# England & Wales mortality monitor – end of 2023

## Summary

Mortality in the final quarter of 2023 compared to the final quarter of recent years was similar to 2019 and lower than in 2020, 2021 or 2022.

At the end of 2023, the cumulative standardised mortality rate for 2023 was 2.2% below the 2013-2022 average and 3.0% above 2019, the last full year before the pandemic.

**The mortality monitor now makes allowance for revised population estimates following the 2021 census, published in November 2023. Appendix 2 has further information.**

**Results are based on the date of registration of deaths. Using date of occurrence would give different results, particularly since late 2022. Appendix 3 discusses this and estimates the impact to July 2023.**

## Background

This is the latest in a series of quarterly updates monitoring mortality in England & Wales. It is based on provisional weekly deaths data published by the Office for National Statistics (ONS) up to 5 January 2024 (i.e. week 1 of 2024) on 17 January 2024. We intend to publish the next quarterly update, for data to Q1 of 2024, in April 2024.

We are also publishing weekly updates. The monitor for week 1 of 2024 uses the same data as this quarterly monitor and shows more detail of excess mortality during the past quarter. Later weekly monitors will be briefer.

All updates are publicly available from the CMI pages of the Institute and Faculty of Actuaries website: https://www.actuaries.org.uk/learn-and-develop/continuous-mortality-investigation/other-cmi-outputs/mortality-monitor. The same page has "beta" mortality monitor software, which is available to Authorised Users. This enables users to produce their own ad hoc updates to the results of this report.

## Notes

We have used our standard approach in producing this report, basing it on data published by the Office for National Statistics.

Our calculations rely on data for registered deaths, and we are conscious that during the coronavirus pandemic the timing of registration of deaths may have differed from previous years. Consequently, comparisons of mortality between years may not be entirely on a like-for-like basis. Also, results for individual weeks may not be consistent between years due to the timing of public holidays.

We have included analysis of the difference between when deaths were registered and when they occurred in Appendix 3.

We recently revised the population data used for the mortality monitor as well as refining our approach to allocating age-grouped deaths to single years of age. Appendix 2 shows the impact of these changes.

All of our analysis in this update is based on Standardised Mortality Rates (SMRs). These adjust the provisional weekly deaths data published by the Office for National Statistics to control for changes in the size and age and gender distribution of the population over time.

## Contents

Charts A, B and C show centred averages of weekly SMRs. The annual averages smooth out seasonal variations. The quarterly averages smooth short-term variations but still show seasonal patterns, allowing the identification of, for example, winters with particularly heavy or light mortality.

Chart D shows cumulative standardised mortality (cSMR) for each year, relative to the average for 2013-2022, and Chart E shows cumulative standardised mortality improvements (cSMRI) for each year (i.e. the progression of annual mortality improvements over the course of each year). Charts D2 and E2 show the same information

as charts D and E respectively in a different format and may be easier to interpret for those with colour vision deficiency.

Charts A to E show results for males and females combined, for ages 20-100. Charts F and G show variations in the cSMR and cSMRI by gender and age band.

Full details of the methods used are included in Working Paper 111.

The numerical results underlying the charts are provided in an accompanying spreadsheet, together with further results, including SMRs by gender and age band.

## Use of this document

Please note that:

- The CMI disclaims any liability from use of or reliance on these calculations, including in relation to financial transactions such as longevity swaps; and
- The CMI does not guarantee that it will continue to publish quarterly updates.

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This document is categorised as a “Research Report” as defined in the Terms and Conditions.

## TAS compliance

This paper is intended to translate publicly available demographic information published by the Office for National Statistics and similar bodies into indicative mortality measures to illustrate recent mortality experience primarily in England & Wales. The paper is intended for use by actuaries and other parties interested in detailed mortality statistics and is for information only.

The paper complies with the principles in the Financial Reporting Council’s Technical Actuarial Standard “TAS 100: General Actuarial Standards”. Any person using this paper should exercise judgement over its suitability and relevance for their purpose.

## Smoothed mortality at a point in time

Chart A shows quarterly (13-week) and annual (53-week) centred averages of SMR, since weekly deaths data became available. Note that although we have used data from 31 July 1999 to 5 January 2024, the quarterly and annual averages start 6 and 26 weeks later and stop 6 and 26 weeks earlier.

The annual average SMR shows a fairly steady fall from 1.71% in early 2000 to 1.29% by mid-2011. From mid-2011 to mid-2018 the annual average SMR was fairly flat, remaining within the range from 1.25% to 1.35%, but it reached a new low of 1.22% in early 2019. It rose rapidly because of the coronavirus pandemic, reaching 1.48% in September 2020, but has since fallen. The latest value is 1.29%.

The quarterly average SMR shows that mortality typically peaks near the start of each year. However during the pandemic the quarterly average SMR peaked at 1.79% in week 15 of 2020 and 1.77% in weeks 1 and 2 of 2021. In contrast, the low of 1.09% in week 30-33 of 2020 was the lowest ever seen. It reached 1.53% in the first quarter of 2023 and the latest value is 1.29%.

**Chart A: Quarterly and annual centred average SMRs – whole period**

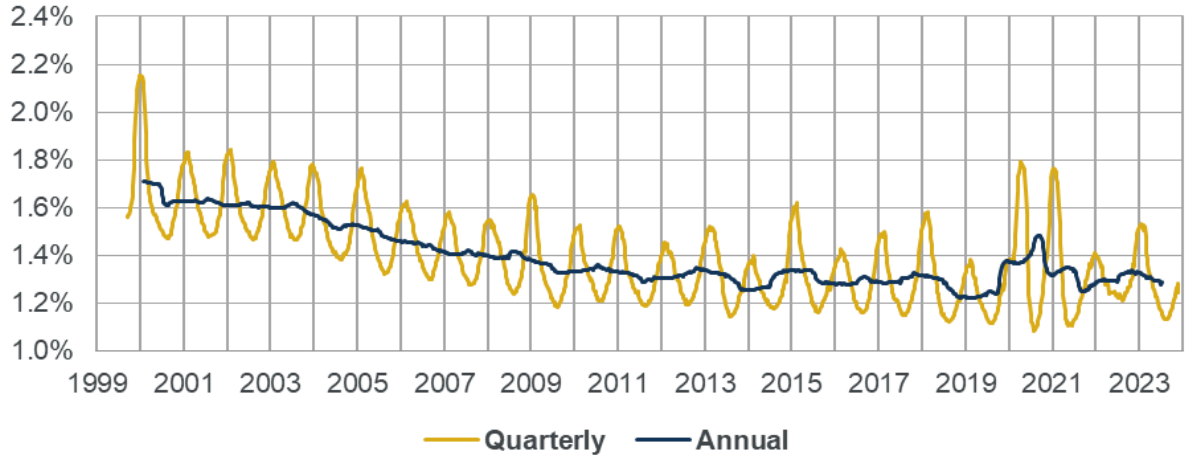



Chart B shows the same information as Chart A, magnified to show the current year and the previous five years more clearly.

