.S. Census Bureau website³ after selecting median age by sex and using individual ages.

2.1.3 HISTORY OF U.S. DEATH RATES

Death rates were determined by age and sex by computing the ratio of U.S. deaths to the U.S. population after grouping the U.S. deaths into the same age groups as used by the CDC for 2020 deaths.

2.1.4 PROJECTED 2020 AND 2021 DEATH RATES

The expected death rates for 2020 and 2021 were found by projecting forward the 2010-2019 death rates by sex and ages, grouped into age groups. The trends by year and age are variable and not linear so the most appropriate projection method is not obvious. The following six different projection methods were considered:

1. Three-Year Average: 2017-2019 – This method was selected to match the baseline rates used in the SOA COVID-19 Group Life Mortality Survey.
2. Seven-Year Linear Trend: 2013-2019
3. Six-Year Linear Trend: 2014-2019
4. Five-Year Linear Trend: 2015-2019
5. Four-Year Linear Trend: 2016-2019
6. Three-Year Linear Trend: 2017-2019

All ages and sexes have some trends in death rates but, for many, the trends over time are not linear. Different diagnosis trends within these categories and other external factors are likely driving these results. Rather than try to estimate these influences with the 2020/2021 selections, a range of trend options are shown to display the sensitivity and create ranges that likely encompass the true underlying expectation. Note that, in order to not distort the comparison of 2021 to 2020, we used the same expected death rates for both years rather than continue the trends from 2020 into 2021 and beyond. The ranges are presented below in Figures 6-8, which illustrate the patterns for a few selected ages and genders. In each chart, the actual numbers are represented by the black line and can then be compared to the different trends.

² <https://wonder.cdc.gov/>

³ <https://www.census.gov/data/datasets/time-series/demo/pepest/2010s-national-detail.html>

Figure 6
DEATH RATES BY YEAR: MALES, AGES 25-34 (EXCLUDING COVID-19)

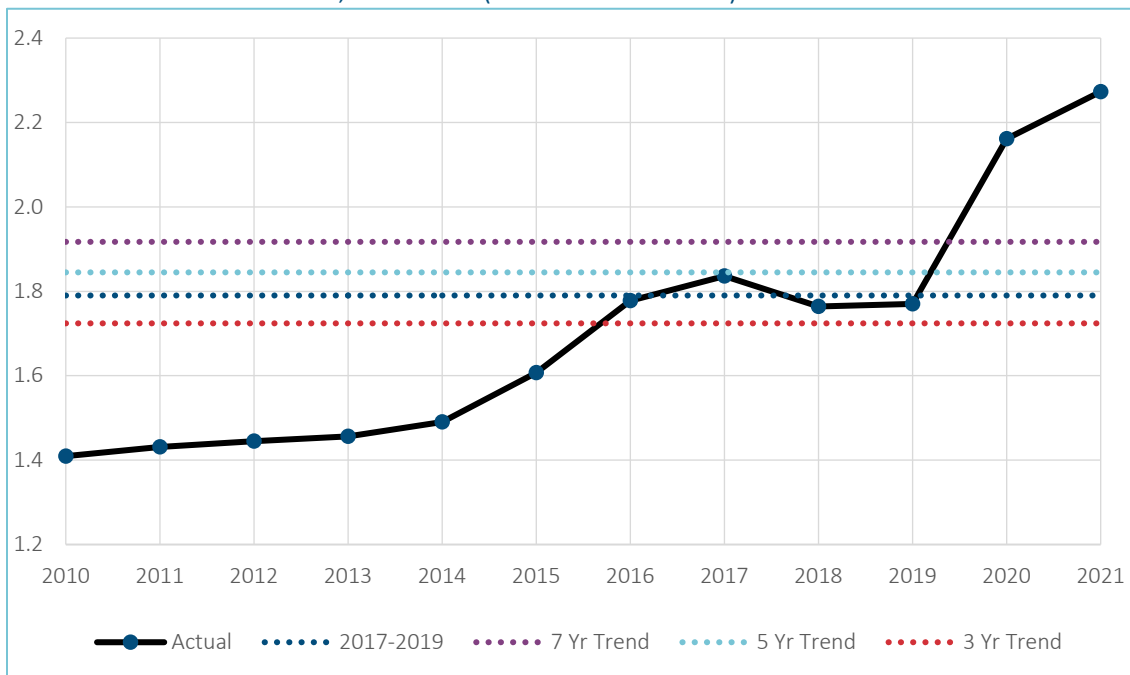


Figure 6 shows death rates that increased from 2013-2017 and then flattened out. The four years (2016-2019) were all within the trend estimates, but death rates rose significantly in 2020 and 2021.

Figure 7
DEATH RATES BY YEAR: FEMALES, AGES 45-54 (EXCLUDING COVID-19)

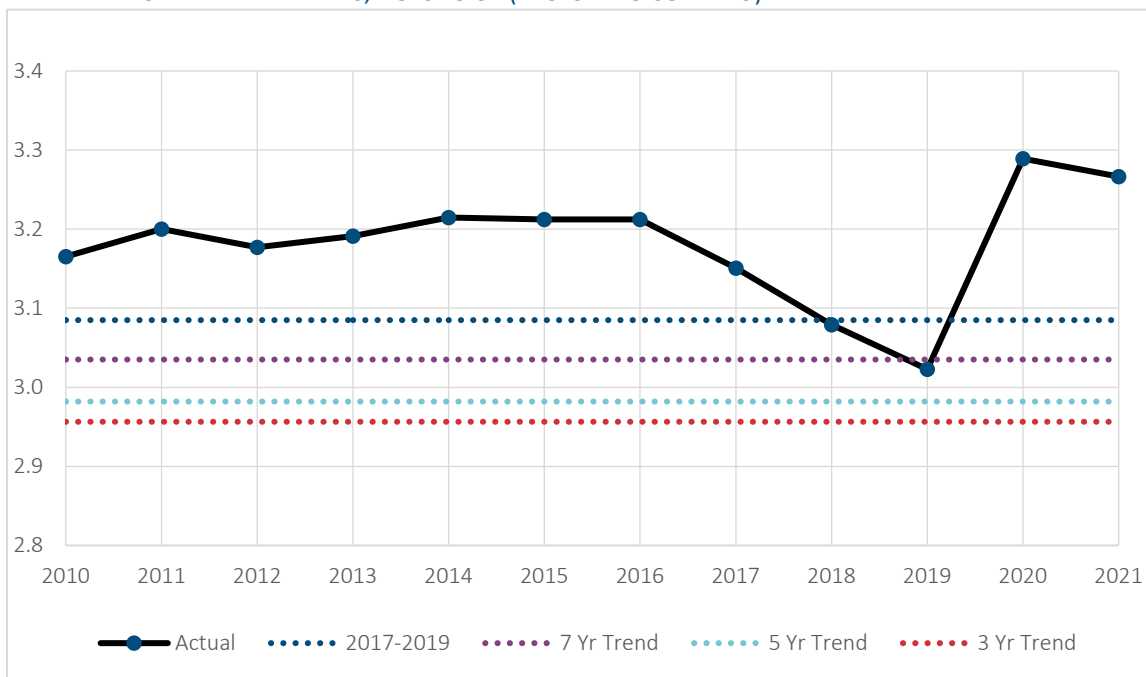


Figure 7 shows that the rates were flat from 2010 to 2016 and then declined through 2019. The range of trend estimates is wider, with the shorter trends being lower. Deaths in 2020 and 2021 were well above the trend estimates.