**Chart B: Quarterly and annual centred average SMRs – current and previous five years**

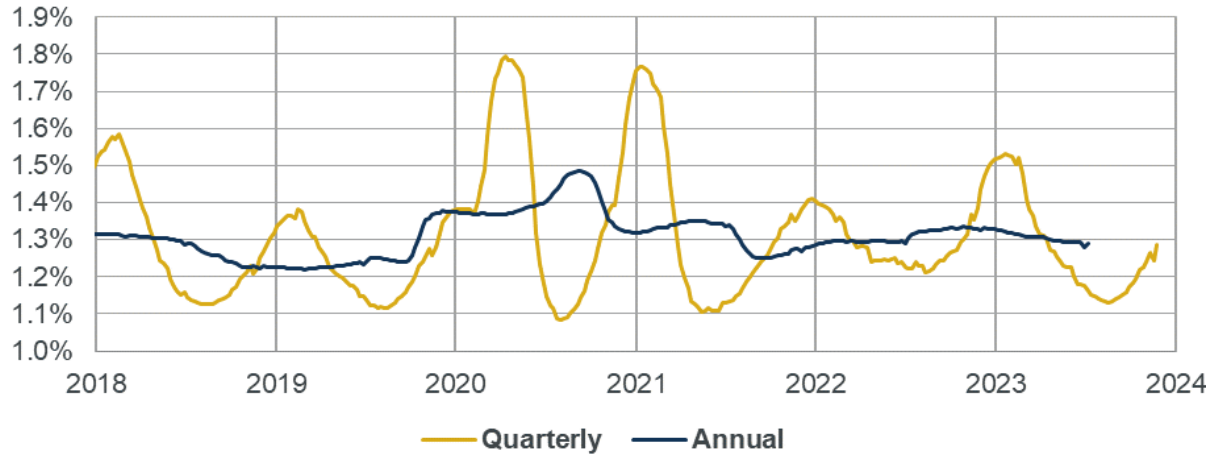
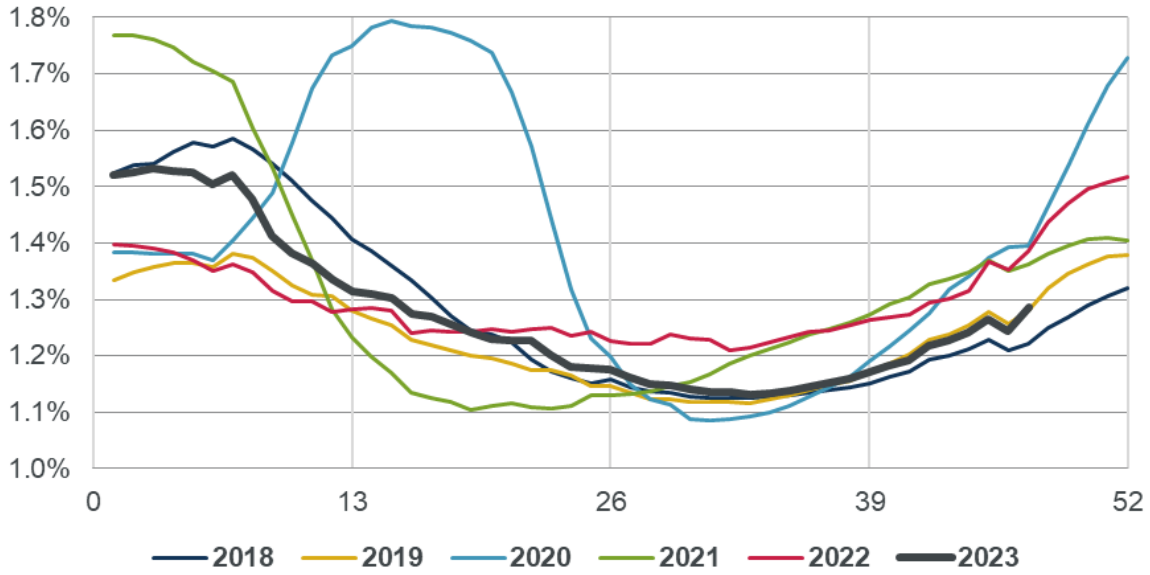



Chart C shows the quarterly average SMRs from Chart B for each year, with values plotted by week number to aid comparison. Although lines are labelled by calendar year, the quarterly averages for weeks towards the start and end of each year will be affected by mortality in earlier and later years respectively. The chart again illustrates the exceptional nature of mortality during the pandemic, with highs in Q2 of 2020 and Q1 of 2021, and lows in Q3 of 2020 and Q2 of 2021. The latest figure is similar to the corresponding point in 2019, lower than in 2020, 2021 or 2022, and higher than in 2018.

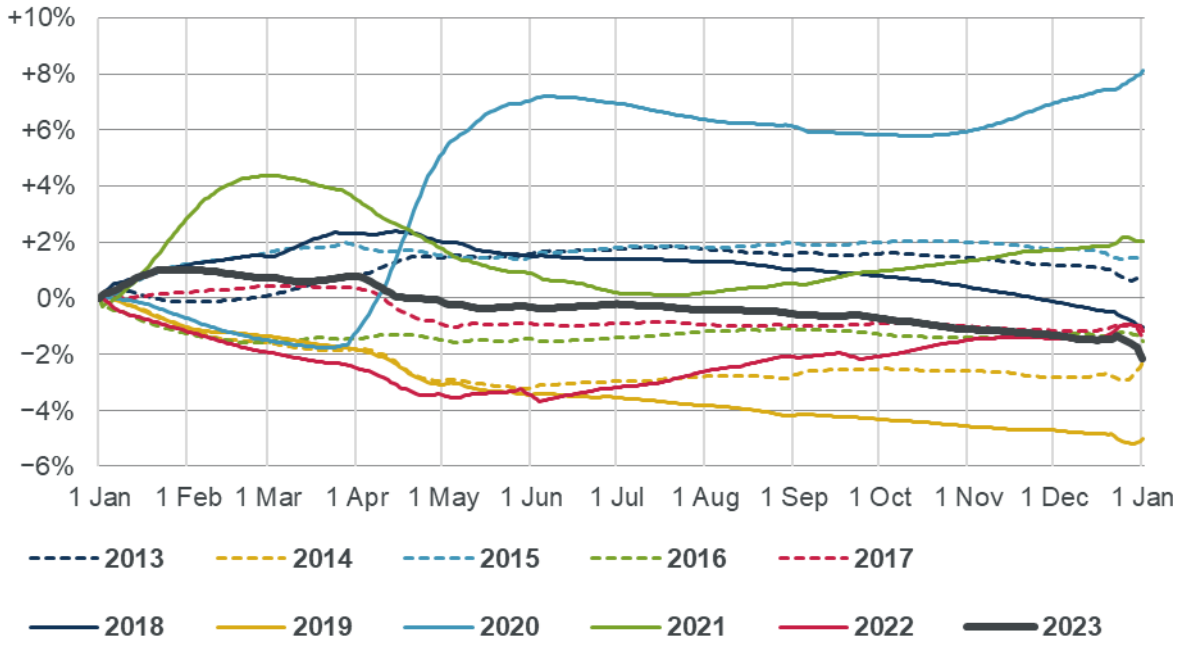
**Chart C: Quarterly centred average SMRs, by week number**




## Cumulative mortality

Chart D shows cumulative standardised mortality rates for 2022 and the previous ten years compared to the 2013-2022 average. The calculation method is described in Section 4.2 of Working Paper 111. Chart D2 (in Appendix 1) shows the same information in a different format and may be easier for those with colour vision deficiency.

**Chart D: Cumulative standardised mortality rate (cSMR) compared to the 2013-2022 average**




All years have a value of 0% at the start of the year, by definition, as there has been no mortality at that point of the year; the year-end values show how mortality for each year as a whole compares to the 2013-2022 average; and intermediate points show how mortality has developed during the year, relative to the average. If mortality improvements had been constant throughout the period considered then the lines for each year would form a "fan", with the end-year values decreasing steadily from year to year. While we saw a decrease of this sort in the years up to 2011 (not shown), there is no clear pattern to the end-year values for later years, as mortality has

been volatile with low improvements. Mortality for complete calendar years was lowest in 2019 and highest in 2020 (of the years shown).

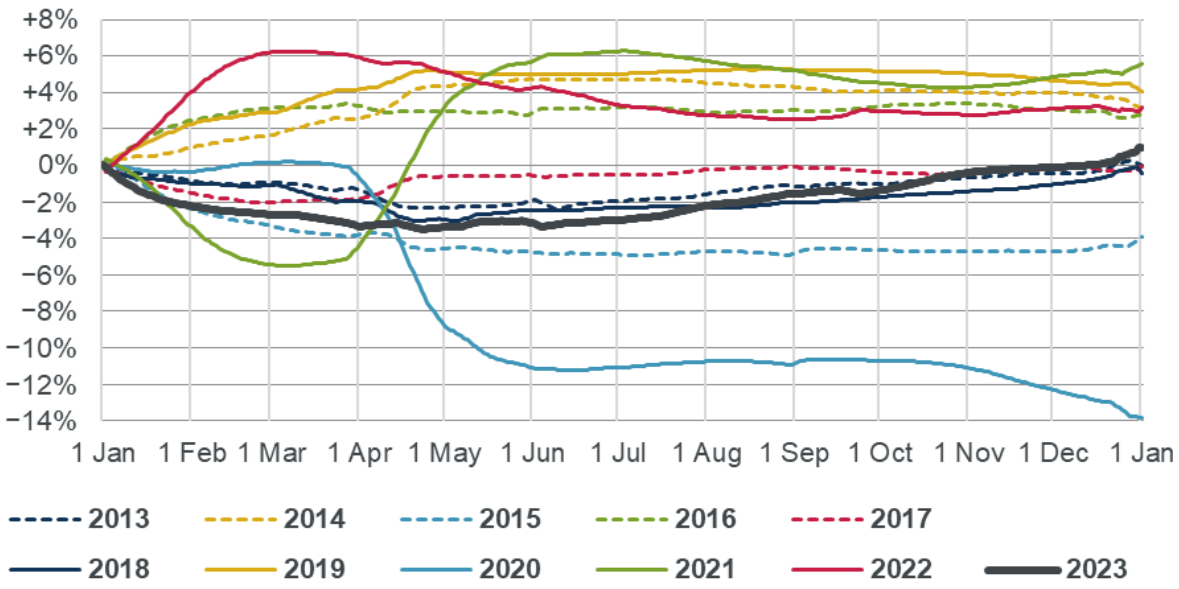
Chart D shows that cumulative standardised mortality to the end of 2023 was 2.2% lower than the ten-year average, and 3.0% above 2019.

Chart E shows the cumulative annual standardised mortality improvement (also described in Section 4.2 of Working Paper 111) for 2023 and for the previous ten years. Chart E2 (in Appendix 1) shows the same information in a different format and may be easier for those with colour vision deficiency.

All years have a value of 0% at the start of the year, by definition, as there has been no mortality at that point of the year; the year-end values show how mortality for each year as a whole compares to the previous year; and intermediate points show how mortality improvements have developed during the year.

Note that Chart E shows cumulative improvements, so a higher value represents a higher improvement and lower mortality; whereas in Chart D a higher value represents higher mortality.

**Chart E: Cumulative annual standardised mortality improvement (cSMRI)**




The cumulative mortality improvement at the end of 2023, relative to 2022, is +1.0%.

Note that:

- The cumulative values at the end of the year in Charts D and E may not necessarily agree precisely with the corresponding values based on annual data. This is because some weeks span two years, requiring us to estimate in which year those deaths were registered.
- Mortality improvements vary by age (as shown later in this report) and the mortality improvements shown in Chart E are sensitive to the age distribution of the chosen standard population.

## Implication for CMI_2023

The CMI aims to consult with Authorised Users of the Model, from late January 2024, on its proposed method and parameter values for CMI_2023.

## Variation by gender and age

Charts F and G shows how cSMR and cSMRI have varied by gender and age band. Tables 1 and 2 show the values at 31 December 2023.

We note that results by age should currently be treated with particular caution as delays in registrations versus occurrences, described in Appendix 3, could have impacted different age ranges to different degrees.

**Table 1: Cumulative standardised mortality rate (cSMR) compared to the 2013-2022 average, by gender and age-band, at 31 December 2023**

| | 0-64 | 65-84 | 85+ | 20-100 | 20-44 | 45-64 | 65-74 | 75-84 |
|---|---|---|---|---|---|---|---|---|
| Male | +4.0% | −3.3% | −2.5% | **−1.9%** | +7.3% | +2.8% | −0.8% | −4.7% |
| Female | +1.0% | −3.0% | −3.0% | **−2.5%** | +5.6% | +0.0% | −1.2% | −4.0% |
| Combined | +2.8% | −3.2% | −2.7% | **−2.2%** | +6.7% | +1.7% | −1.0% | −4.4% |

**Table 2: Cumulative annual standardised mortality improvement (cSMRI), by gender and age–band, at 31 December 2023**

| | 0–64 | 65–84 | 85+ | 20–100 | 20–44 | 45–64 | 65–74 | 75–84 |
|---|---|---|---|---|---|---|---|---|
| Male | −2.1% | +1.0% | +1.8% | **+0.9%** | −4.4% | −1.2% | +0.5% | +1.3% |
| Female | 0.2% | +1.3% | +1.3% | **+1.2%** | −1.0% | +0.6% | +0.8% | +1.6% |
| Combined | −1.2% | +1.1% | +1.6% | **+1.0%** | −3.2% | −0.5% | +0.6% | +1.4% |

For the period from 2011 to 2019:

- The spread of mortality rates is widest for ages 65-84 and narrowest for ages 85+, for both genders.
- Mortality improvements have been most volatile for the 85+ age band, particularly for females.

Mortality rose during 2020 and 2021 due to the coronavirus pandemic:

- For ages 65 and above, mortality was higher in 2020 than in 2021.
- For ages 0-64, mortality was higher in 2021 than in 2020.

In 2022:

- Cumulative mortality rates for the older age groups were below the 2013-2022 average, but those for 20-44 were well above the 2013-2022 average.
- Cumulative mortality improvements were positive for almost all groups (the exception being the 85+ age group for both males and females) and were particularly high for the 45-64 age group.