Figure 8
DEATH RATES BY YEAR: FEMALES, AGES 75-84 (EXCLUDING COVID-19)

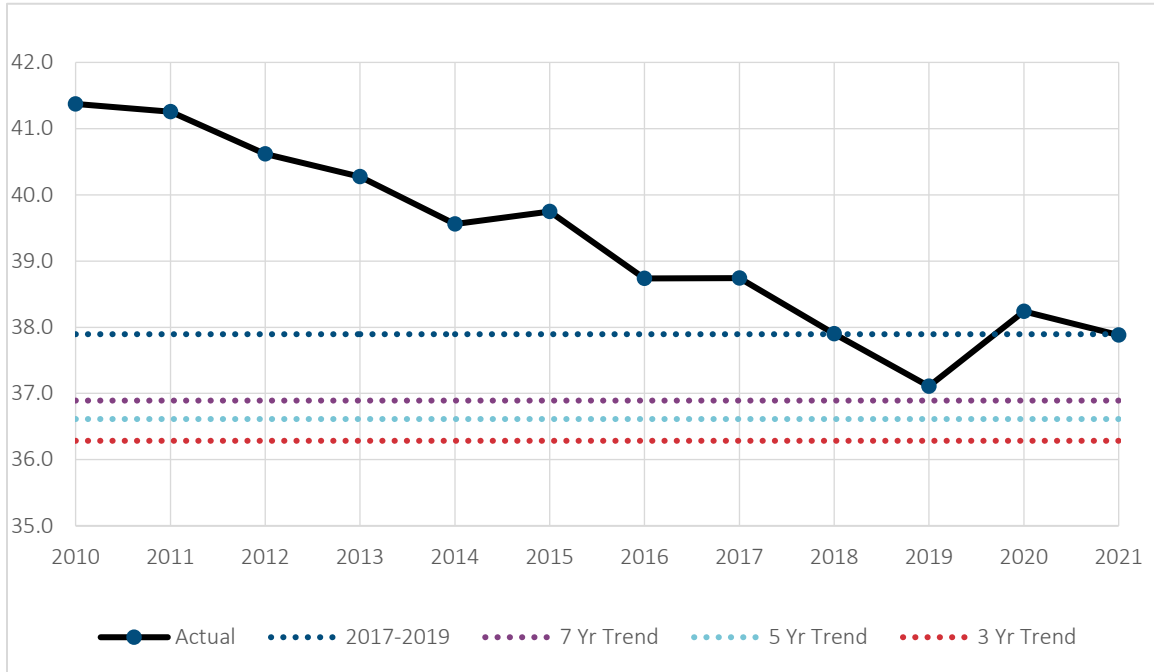


Figure 8 shows an example in which the trends all produce similar expectations that are below the three-year average. The female 75-84 age group shows evident long-term mortality improvement through 2019, with some elevation in 2020 and with 2021 near the average of 2017-2019.

Table 7 shows the sensitivity of 2020 actual deaths to the different expected death assumptions and generally shows the five-year trend to be between the three- and seven-year trends. The biggest uncertainty is in the younger ages, given lower deaths and hence higher volatility. The complete set of expected deaths rates for the six methods are displayed in Appendix A.

Note that, for the 2021 results in Table 8, we did not continue to trend the death rates forward but, instead, used the same expected deaths rate in both 2020 and 2021, with assumed 1.5% population growth between 2020 and 2021.

Table 7
ACTUAL TO EXPECTED DEATHS: MARCH 22, 2020 TO JANUARY 2, 2021 BY METHOD

Age	2017-2019	7 Yr Trend	6 Yr Trend	5 Yr Trend	4 Yr Trend	3 Yr Trend
LT 15	92.6%	95.4%	95.5%	96.5%	96.9%	96.3%
15-34	125.1%	117.9%	119.1%	122.8%	128.2%	130.2%
35-64	123.4%	122.2%	122.6%	123.1%	123.9%	124.1%
GE 65	122.7%	121.4%	121.3%	122.0%	121.8%	123.0%
All Ages	122.6%	121.2%	121.2%	122.0%	122.2%	123.2%

Table 8**ACTUAL TO EXPECTED DEATHS: JANUARY 3, 2021 TO JANUARY 1, 2022 BY METHOD**

Age	2017-2019	7 Yr Trend	6 Yr Trend	5 Yr Trend	4 Yr Trend	3 Yr Trend
LT 15	98.1%	101.0%	101.2%	102.2%	102.7%	102.2%
15-34	133.3%	125.6%	126.9%	130.8%	136.6%	138.7%
35-64	131.4%	130.2%	130.6%	131.1%	132.0%	132.2%
GE 65	113.6%	112.5%	112.4%	113.0%	112.8%	114.0%
All Ages	117.9%	116.5%	116.6%	117.3%	117.5%	118.5%

2.2 STEP 2: COLLECT ACTUAL DEATHS AND ESTIMATE COMPLETION FACTORS

The CDC publishes 2020 and 2021 deaths by incurred week⁴.

The CDC publishes deaths across all ages daily, but deaths by age, sex, and week are published at the end of the day on Wednesday, covering incurred periods through the prior Sunday. The death counts are provided in total and for deaths identified as at least partially due to COVID-19. Since the numbers are on an incurred basis, they are incomplete due to reporting lags. The weekly death totals have been collected back to May of 2020 and the completion occurring for the prior weeks can be determined. The delays in reporting extend back many weeks and completion factors are used to infer deaths in more recent weeks.

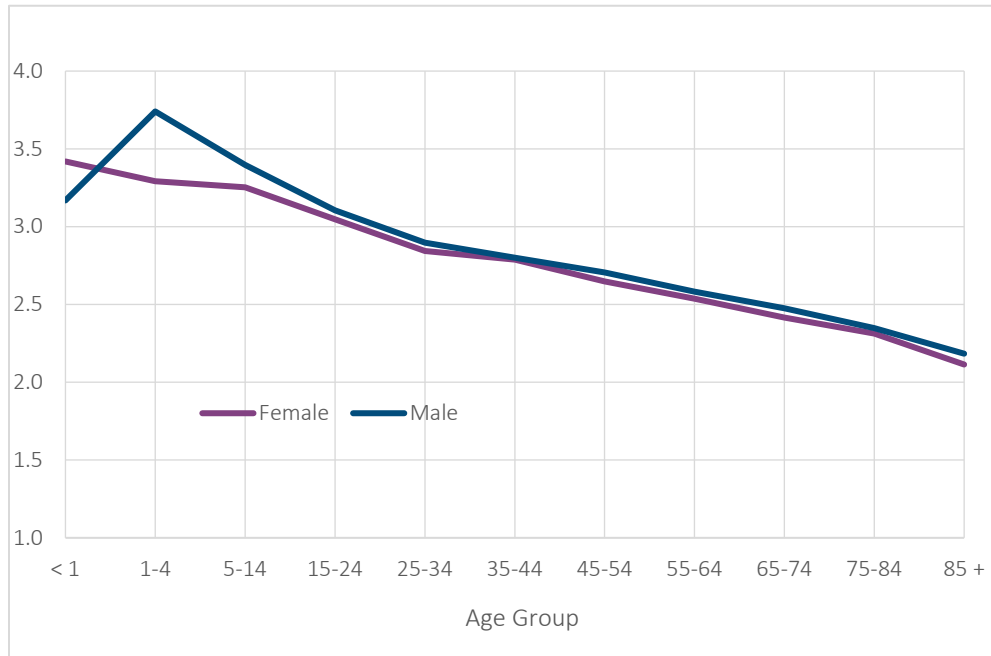
The delays are material. For example, at the younger ages, death totals eight weeks later are still short by as much as 8%. This delay in reporting has likely been a source of confusion about how to interpret the CDC death totals. The method used is to determine average week-to-week completion factors by lag and then accumulate these to determine the total completion for each starting lag.

There are two complications that have been addressed. The first is that there is a clear difference in completion of COVID-19 deaths versus the total deaths. This makes sense as sometimes it can take a while to establish the cause of death, even if the death has already been reported. Both the week-to-week completion factors and total completion factors are determined in total for all deaths, and then also separately for the COVID-19 deaths. The total completed deaths excluding COVID-19 are then determined as the difference between these two estimates.

The second complication is that the completion varies by age, with older ages being reported more quickly than younger ages. To account for this, the week-to-week and total completion factors are determined by age group and sex. The chart below illustrates the magnitude of the sex-age differences. At the older ages, the sex difference all but disappears, but the age differences persist.

⁴ <https://data.cdc.gov/NCHS/Provisional-COVID-19-Death-Counts-by-Sex-Age-and-W/vsak-wrfu>

Figure 9
LAG ZERO TOTAL COMPLETION FACTORS BY AGE AND SEX



Based on CDC data as of May 25, 2022

The method for developing the completion factors is described below. The week-to-week completion factors are determined first: As an example, for 45- to 54-year-old females, there were 715 deaths in the week ending December 5, as of December 16, and 1,019 deaths for the week ending December 5, as of December 23. The initial reporting is defined as lag one, while the next week's reporting is defined as lag two. This means that, for this week, the lag one-to-two weekly completion factor is 1.425 ($1,019 / 715$). We find this ratio for all weeks and then divide the lag-two totals by the lag-one totals to get the lag one-to-two weekly completion factor. For this lag and sex-age combination, the lag one-to-two weekly completion factor comes out to 1.363.