In 2023:

- Cumulative mortality rates for the combined 20-100 age group are lower than the 2013-2022 average, but there is considerable variation by age. Mortality for males and females aged 20-44 is higher than in any of the previous ten years other than 2021, but mortality for the 75-84 age group is lower than any of the previous years except 2019.
- Cumulative mortality improvements for most age groups are modest, but towards the bottom of the range of the previous ten years

**Chart F: Cumulative standardised mortality rate (cSMR) compared to the 2013-2022 average, by gender and age-band**

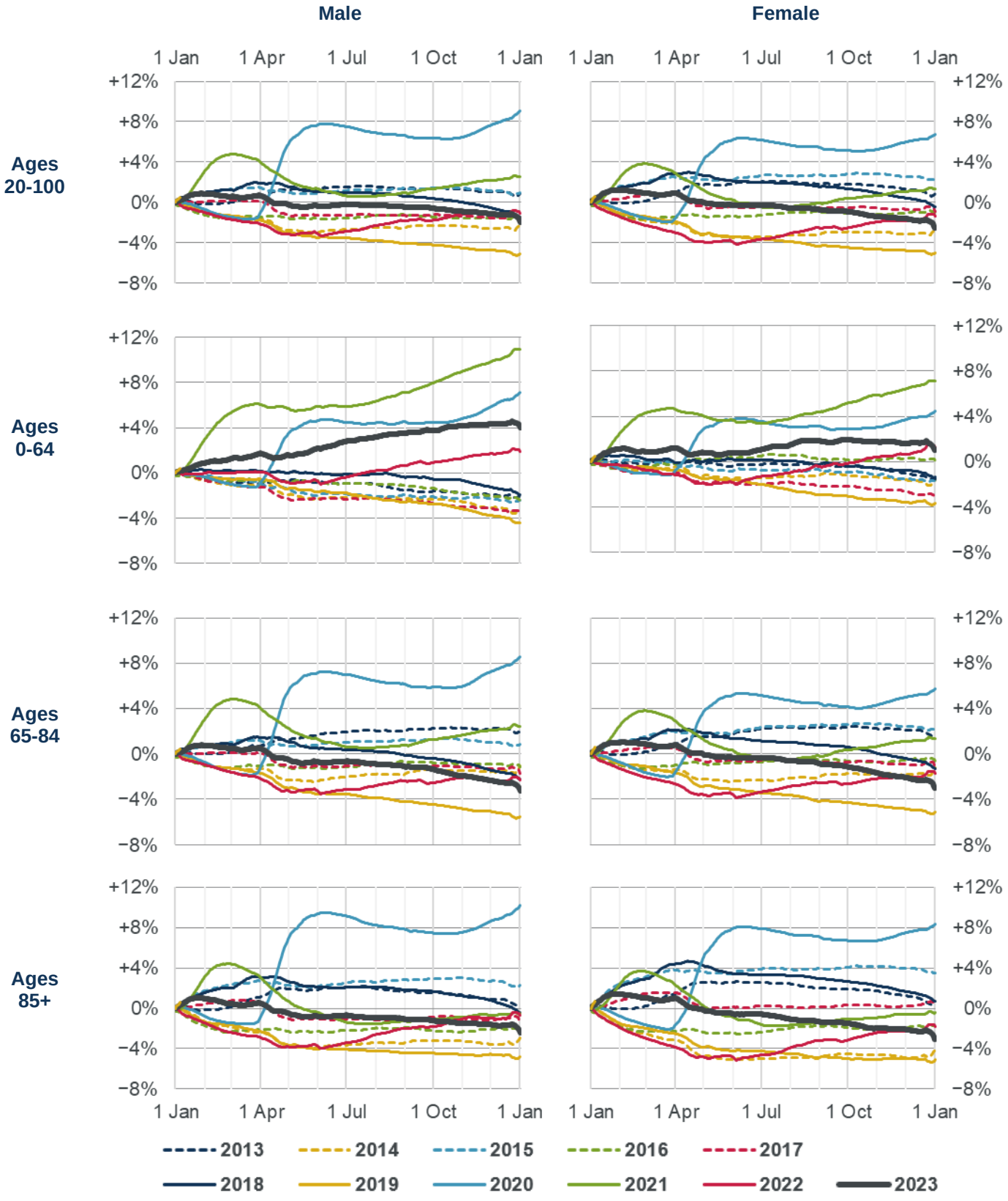


**Chart F (cont): Cumulative standardised mortality rate (cSMR) compared to the 2013-2022 average, by gender and age-band**

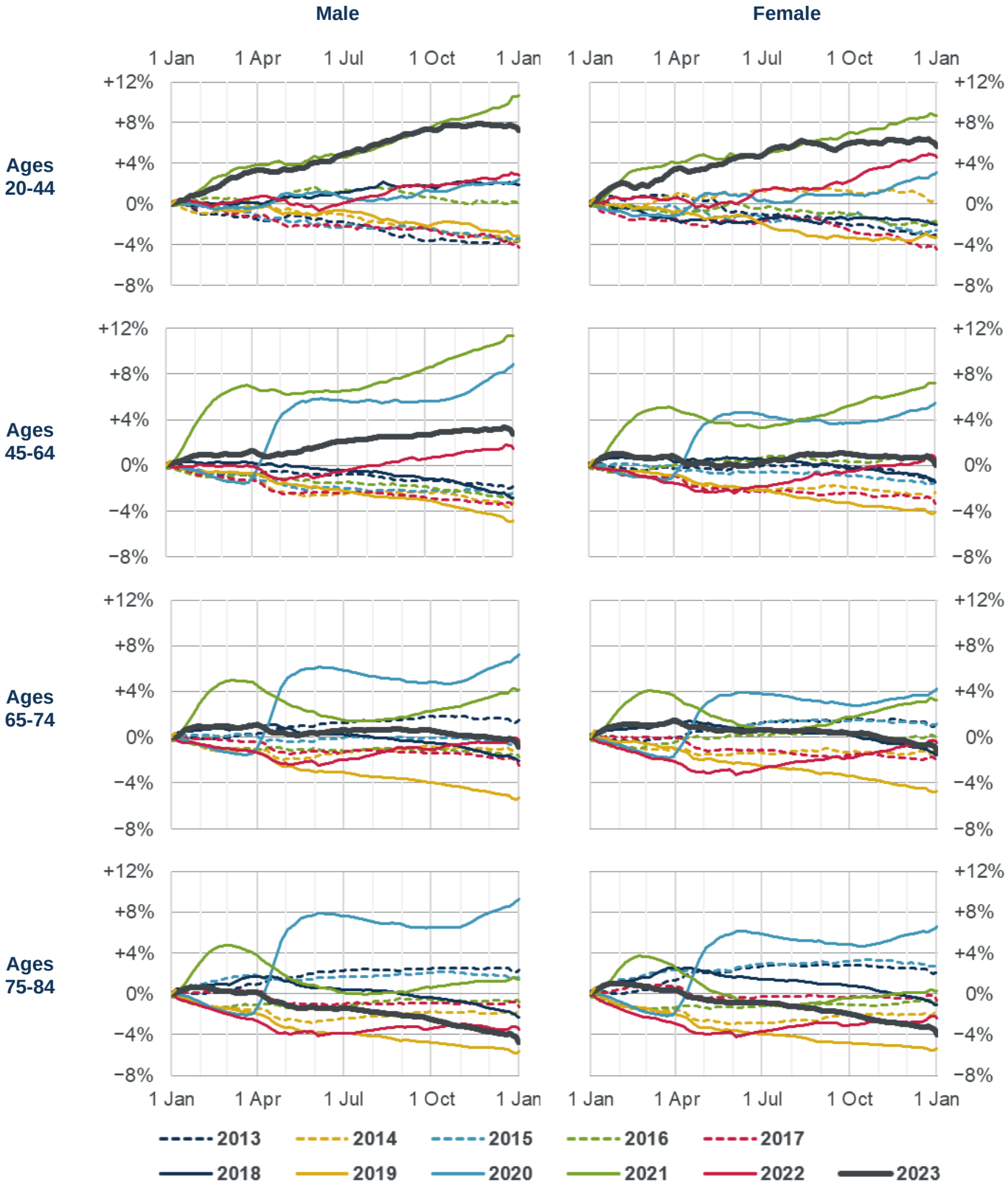


**Chart G: Cumulative annual standardised mortality improvement (cSMRI), by gender and age band**

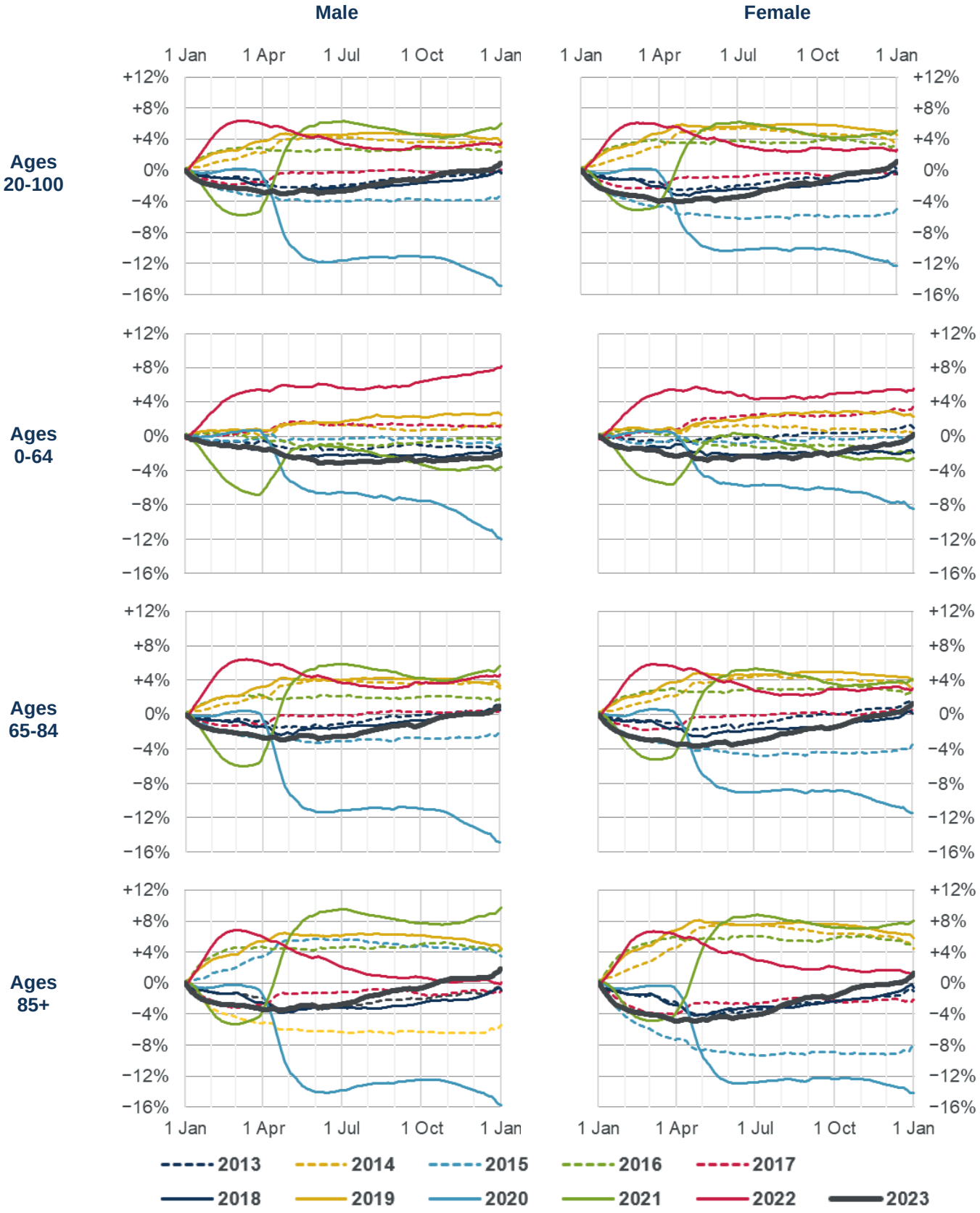
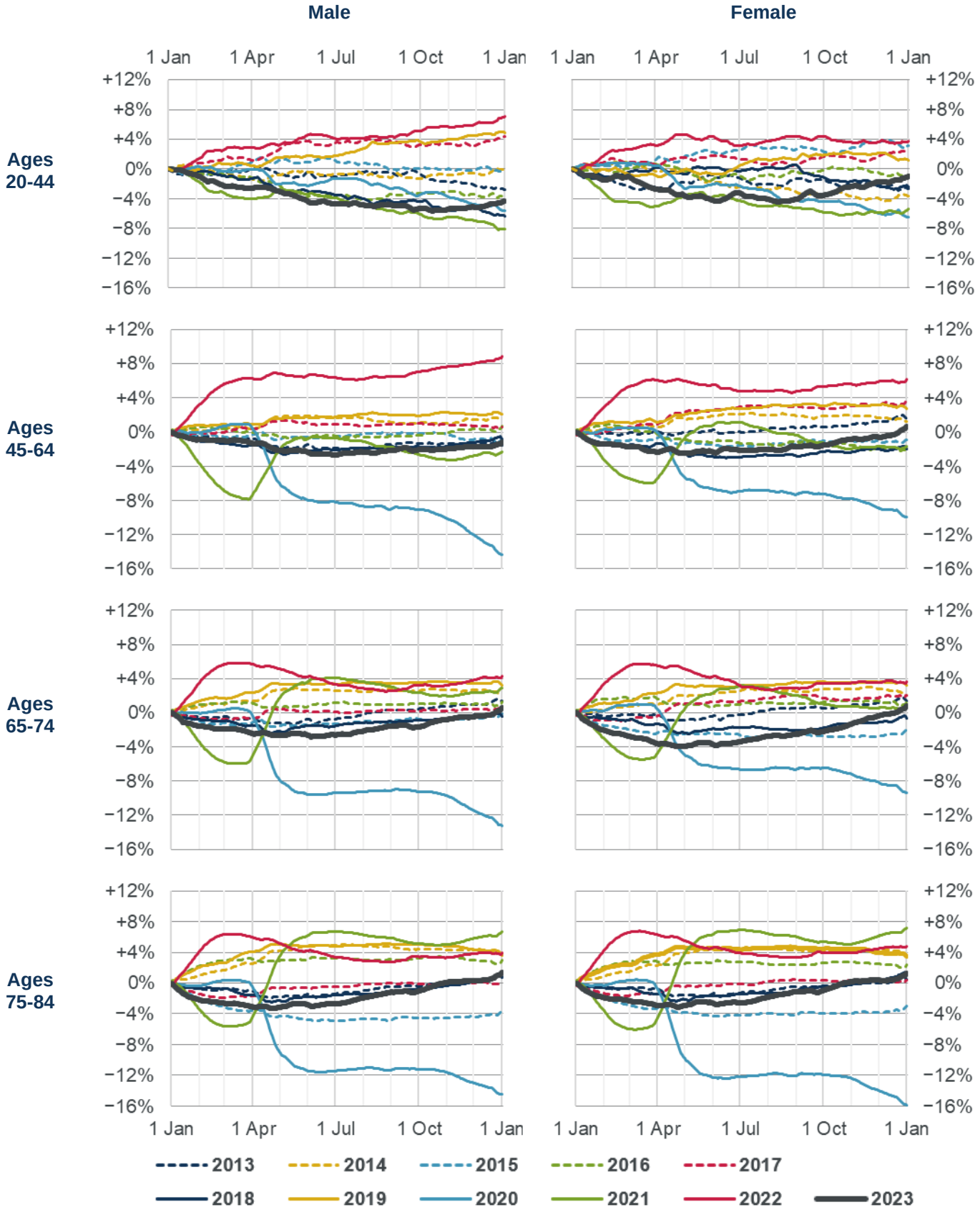