The product of these week-to-week completion factors then determines the total completion factor. For example, the lag-zero total completion factors are equal to the zero-to-one weekly completion factor times the one-to-two weekly completion factor times the two-to-three weekly completion factor, and so on. The lag-two total completion factor is equal to the two-to-three weekly completion factor times the three-to-four weekly completion factor, and so on. Thirty-six weeks of lag were considered, at which point there is very little change. As an example, the lag-two total completion factor for 45-54 females determined using this method is 1.491. Then, the lag-one total completion factor for 45-54 females is found by taking the lag-two total completion factor times the one-to-two weekly completion factor, producing 2.033 ($1.491 * 1.363$). The complete set of week-to-week and total completion factors by sex and the ten age group categories are displayed in Appendix B for both all deaths and COVID-19 deaths. Note that, for COVID-19 deaths at the youngest ages, there were not sufficient deaths by week to create reasonable factors. For these ages (less than 15), we used the total death weekly completion factors times the ratio of all-ages-and-sexes COVID-19 weekly completion factors to the total death weekly completion factors by lag.

These factors are applied as follows: If the CDC reports a certain number of incurred deaths in a sex-age combination for a given week, as of a specified date, then we determine the weekly lag for this date and apply the total completion factor to estimate the eventual total deaths for that week. As an example, as of

February 3, 2021, there were 715 reported deaths incurred in the week ending January 23, 2021. We would classify this as a lag-one week and so apply the lag-one total completion factor (2.033) and estimate that, by the time the reporting is complete, there will be 1,454 total deaths for this sex-age combination.

Note that, in June of 2022, the CDC paused their process for several weeks while they modified their method of collecting death data. Once they began publishing the tables again on June 24, it took several additional weeks to fill in the death history. Due to this disruption, we have not updated the completion factors since May 25, 2022 and continue to use these factors for more recent completion estimates.

2.3 STEP 3: ADJUST FOR SEASONALITY

U.S. deaths exhibit clear seasonal variations, so adjustments are made to the expectations to reflect these patterns with adjustments varying by sex and age. This is done by comparing deaths in a month to the average deaths per month for that year. This ratio is calculated by sex and age group for each month and each year, while excluding the years with the lowest and highest ratios before computing the overall ratio. This method is illustrated in the following table for males over age 85. The January with the highest ratio was in 2013 and the January with the lowest ratio was in 2012, so these years are excluded from the total.

Table 9
JANUARY CDC DEATHS FOR 85+ MALES BY YEAR

Year	Deaths	Avg Deaths	Ratio	Rank
2010	25,213	22,989	109.7%	9
2011	27,549	23,785	115.8%	5
2012	26,728	24,509	109.1%	10
2013	32,795	25,372	129.3%	1
2014	28,303	25,732	110.0%	8
2015	33,577	26,809	125.2%	3
2016	30,179	26,946	112.0%	6
2017	32,628	27,906	116.9%	4
2018	35,923	28,110	127.8%	2
2019	31,145	28,180	110.5%	7
Total	244,517	210,457	116.2%	

Total excludes 2012 and 2013

There is a final adjustment for the number of days in the month relative to the average number of days per month over the year. For example, January has 31 days, while the average days per month across all years and months is 30.44. Therefore, when setting a daily expectation for January, the ratio calculated above (116.2%) is multiplied by 30.44/31 to get a final adjustment of 114.1%.

The death rate seasonal factors are adjusted for the days in each month, so they can be compared across months. This is important since the 2020 and 2021 CDC deaths are expressed weekly rather than monthly. The adjustments for weeks that cross over months are found by using the factors for the two months weighted by the number of days in each month. For example, the week from March 29 to April 4 will have an adjustment based on three days of March rates and four days of April rates.

The seasonal patterns by age and sex are interesting and displayed in the following figures. The patterns are split into two different sets of age ranges to improve legibility and to illustrate that there are broad differences in the patterns by age (young versus old).

Figure 10
FEMALE SEASONAL FACTORS BY MONTH AND AGE GROUP (AGES 0-44)

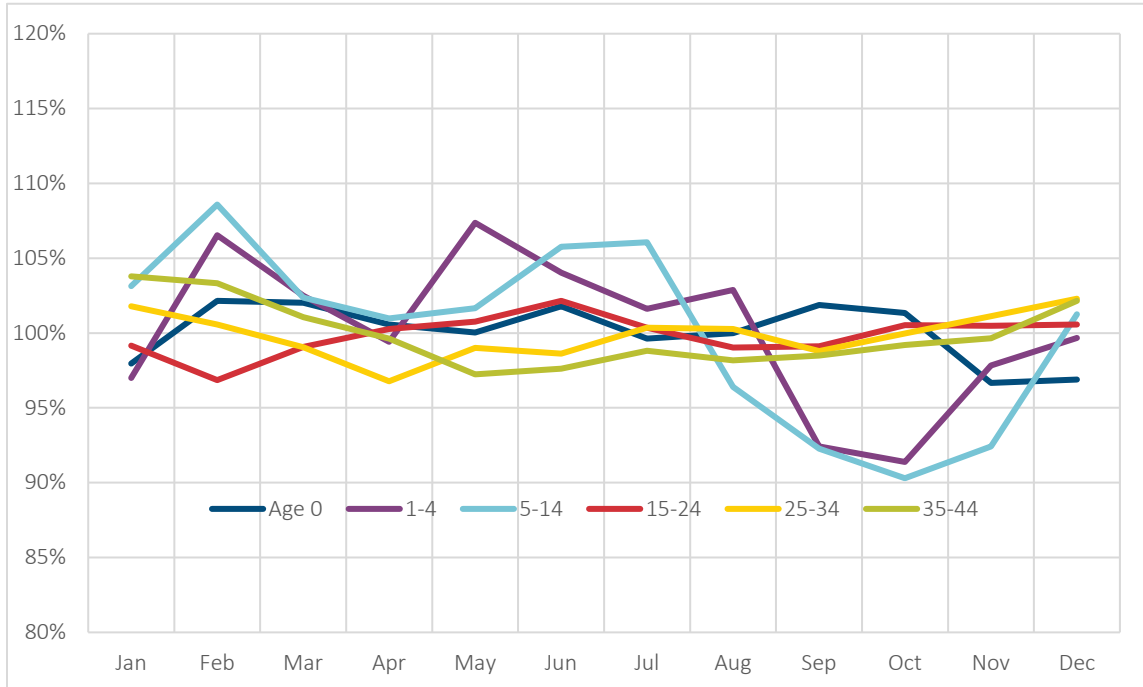


Figure 11
FEMALE SEASONAL FACTORS BY MONTH AND AGE GROUP (AGES 45-85+)

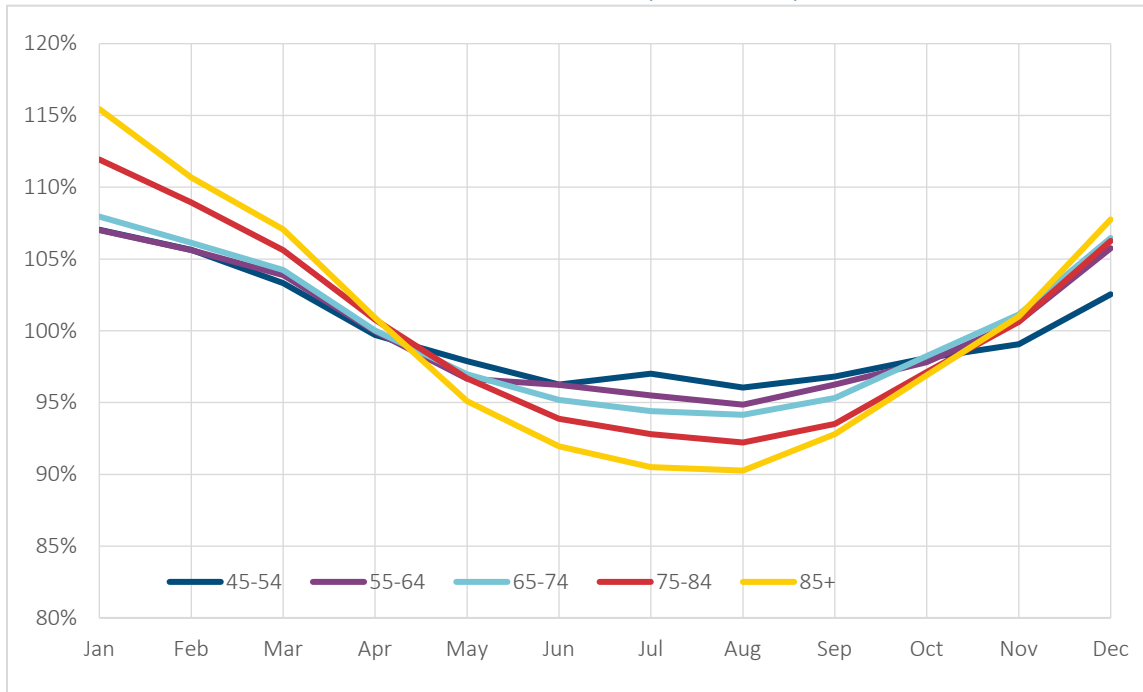


Figure 12
MALE SEASONAL FACTORS BY MONTH AND AGE GROUP (AGES 0-44)