**Chart G (cont): Cumulative annual standardised mortality improvement (cSMRI), by gender and age band**



## Appendix 1 – Accessible versions of charts D and E

**Chart D2: Cumulative standardised mortality rate (cSMR) compared to the 2013-2022 average, showing 2013-2023 and highlighting individual years**

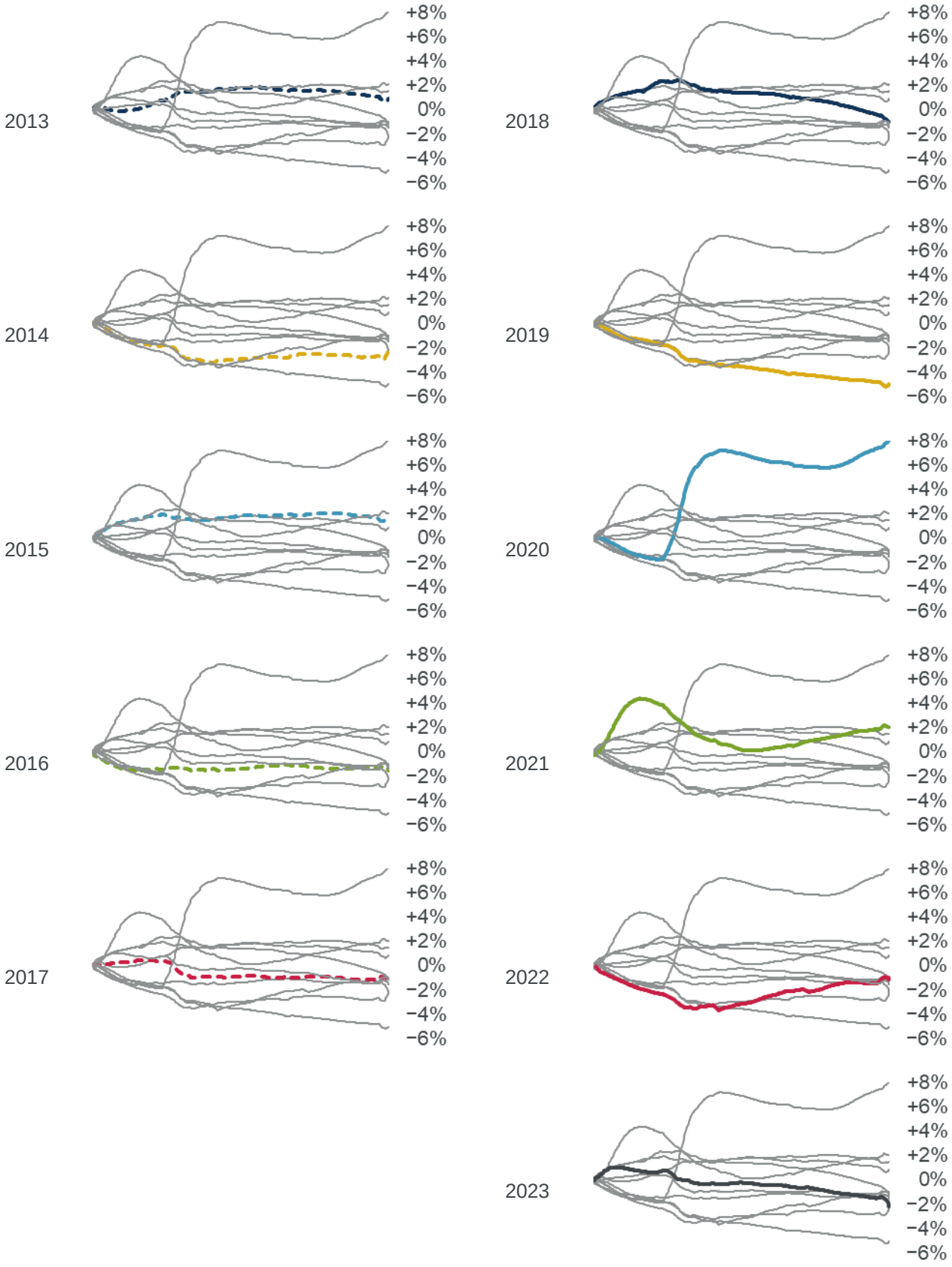
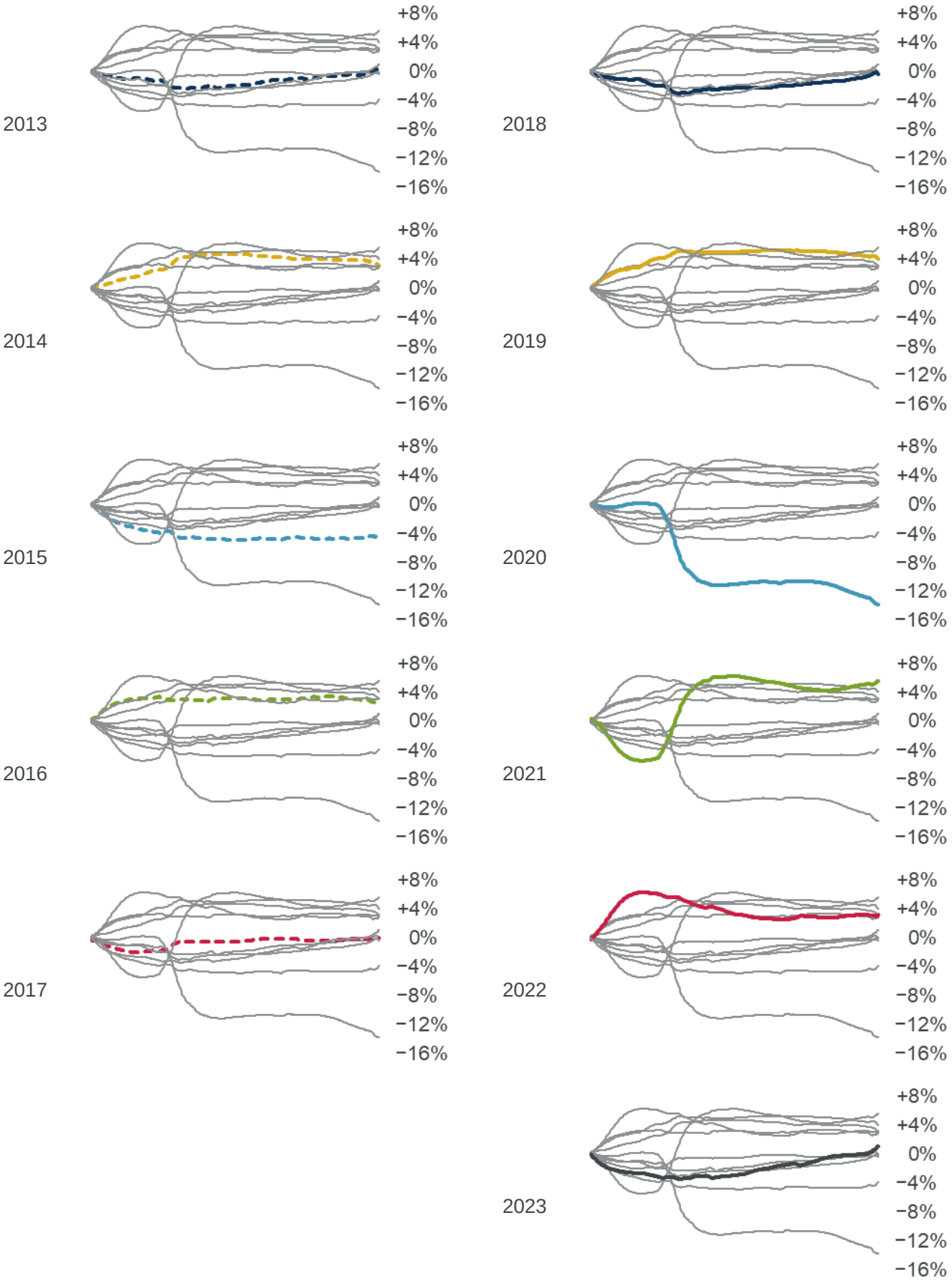