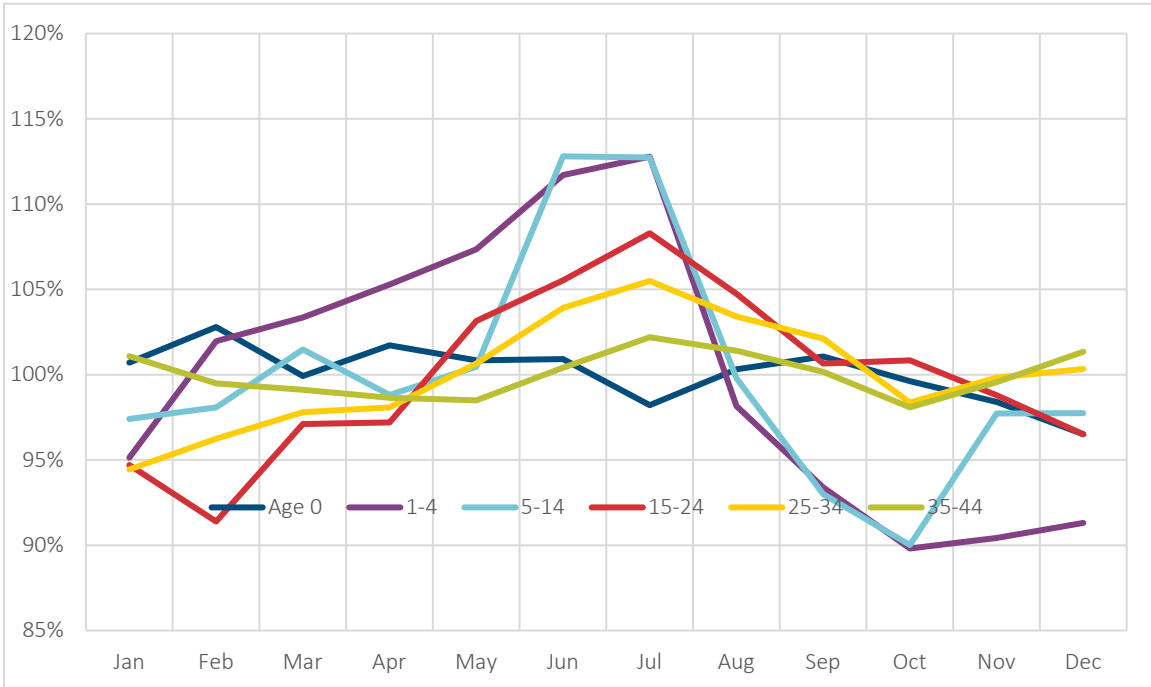
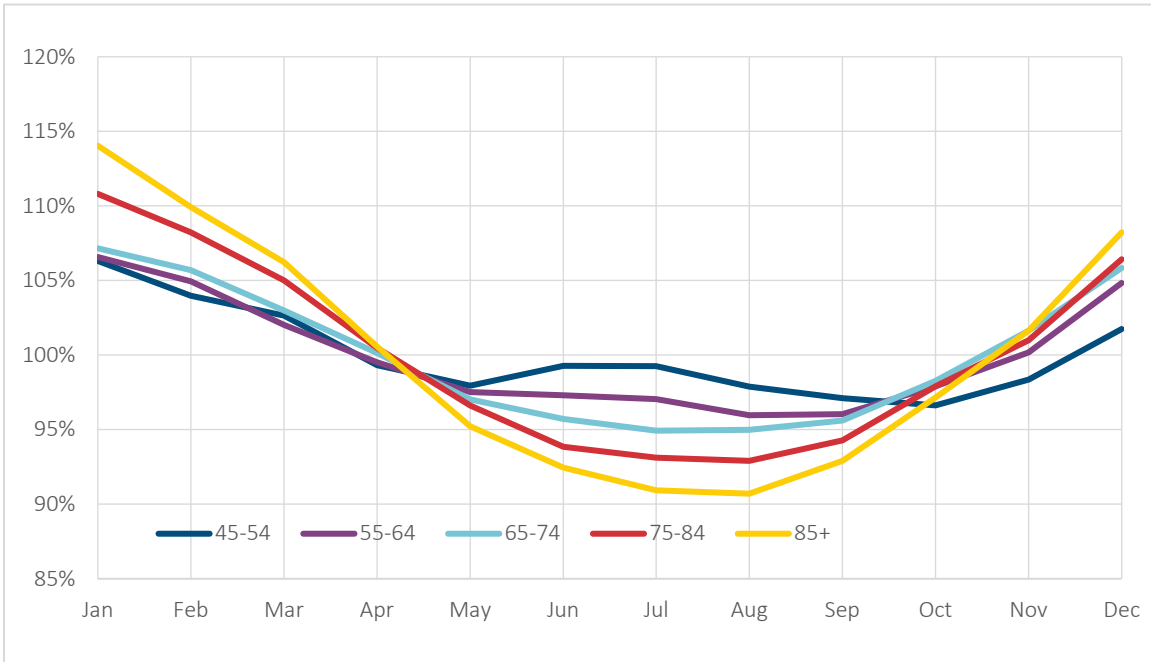


Figure 13
MALE SEASONAL FACTORS BY MONTH AND AGE GROUP (AGES 45-85+)



2.4 COMPARISONS TO SOA COVID-19 GROUP LIFE SURVEY

In August of 2022, the SOA released its third public summary of the results of their Group Life COVID-19 Mortality Survey, with results through March 31, 2022:

<https://www.soa.org/resources/experience-studies/2022/group-life-covid-19-mortality-03-2022/>

One finding from this report was that, in the last nine months of 2020, the total deaths were 19.8% higher than the baseline expectation, and 5.1% higher excluding COVID-19. For the full year 2021, these respective numbers were 22% and 3.6%. The following two tables show these numbers using several different death rate expectations.

Table 10

U.S. POPULATION 2020 MORTALITY: MARCH 22, 2020 TO JANUARY 2, 2021

	Total Death Actual to Expected				
	Actual	2017-2019	7 Yr Trend	5 Yr Trend	3 Yr Trend
All Ages	2,728,042	122.6%	121.2%	122.0%	123.2%
Age >= 15	2,705,745	122.9%	121.5%	122.3%	123.5%
Ages: 15-64	687,553	123.6%	121.6%	123.0%	124.9%
Death A to E: Excluding COVID-19					
All Ages	2,335,954	105.0%	103.8%	104.5%	105.5%
Age >= 15	2,313,804	105.1%	103.9%	104.5%	105.6%
Ages: 15-64	612,424	110.1%	108.4%	109.6%	111.2%

Table 11

U.S. POPULATION 2021 MORTALITY: JANUARY 3, 2021 TO JANUARY 1, 2022

	Total Death Actual to Expected				
	Actual	2017-2019	7 Yr Trend	5 Yr Trend	3 Yr Trend
All Ages	3,457,109	117.9%	116.5%	117.3%	118.5%
Age >= 15	3,427,368	118.1%	116.7%	117.5%	118.6%
Ages: 15-64	940,768	131.7%	129.6%	131.0%	133.0%
Death A to E: Excluding COVID-19					
All Ages	2,999,332	102.3%	101.1%	101.8%	102.8%
Age >= 15	2,970,010	102.3%	101.1%	101.8%	102.8%
Ages: 15-64	796,438	111.5%	109.7%	110.9%	112.6%

Comparing these numbers to the Group Life numbers, we see that, in the last nine months of 2020, the proportional impact for the Group Life market was somewhat below the impact for the U.S. population (19.8% versus 22.6%), whereas the Group Life market had a similar impact for non-COVID deaths. (5.1% versus 5.0%). For 2021, the Group Life experience was proportionally worse (22.0% versus 17.9% and 3.6% versus 2.3%).

One of the features of 2021 was that excess mortality was worse for the working ages. We see that the impact on the U.S. population between 15 and 64 was 31.7% worse, much higher than for the Group Life market. The two populations are different, with Group Life having fewer, but not zero, older people exposed to coverage. In the last version of this report, we considered age-adjusted results by using only 55% of the lives exposed above age 64. Continuing to use this adjustment, we see the following results:

Table 12**AGE-ADJUSTED U.S. POPULATION RESULTS**

	Actual to Expected March 22, 2020 to January 2, 2021				
	Actual	2017-2019	7 Yr Trend	5 Yr Trend	3 Yr Trend
Total	1,819,856	122.5%	121.1%	122.0%	123.3%
Excluding COVID	1,570,333	105.7%	104.5%	105.3%	106.4%
	Actual to Expected January 3, 2021 to January 1, 2022				
Total	2,338,139	120.0%	118.6%	119.5%	120.7%
Excluding COVID	2,021,225	103.7%	102.5%	103.3%	104.4%

With this adjustment, the Group Life market was still proportionally worse in 2021 (22.0% versus 20.0%).

Section 3: Acknowledgments

I acknowledge the Society of Actuaries for supporting this work, and to the peer reviewers for providing feedback. I also acknowledge the support of my employer, Guy Carpenter, for the time and encouragement to pursue this analysis.

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Appendix A: Expected 2020-2021 Death Rates by Age and Gender

Table A-1

U.S. POPULATION: 2020-2021 FEMALE DEATH RATES: ANNUAL PER 1000 LIVES

Age	2017-2019	7 Yr Trend	6 Yr Trend	5 Yr Trend	4 Yr Trend	3 Yr Trend
Under 1 year	5.08	4.96	4.93	4.88	4.86	4.89
1-4 years	0.21	0.21	0.21	0.2	0.2	0.21
5-14 years	0.12	0.12	0.12	0.12	0.12	0.12
15-24 years	0.39	0.41	0.4	0.39	0.38	0.37
25-34 years	0.8	0.85	0.85	0.83	0.8	0.78
35-44 years	1.41	1.45	1.44	1.44	1.41	1.41
45-54 years	3.03	2.99	2.96	2.93	2.91	2.91
55-64 years	6.72	6.8	6.76	6.74	6.69	6.66
65-74 years	14.23	14.04	14.04	13.96	13.93	13.81
75-84 years	37.9	36.89	36.85	36.61	36.69	36.29
85 years +	128.52	127.21	127.52	126.41	127.12	125.25

Table A-2

U.S. POPULATION: 2020-2021 MALE DEATH RATES: ANNUAL PER 1000 LIVES

Age	2017-2019	7 Yr Trend	6 Yr Trend	5 Yr Trend	4 Yr Trend	3 Yr Trend
Under 1 year	6.16	6.02	6.03	5.98	5.94	5.93
1-4 years	0.27	0.26	0.26	0.25	0.25	0.25
5-14 years	0.15	0.15	0.15	0.15	0.15	0.15
15-24 years	1.02	1.06	1.04	1.01	0.96	0.95
25-34 years	1.79	1.92	1.9	1.84	1.76	1.72
35-44 years	2.52	2.68	2.68	2.65	2.6	2.59
45-54 years	4.94	4.9	4.9	4.89	4.87	4.85
55-64 years	11.16	11.25	11.21	11.18	11.15	11.12
65-74 years	21.91	21.91	21.91	21.85	21.84	21.74
75-84 years	51.66	50.36	50.37	50.14	50.26	49.77
85 years +	144.38	141.86	142.19	141.58	142.17	140.26

Appendix B: Death Completion Factors by Age and Gender

Table B-1

FEMALE ALL DEATHS: WEEK-TO-WEEK COMPLETION FACTORS BY AGE

Lag	< 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	> 84
0	3.127	3.089	3.219	2.891	2.856	2.676	2.489	2.379	2.295	2.207	2.116
1	1.534	1.427	1.391	1.357	1.342	1.334	1.307	1.301	1.276	1.245	1.224
2	1.273	1.199	1.250	1.193	1.194	1.184	1.183	1.179	1.163	1.150	1.136
3	1.207	1.259	1.256	1.198	1.155	1.151	1.151	1.149	1.139	1.129	1.115
4	1.174	1.177	1.177	1.126	1.096	1.093	1.096	1.090	1.082	1.073	1.063
5	1.087	1.110	1.073	1.048	1.055	1.048	1.047	1.040	1.036	1.031	1.026
6	1.048	1.054	1.041	1.045	1.038	1.028	1.028	1.025	1.021	1.018	1.015
7	1.042	1.028	1.035	1.030	1.027	1.023	1.019	1.016	1.014	1.011	1.009
8	1.028	1.020	1.028	1.018	1.021	1.017	1.014	1.013	1.009	1.008	1.006
9	1.022	1.034	1.013	1.014	1.014	1.014	1.010	1.008	1.007	1.005	1.004
10	1.023	1.024	1.013	1.012	1.010	1.008	1.007	1.006	1.005	1.004	1.003
11	1.017	1.008	1.008	1.008	1.010	1.008	1.006	1.005	1.004	1.003	1.002
12	1.013	1.006	1.013	1.009	1.010	1.007	1.005	1.004	1.003	1.003	1.002
13	1.003	1.008	0.999	0.994	0.993	0.996	0.994	0.993	0.993	0.993	0.993
14	1.006	1.006	1.005	1.005	1.004	1.005	1.003	1.003	1.002	1.002	1.002
15	1.007	1.012	1.011	1.007	1.004	1.003	1.003	1.002	1.002	1.002	1.001
16	1.007	1.002	1.003	1.004	1.006	1.004	1.003	1.002	1.002	1.002	1.001
17	1.016	1.006	1.013	1.014	1.015	1.013	1.012	1.012	1.011	1.011	1.011
18	1.005	1.004	1.005	1.002	1.003	1.002	1.002	1.002	1.002	1.002	1.001
19	1.005	1.004	1.001	1.002	1.002	1.003	1.001	1.002	1.001	1.001	1.001
20	1.004	1.002	1.000	1.002	1.002	1.001	1.001	1.001	1.001	1.001	1.000
21	1.000	1.000	1.003	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001
22	1.001	1.002	1.000	1.003	1.001	1.001	1.001	1.001	1.001	1.001	1.001
23	1.003	1.002	1.001	1.002	1.001	1.002	1.001	1.001	1.001	1.001	1.001
24	1.002	1.006	0.999	1.001	1.002	1.001	1.001	1.001	1.002	1.001	1.001
25	1.003	1.002	1.000	1.001	1.001	1.002	1.001	1.001	1.001	1.001	1.001
26	1.001	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001
27	1.002	1.000	1.000	1.001	1.000	1.001	1.001	1.001	1.001	1.001	1.001
28	1.004	1.000	1.003	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.001
29	1.002	1.000	0.999	1.001	1.000	1.001	1.000	1.000	1.000	1.000	1.000
30	1.000	1.000	1.003	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000
31	1.000	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000
32	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
33	1.001	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
34	1.001	1.002	1.000	1.001	1.001	1.000	1.000	1.000	1.000	1.000	1.000
35	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
36	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-2
MALE ALL DEATHS: WEEK-TO-WEEK COMPLETION FACTORS BY AGE

Lag	< 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	> 84
0	3.081	3.048	2.965	2.968	2.906	2.673	2.533	2.433	2.327	2.223	2.120
1	1.475	1.448	1.405	1.390	1.356	1.330	1.331	1.308	1.286	1.246	1.231
2	1.252	1.207	1.277	1.192	1.173	1.173	1.179	1.177	1.167	1.154	1.140
3	1.218	1.250	1.244	1.183	1.151	1.147	1.145	1.145	1.145	1.134	1.120
4	1.160	1.248	1.165	1.112	1.100	1.097	1.092	1.090	1.082	1.074	1.066
5	1.090	1.062	1.067	1.056	1.054	1.050	1.045	1.044	1.038	1.032	1.028
6	1.046	1.041	1.040	1.041	1.034	1.032	1.029	1.027	1.022	1.018	1.016
7	1.040	1.034	1.030	1.027	1.027	1.025	1.020	1.018	1.014	1.012	1.010
8	1.031	1.029	1.030	1.017	1.019	1.019	1.016	1.012	1.011	1.007	1.006
9	1.019	1.015	1.020	1.014	1.013	1.014	1.011	1.009	1.008	1.005	1.005
10	1.020	1.013	1.008	1.012	1.012	1.010	1.008	1.007	1.006	1.004	1.003
11	1.014	1.008	1.004	1.012	1.010	1.008	1.007	1.006	1.004	1.003	1.002
12	1.012	1.015	1.007	1.006	1.008	1.007	1.005	1.005	1.004	1.003	1.002
13	1.005	0.993	0.996	0.991	0.995	0.997	0.996	0.996	0.994	0.993	0.993
14	1.010	1.010	1.005	1.005	1.005	1.004	1.003	1.003	1.002	1.002	1.001
15	1.012	1.007	1.005	1.005	1.003	1.005	1.003	1.003	1.002	1.002	1.001
16	1.007	1.011	1.003	1.003	1.002	1.003	1.003	1.003	1.002	1.002	1.001
17	1.015	1.025	1.012	1.018	1.014	1.012	1.011	1.010	1.011	1.011	1.011
18	1.007	1.010	1.002	1.001	1.002	1.002	1.002	1.002	1.002	1.001	1.001
19	1.005	1.006	1.002	1.002	1.001	1.001	1.001	1.002	1.002	1.001	1.001
20	1.003	1.003	1.001	1.001	1.002	1.001	1.001	1.001	1.001	1.001	1.001
21	1.004	1.000	1.001	1.002	1.001	1.001	1.001	1.001	1.001	1.001	1.001
22	1.002	1.005	1.003	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001
23	1.002	1.000	1.002	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001
24	1.003	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001
25	1.001	1.002	1.000	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.001
26	1.002	1.003	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001
27	1.003	1.000	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001
28	1.003	1.000	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.001
29	1.002	1.003	1.001	1.001	1.000	1.000	1.001	1.000	1.000	1.000	1.000
30	1.004	1.000	1.001	1.000	1.001	1.001	1.000	1.000	1.000	1.000	1.000
31	1.002	1.000	1.001	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000
32	1.001	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
33	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
34	1.000	1.004	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
35	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
36	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-3
FEMALE ALL DEATHS: TOTAL COMPLETION FACTORS BY AGE