**Chart E2: Cumulative annual standardised mortality improvement (cSMRI) for 2013-2023, highlighting individual years**



## Appendix 2 – Impact of updated population estimates on results

Versions of the mortality monitor from week 26 of 2023 to week 51 of 2023 made approximate allowance for the impact of results of the 2021 census in England & Wales on views of mortality rates and improvements. Those versions used the same dataset as the latest version of the CMI Mortality Projections Model, CMI_2022. The dataset was based on an estimate of the mid-2021 population published by the ONS and the CMI's estimate of implied revisions to the populations from mid-2012 to mid-2020.

We updated the dataset used for the mortality monitor for week 52 of 2023 to reflect:

- the ONS's own estimates of the mid-2012 to mid-2020 populations;
- the ONS's revised estimates of the mid-2021 population;
- the ONS's estimate of the mid-2022 population;
- our own revised estimates of the mid-2023 and mid-2024 populations;
- changes to the way we allocate age-grouped deaths to single years of age; and
- using more granular deaths data for 2020 onwards.

This appendix provides an indication of the impact of updating the dataset used for the monitor by comparing:

- the results for end of 2023 in the body of this mortality monitor, using the "new" population estimates; and
- illustrative results based on the "previous" population estimates used for monitors for weeks 26 to 51 of 2023.

## Results

Chart A2A is a version of Chart D, showing cumulative mortality rates relative to the 2013-2022 average. The end-year figures for 2021 to 2023 are higher relative to 2019 in Chart A1A (using the previous dataset) than in Chart D (using the new dataset).

**Chart A2A: (Like Chart D) Cumulative standardised mortality rate (cSMR) compared to the 2013-2022 average – using the previous dataset.**

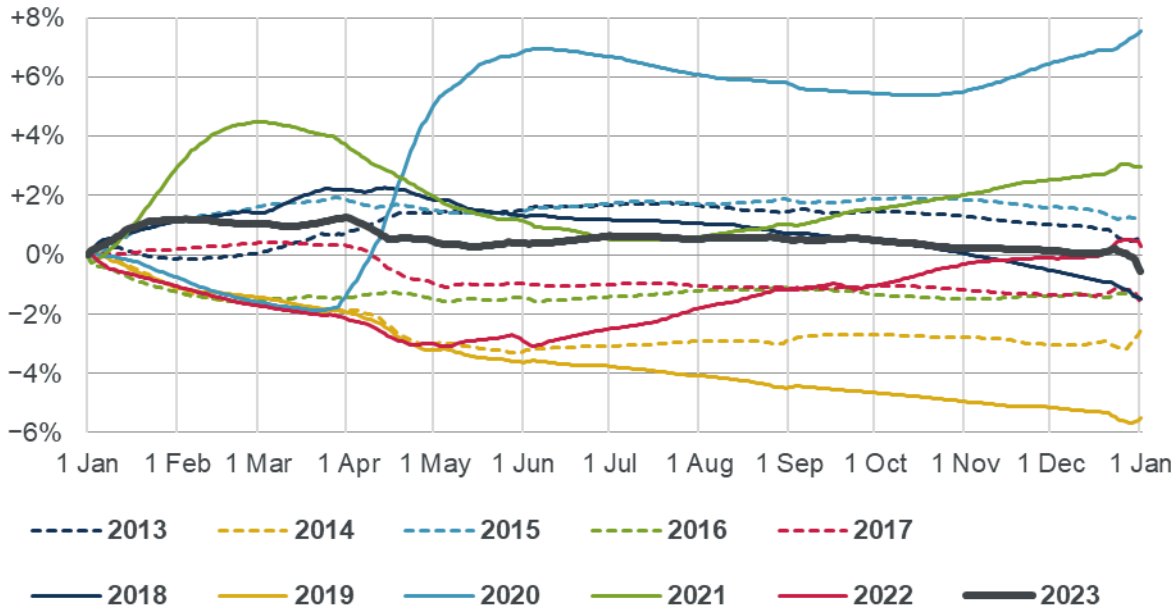



Chart A2B compares full year cumulative standardised mortality rates compared to the 2013-2022 average from the two datasets directly to make the differences clearer. It shows that the difference in SMRs relative to the ten year average between the two datasets is greatest in 2021, 2022 and 2023.