Lag	< 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	> 84
0	12.219	10.926	10.813	7.892	7.235	6.441	5.717	5.269	4.748	4.248	3.809
1	3.907	3.537	3.359	2.730	2.533	2.407	2.297	2.214	2.069	1.925	1.800
2	2.547	2.479	2.414	2.012	1.888	1.805	1.757	1.702	1.622	1.547	1.471
3	2.001	2.068	1.931	1.686	1.581	1.525	1.485	1.443	1.394	1.345	1.294
4	1.658	1.642	1.537	1.407	1.369	1.324	1.290	1.256	1.224	1.191	1.160
5	1.412	1.395	1.306	1.249	1.249	1.212	1.177	1.153	1.131	1.110	1.091
6	1.299	1.257	1.218	1.192	1.184	1.156	1.124	1.108	1.092	1.076	1.063
7	1.239	1.192	1.169	1.141	1.141	1.125	1.094	1.082	1.069	1.057	1.047
8	1.190	1.159	1.130	1.107	1.110	1.099	1.074	1.065	1.055	1.045	1.038
9	1.158	1.136	1.099	1.088	1.088	1.080	1.059	1.051	1.045	1.037	1.032
10	1.133	1.099	1.084	1.072	1.073	1.066	1.049	1.043	1.037	1.032	1.027
11	1.108	1.074	1.070	1.060	1.062	1.057	1.042	1.036	1.033	1.027	1.024
12	1.090	1.065	1.061	1.052	1.052	1.048	1.035	1.032	1.028	1.024	1.021
13	1.076	1.058	1.047	1.043	1.041	1.040	1.030	1.028	1.025	1.022	1.019
14	1.073	1.050	1.049	1.049	1.048	1.045	1.036	1.034	1.032	1.029	1.026
15	1.067	1.043	1.043	1.044	1.044	1.039	1.033	1.032	1.029	1.027	1.025
16	1.059	1.031	1.032	1.037	1.039	1.036	1.029	1.029	1.027	1.025	1.023
17	1.052	1.029	1.030	1.033	1.033	1.032	1.026	1.027	1.025	1.023	1.022
18	1.035	1.023	1.016	1.018	1.018	1.019	1.014	1.014	1.014	1.012	1.011
19	1.030	1.019	1.011	1.016	1.015	1.017	1.012	1.012	1.012	1.011	1.009
20	1.025	1.015	1.009	1.014	1.013	1.015	1.011	1.011	1.011	1.010	1.008
21	1.021	1.013	1.009	1.013	1.012	1.013	1.009	1.010	1.010	1.009	1.008
22	1.021	1.013	1.007	1.011	1.010	1.012	1.009	1.009	1.009	1.008	1.007
23	1.020	1.011	1.007	1.008	1.010	1.010	1.008	1.008	1.008	1.007	1.006
24	1.017	1.010	1.005	1.006	1.009	1.009	1.007	1.006	1.007	1.006	1.005
25	1.014	1.004	1.007	1.005	1.007	1.008	1.005	1.005	1.006	1.005	1.004
26	1.011	1.002	1.007	1.004	1.005	1.005	1.005	1.004	1.004	1.004	1.003
27	1.010	1.002	1.005	1.003	1.004	1.005	1.003	1.003	1.003	1.003	1.002
28	1.008	1.002	1.005	1.002	1.004	1.003	1.002	1.002	1.002	1.002	1.001
29	1.004	1.002	1.003	1.002	1.002	1.002	1.002	1.001	1.001	1.001	1.001
30	1.003	1.002	1.004	1.001	1.002	1.002	1.001	1.001	1.001	1.001	1.000
31	1.003	1.002	1.001	1.001	1.002	1.001	1.001	1.000	1.001	1.000	1.000
32	1.003	1.002	1.001	1.001	1.001	1.001	1.001	1.000	1.000	1.000	1.000
33	1.003	1.002	1.001	1.000	1.001	1.001	1.000	1.000	1.000	1.000	1.000
34	1.002	1.002	1.000	1.001	1.001	1.000	1.000	1.000	1.000	1.000	1.000
35	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
36	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-4
MALE ALL DEATHS: TOTAL COMPLETION FACTORS BY AGE

Lag	< 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	> 84
0	11.509	11.193	9.773	8.026	7.204	6.379	5.892	5.459	4.930	4.327	3.876
1	3.736	3.673	3.297	2.704	2.479	2.387	2.326	2.244	2.118	1.946	1.828
2	2.532	2.536	2.346	1.945	1.827	1.795	1.748	1.716	1.647	1.562	1.485
3	2.023	2.101	1.837	1.632	1.557	1.531	1.482	1.458	1.411	1.353	1.303
4	1.661	1.681	1.477	1.380	1.353	1.335	1.295	1.273	1.233	1.194	1.164
5	1.432	1.346	1.267	1.241	1.230	1.217	1.185	1.168	1.140	1.111	1.092
6	1.314	1.268	1.187	1.175	1.167	1.159	1.134	1.119	1.098	1.076	1.062
7	1.256	1.218	1.142	1.129	1.128	1.123	1.102	1.089	1.074	1.057	1.046
8	1.208	1.178	1.108	1.099	1.099	1.096	1.081	1.070	1.060	1.045	1.035
9	1.172	1.144	1.076	1.080	1.078	1.075	1.064	1.057	1.049	1.038	1.030
10	1.150	1.127	1.055	1.065	1.065	1.060	1.052	1.047	1.041	1.032	1.025
11	1.128	1.112	1.047	1.052	1.052	1.050	1.044	1.040	1.035	1.028	1.022
12	1.113	1.103	1.043	1.040	1.042	1.042	1.037	1.034	1.030	1.024	1.019
13	1.100	1.087	1.036	1.034	1.034	1.035	1.031	1.029	1.027	1.021	1.017
14	1.094	1.094	1.040	1.044	1.040	1.039	1.036	1.034	1.032	1.028	1.024
15	1.084	1.083	1.035	1.039	1.034	1.034	1.033	1.031	1.030	1.026	1.023
16	1.071	1.075	1.030	1.034	1.031	1.029	1.030	1.028	1.027	1.024	1.021
17	1.063	1.063	1.027	1.031	1.029	1.026	1.027	1.025	1.025	1.023	1.020
18	1.047	1.038	1.014	1.013	1.015	1.014	1.016	1.015	1.014	1.012	1.009
19	1.040	1.028	1.012	1.012	1.013	1.013	1.014	1.013	1.012	1.010	1.008
20	1.035	1.021	1.010	1.010	1.011	1.011	1.013	1.011	1.011	1.009	1.007
21	1.032	1.018	1.009	1.009	1.010	1.010	1.011	1.010	1.010	1.008	1.007
22	1.028	1.018	1.008	1.007	1.008	1.009	1.010	1.009	1.009	1.008	1.006
23	1.026	1.013	1.006	1.006	1.008	1.008	1.009	1.008	1.008	1.007	1.006
24	1.024	1.013	1.004	1.005	1.007	1.007	1.008	1.007	1.007	1.006	1.005
25	1.021	1.013	1.003	1.004	1.006	1.006	1.006	1.005	1.005	1.005	1.004
26	1.020	1.012	1.003	1.004	1.005	1.005	1.005	1.004	1.004	1.004	1.003
27	1.017	1.009	1.003	1.003	1.004	1.004	1.004	1.003	1.003	1.003	1.002
28	1.014	1.009	1.003	1.002	1.003	1.003	1.003	1.002	1.002	1.002	1.001
29	1.011	1.009	1.003	1.002	1.002	1.002	1.002	1.002	1.001	1.001	1.001
30	1.009	1.006	1.002	1.001	1.002	1.002	1.002	1.001	1.001	1.001	1.001
31	1.006	1.006	1.001	1.001	1.001	1.001	1.001	1.001	1.001	1.000	1.000
32	1.004	1.006	1.000	1.000	1.001	1.001	1.001	1.001	1.001	1.000	1.000
33	1.002	1.006	0.999	1.000	1.001	1.001	1.001	1.000	1.000	1.000	1.000
34	1.001	1.004	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
35	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
36	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-5
FEMALE COVID-19: WEEK-TO-WEEK COMPLETION FACTORS BY AGE

Lag	< 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	> 84
0	4.000	2.500	1.000	3.333	2.902	2.683	2.576	2.491	2.382	2.263	2.160
1	1.333	1.400	1.889	1.459	1.351	1.488	1.391	1.378	1.361	1.311	1.287
2	2.000	1.111	1.238	1.274	1.304	1.219	1.247	1.195	1.188	1.182	1.171
3	1.300	1.500	1.154	1.200	1.176	1.151	1.141	1.128	1.113	1.115	1.101
4	0.933	1.071	1.172	1.106	1.101	1.065	1.079	1.074	1.067	1.064	1.056
5	1.067	1.071	1.086	1.046	1.063	1.052	1.046	1.037	1.036	1.033	1.028
6	1.118	1.214	1.049	1.041	1.044	1.037	1.030	1.024	1.022	1.020	1.018
7	1.190	1.118	1.116	1.016	1.031	1.022	1.017	1.014	1.015	1.012	1.010
8	1.000	1.000	1.021	1.009	1.024	1.014	1.013	1.012	1.008	1.007	1.006
9	1.107	1.053	1.000	1.013	1.016	1.018	1.007	1.007	1.007	1.005	1.004
10	1.033	1.048	1.082	1.017	1.015	1.011	1.006	1.005	1.004	1.003	1.004
11	1.156	1.045	1.039	1.017	1.009	1.009	1.008	1.004	1.004	1.003	1.002
12	1.083	1.053	1.019	1.031	1.017	1.013	1.007	1.003	1.002	1.002	1.002
13	1.086	1.053	1.019	0.996	0.999	0.996	0.994	0.990	0.993	0.993	0.994
14	1.000	1.000	1.018	1.004	1.007	1.005	1.003	1.002	1.002	1.001	1.001
15	1.000	1.111	1.019	1.011	1.009	1.003	1.003	1.002	1.001	1.001	1.002
16	1.000	1.053	1.000	1.004	1.008	1.003	1.003	1.002	1.001	1.001	1.001
17	1.065	1.000	1.000	1.018	1.014	1.013	1.011	1.014	1.011	1.011	1.012
18	1.000	1.000	1.000	1.003	1.006	1.003	1.002	1.002	1.001	1.001	1.001
19	1.031	1.000	1.000	1.000	1.003	1.003	1.003	1.001	1.001	1.001	1.001
20	1.000	1.000	1.000	1.003	1.002	1.002	1.001	1.001	1.000	1.001	1.001
21	1.000	1.000	1.000	1.000	1.001	1.002	1.001	1.002	1.002	1.001	1.001
22	1.000	1.000	1.000	1.003	1.001	1.002	1.001	1.001	1.000	1.000	1.001
23	1.029	1.000	1.000	1.003	1.001	1.001	1.001	1.001	1.001	1.000	1.000
24	1.000	1.063	1.000	1.000	1.003	1.002	1.001	1.001	1.001	1.001	1.000
25	1.027	1.000	1.000	1.000	1.000	1.001	1.001	1.000	1.001	1.001	1.001
26	1.000	1.000	1.029	1.000	1.000	1.001	1.000	1.001	1.001	1.000	1.001
27	1.000	1.000	1.000	1.000	1.002	1.002	1.001	1.001	1.001	1.000	1.001
28	1.000	1.000	1.000	1.003	1.001	1.001	1.001	1.000	1.001	1.000	1.001
29	1.028	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000
30	1.000	1.000	1.000	1.000	1.001	1.001	1.000	1.000	1.000	1.000	1.000
31	1.000	1.000	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	1.000
32	1.000	1.000	1.000	1.003	1.000	1.000	1.000	1.000	1.000	1.000	1.000
33	1.000	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000
34	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
35	1.003	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
36	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-6
MALE COVID-19: WEEK-TO-WEEK COMPLETION FACTORS BY AGE

Lag	< 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	> 84
0	2.000	1.500	2.500	2.313	2.804	2.374	2.467	2.512	2.346	2.341	2.151
1	2.000	1.667	1.750	1.545	1.479	1.393	1.402	1.362	1.358	1.315	1.296
2	1.182	1.600	1.750	1.407	1.275	1.210	1.213	1.213	1.200	1.182	1.174
3	1.000	1.222	1.188	1.149	1.163	1.152	1.119	1.124	1.127	1.113	1.099
4	1.050	1.286	1.200	1.070	1.084	1.089	1.075	1.070	1.068	1.063	1.059
5	1.190	1.059	1.000	1.038	1.051	1.056	1.042	1.040	1.035	1.033	1.029
6	1.040	1.167	1.111	1.030	1.032	1.030	1.028	1.025	1.020	1.019	1.016
7	1.179	1.048	1.152	1.030	1.034	1.024	1.017	1.017	1.012	1.012	1.011
8	1.118	1.000	1.139	1.046	1.029	1.017	1.016	1.011	1.010	1.008	1.006
9	1.029	1.048	1.049	1.043	1.020	1.016	1.009	1.008	1.006	1.005	1.005
10	1.061	1.000	1.000	1.015	1.018	1.009	1.006	1.007	1.005	1.004	1.003
11	1.086	1.000	1.000	1.017	1.016	1.008	1.009	1.006	1.004	1.003	1.002
12	1.075	1.053	1.075	1.006	1.018	1.008	1.008	1.004	1.003	1.002	1.002
13	1.026	0.895	1.000	1.000	1.004	0.999	0.997	0.995	0.994	0.994	0.994
14	1.154	1.000	1.050	1.010	1.007	1.006	1.002	1.003	1.002	1.001	1.001
15	1.022	1.000	1.025	1.008	1.007	1.003	1.002	1.003	1.002	1.001	1.001
16	1.071	1.000	1.027	1.003	1.005	1.002	1.002	1.002	1.001	1.001	1.001
17	1.000	1.143	1.000	1.020	1.014	1.011	1.009	1.011	1.011	1.012	1.011
18	1.000	1.000	1.026	1.000	1.002	1.002	1.002	1.002	1.001	1.001	1.001
19	1.000	1.000	1.025	1.000	1.002	1.003	1.001	1.001	1.002	1.001	1.001
20	1.027	1.000	1.000	1.002	1.003	1.001	1.001	1.001	1.001	1.001	1.000
21	1.079	1.000	1.000	1.000	1.002	1.002	1.001	1.001	1.001	1.001	1.001
22	1.000	1.000	1.000	1.002	1.004	1.001	1.001	1.001	1.001	1.001	1.001
23	1.000	1.000	1.000	1.004	1.002	1.001	1.001	1.001	1.001	1.000	1.000
24	1.000	1.000	1.000	1.000	1.001	1.002	1.001	1.001	1.001	1.001	1.001
25	1.000	1.000	1.021	1.002	1.002	1.001	1.001	1.000	1.001	1.000	1.001
26	1.000	1.133	1.000	1.002	1.001	1.002	1.001	1.001	1.000	1.000	1.000
27	1.000	1.000	1.000	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.001
28	1.000	1.000	1.000	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.001
29	1.000	1.000	1.022	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000
30	1.000	1.000	1.000	1.002	1.001	1.000	1.000	1.001	1.000	1.000	1.000
31	1.029	1.000	1.023	1.000	1.000	1.001	1.001	1.000	1.000	1.000	1.000
32	1.000	1.000	1.000	1.000	1.001	1.001	1.000	1.000	1.000	1.000	1.000
33	1.000	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000
34	1.000	1.000	1.000	1.000	1.001	1.001	1.000	1.000	1.000	1.000	1.000
35	1.001	1.002	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
36	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-7
FEMALE COVID-19: TOTAL COMPLETION FACTORS BY AGE

Lag	< 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	> 84
0	34.151	14.427	5.112	10.445	8.688	7.401	6.459	5.642	5.141	4.612	4.149
1	8.538	5.771	5.112	3.133	2.993	2.758	2.508	2.265	2.158	2.038	1.921
2	6.403	4.122	2.706	2.147	2.216	1.853	1.803	1.644	1.585	1.555	1.492
3	3.202	3.710	2.186	1.685	1.699	1.520	1.445	1.375	1.334	1.315	1.274
4	2.463	2.473	1.894	1.404	1.445	1.320	1.266	1.220	1.199	1.179	1.157
5	2.639	2.308	1.616	1.270	1.313	1.240	1.174	1.135	1.124	1.109	1.095
6	2.474	2.154	1.488	1.214	1.236	1.178	1.122	1.095	1.084	1.073	1.066
7	2.213	1.774	1.419	1.166	1.183	1.136	1.089	1.069	1.061	1.051	1.047
8	1.859	1.587	1.271	1.148	1.147	1.111	1.070	1.054	1.045	1.039	1.037
9	1.859	1.587	1.245	1.137	1.121	1.096	1.057	1.042	1.037	1.032	1.030
10	1.679	1.508	1.245	1.122	1.103	1.077	1.049	1.034	1.030	1.026	1.026
11	1.625	1.440	1.151	1.103	1.087	1.064	1.043	1.029	1.026	1.023	1.022
12	1.406	1.377	1.107	1.085	1.077	1.055	1.035	1.025	1.022	1.019	1.020
13	1.297	1.308	1.087	1.052	1.060	1.042	1.028	1.022	1.019	1.017	1.018
14	1.195	1.243	1.067	1.056	1.061	1.046	1.034	1.032	1.026	1.024	1.025
15	1.195	1.243	1.049	1.052	1.053	1.040	1.031	1.030	1.025	1.022	1.024
16	1.195	1.118	1.030	1.041	1.044	1.037	1.027	1.028	1.023	1.021	1.022
17	1.195	1.063	1.030	1.037	1.036	1.034	1.024	1.026	1.022	1.020	1.021
18	1.123	1.063	1.030	1.019	1.022	1.021	1.013	1.012	1.011	1.008	1.009
19	1.123	1.063	1.030	1.015	1.016	1.018	1.011	1.010	1.010	1.007	1.008
20	1.089	1.063	1.030	1.015	1.013	1.015	1.008	1.008	1.009	1.006	1.007
21	1.089	1.063	1.030	1.012	1.012	1.014	1.007	1.007	1.008	1.005	1.006
22	1.089	1.063	1.030	1.012	1.011	1.012	1.006	1.006	1.007	1.004	1.005
23	1.089	1.063	1.030	1.009	1.009	1.010	1.005	1.005	1.006	1.004	1.004
24	1.058	1.063	1.030	1.006	1.009	1.009	1.004	1.004	1.006	1.004	1.004
25	1.058	1.000	1.030	1.006	1.006	1.007	1.004	1.003	1.005	1.003	1.004
26	1.030	1.000	1.030	1.006	1.006	1.006	1.003	1.002	1.005	1.002	1.003
27	1.030	1.000	1.001	1.006	1.006	1.005	1.003	1.002	1.004	1.002	1.003
28	1.030	1.000	1.001	1.006	1.004	1.003	1.002	1.001	1.003	1.002	1.002
29	1.030	1.000	1.001	1.003	1.003	1.003	1.001	1.001	1.002	1.001	1.001
30	1.003	1.000	1.001	1.003	1.002	1.002	1.001	1.001	1.002	1.001	1.001
31	1.003	1.000	1.001	1.003	1.001	1.001	1.001	1.001	1.002	1.001	1.001
32	1.003	1.000	1.001	1.003	1.001	1.000	1.001	1.000	1.001	1.001	1.001
33	1.003	1.000	1.001	1.000	1.001	1.000	1.001	1.000	1.001	1.000	1.000
34	1.003	1.000	1.001	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000
35	1.003	1.000	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
36	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-8
MALE COVID-19: TOTAL COMPLETION FACTORS BY AGE

Lag	< 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	> 84
0	15.270	10.420	22.228	8.138	8.771	6.175	5.910	5.759	5.169	4.765	4.170
1	7.635	6.947	8.891	3.519	3.129	2.602	2.396	2.292	2.204	2.036	1.938
2	3.817	4.168	5.081	2.277	2.115	1.868	1.709	1.683	1.622	1.549	1.496
3	3.230	2.605	2.903	1.618	1.659	1.543	1.409	1.387	1.352	1.310	1.274
4	3.230	2.131	2.445	1.408	1.427	1.340	1.260	1.234	1.199	1.177	1.159
5	3.076	1.658	2.037	1.317	1.317	1.231	1.172	1.154	1.123	1.107	1.095
6	2.584	1.566	2.037	1.269	1.253	1.165	1.125	1.110	1.085	1.072	1.064
7	2.485	1.342	1.834	1.232	1.215	1.131	1.095	1.083	1.063	1.053	1.048
8	2.108	1.281	1.592	1.196	1.175	1.105	1.076	1.065	1.051	1.040	1.036
9	1.886	1.281	1.398	1.143	1.142	1.086	1.059	1.053	1.040	1.032	1.029
10	1.832	1.223	1.333	1.096	1.119	1.069	1.049	1.045	1.034	1.027	1.024
11	1.728	1.223	1.333	1.080	1.100	1.059	1.043	1.038	1.029	1.023	1.021
12	1.591	1.223	1.333	1.062	1.083	1.051	1.034	1.032	1.024	1.020	1.019
13	1.480	1.162	1.240	1.056	1.064	1.043	1.026	1.027	1.021	1.018	1.017
14	1.442	1.298	1.240	1.056	1.059	1.044	1.029	1.032	1.027	1.024	1.022
15	1.250	1.298	1.181	1.045	1.052	1.038	1.026	1.028	1.025	1.023	1.021
16	1.223	1.298	1.152	1.037	1.044	1.035	1.024	1.026	1.023	1.021	1.020
17	1.142	1.298	1.122	1.034	1.039	1.033	1.022	1.023	1.022	1.021	1.019
18	1.142	1.136	1.122	1.014	1.025	1.021	1.013	1.012	1.011	1.009	1.009
19	1.142	1.136	1.094	1.014	1.023	1.019	1.011	1.010	1.009	1.007	1.007
20	1.142	1.136	1.067	1.014	1.021	1.016	1.010	1.009	1.008	1.006	1.007
21	1.112	1.136	1.067	1.012	1.018	1.015	1.009	1.008	1.007	1.005	1.006
22	1.030	1.136	1.067	1.012	1.015	1.013	1.008	1.007	1.006	1.004	1.005
23	1.030	1.136	1.067	1.010	1.011	1.012	1.007	1.006	1.005	1.004	1.004
24	1.030	1.136	1.067	1.006	1.009	1.010	1.007	1.005	1.004	1.004	1.004
25	1.030	1.136	1.067	1.006	1.009	1.009	1.005	1.004	1.004	1.003	1.004
26	1.030	1.136	1.045	1.004	1.007	1.007	1.005	1.004	1.003	1.003	1.003
27	1.030	1.002	1.045	1.002	1.006	1.005	1.004	1.003	1.003	1.002	1.003
28	1.030	1.002	1.045	1.002	1.005	1.004	1.003	1.002	1.002	1.002	1.002
29	1.030	1.002	1.045	1.002	1.003	1.003	1.002	1.002	1.001	1.001	1.001
30	1.030	1.002	1.023	1.002	1.003	1.003	1.002	1.001	1.001	1.001	1.001
31	1.030	1.002	1.023	1.000	1.002	1.002	1.001	1.001	1.001	1.000	1.001
32	1.001	1.002	1.000	1.000	1.002	1.001	1.001	1.001	1.001	1.000	1.001
33	1.001	1.002	1.000	1.000	1.001	1.001	1.001	1.001	1.001	1.001	1.000
34	1.001	1.002	1.000	1.000	1.001	1.001	1.000	1.000	1.000	1.000	1.000
35	1.001	1.002	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
36	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Appendix C: Additional Analysis on the Mortality Impacts of COVID-19

There has been a large amount of analysis performed by many different groups on the mortality impact of COVID-19. This document does not explicitly provide a summary review of this work, nor its relationship to the analysis described above. Instead, the intent was to provide an objective measurement of the observed deaths relative to a range of reasonable expectations. The following links are a subset of possible references that can be considered to pursue an enhanced understanding of the underlying dynamics.

https://covid.cdc.gov/covid-data-tracker/#trends_dailytrendsdeaths

https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm

<https://jamanetwork.com/journals/jama/fullarticle/2774445>

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