**Chart A2B: Annual SMRs for 2011-2023, relative to the 2013-2022 average – comparing new and previous datasets.**

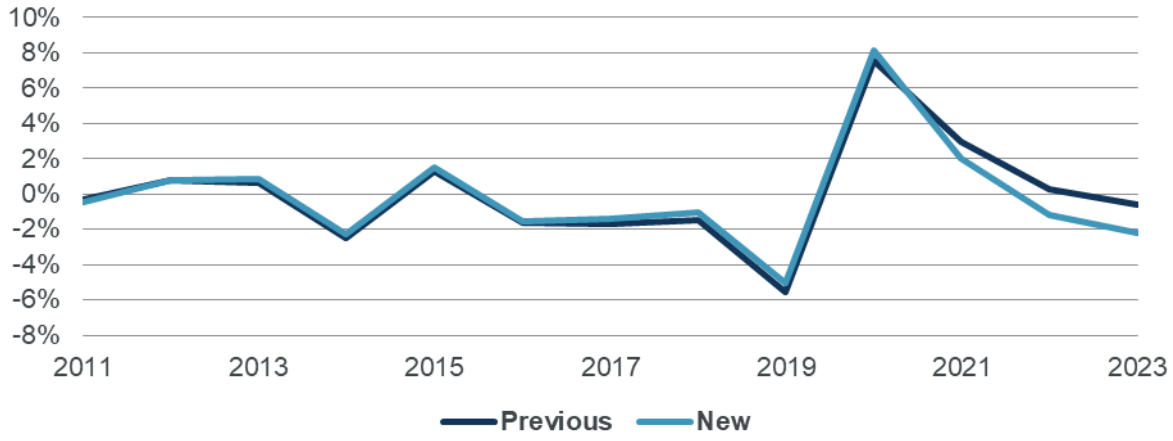



Chart A2C compares full year cumulative standardised mortality improvements from the two datasets. It shows that the improvements are generally broadly similar, with the largest difference in improvements in 2021.

**Chart A2C: Annual improvements for 2011-2023 – comparing new and previous datasets.**

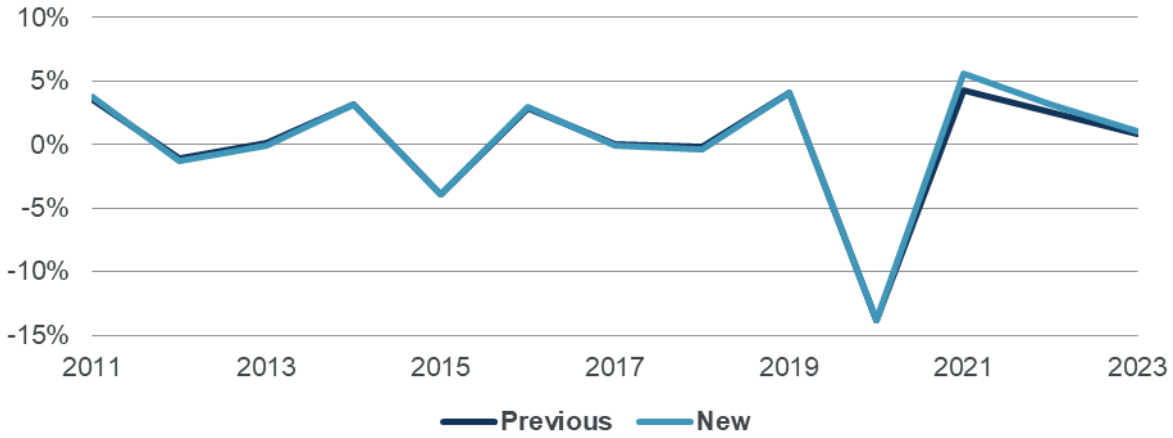



Table A2.1 compares improvements by age band at end 2023 for the new and previous datasets. The differences are typically up to 0.2%, with the largest difference of 0.5% being for the age 85+ age band.

**Table A2.1: Annual improvements for 2023 by age band – comparing new and previous datasets.**

| | 0-64 | 65-84 | 85+ | 20-100 | 20-44 | 45-64 | 65-74 | 75-84 |
|---|---|---|---|---|---|---|---|---|
| Previous | -1.0% | 1.2% | 1.1% | 0.9% | -3.1% | -0.3% | 0.6% | 1.5% |
| New | -1.2% | 1.1% | 1.6% | 1.0% | -3.2% | -0.5% | 0.6% | 1.4% |
| Difference | -0.2% | -0.1% | 0.5% | 0.1% | -0.1% | -0.2% | 0.0% | -0.1% |

Table A2.2 shows the percentage change in annual ASMRs due to each of the following:

- changes to the population dataset;
- changes to the method used to assign deaths from age bands to single year of age (SYOA); and
- using more granular age bands from 2020 onwards.

For each year, the ASMR is only affected by the change in population data for that year.

**Table A2.2: Components of percentage changes in annual ASMRs due to revised population data and methods**

| Year | Population data | SYOA method | Granular data | Total |
|---|---|---|---|---|
| 2011 | +0.0% | +0.2% | - | **+0.2%** |
| 2012 | +0.0% | +0.3% | - | **+0.3%** |
| 2013 | +0.0% | +0.5% | - | **+0.5%** |
| 2014 | +0.1% | +0.5% | - | **+0.6%** |
| 2015 | +0.1% | +0.4% | - | **+0.5%** |
| 2016 | +0.2% | +0.2% | - | **+0.4%** |
| 2017 | +0.3% | +0.3% | - | **+0.5%** |
| 2018 | +0.3% | +0.4% | - | **+0.8%** |
| 2019 | +0.3% | +0.5% | +0.0% | **+0.8%** |
| 2020 | +0.4% | +0.5% | -0.1% | **+0.8%** |
| 2021 | -0.7% | +0.1% | +0.0% | **-0.6%** |
| 2022 | -1.4% | +0.2% | -0.0% | **-1.2%** |
| 2023 | -1.5% | +0.3% | -0.1% | **-1.3%** |

Table A2.3 shows the impact of changes in data and methods on ASMRs relative to the 2013-2022 average. The “population data” impact is a combination of the change in the specific year and 2013-2022.

**Table A2.3: Components of changes in annual ASMRs relative to the 2013-2022 average due to revised population data and methods**

| Year | Population data | SYOA method | Granular data | Total |
|---|---|---|---|---|
| 2011 | 0.0% | -0.2% | +0.0% | **-0.1%** |
| 2012 | 0.0% | -0.0% | +0.0% | **+0.0%** |
| 2013 | 0.1% | +0.1% | +0.0% | **+0.2%** |
| 2014 | 0.1% | +0.1% | +0.0% | **+0.2%** |
| 2015 | 0.2% | +0.0% | +0.0% | **+0.2%** |
| 2016 | 0.2% | -0.2% | +0.0% | **+0.1%** |
| 2017 | 0.3% | -0.1% | +0.0% | **+0.2%** |
| 2018 | 0.4% | +0.1% | +0.0% | **+0.4%** |
| 2019 | 0.4% | +0.1% | +0.0% | **+0.5%** |
| 2020 | 0.5% | +0.2% | -0.1% | **+0.6%** |
| 2021 | -0.7% | -0.2% | +0.0% | **-0.9%** |
| 2022 | -1.3% | -0.2% | +0.0% | **-1.5%** |
| 2023 | -1.5% | -0.0% | -0.1% | **-1.6%** |

Table A2.4 shows the impact of changes in data and methods on annual mortality improvements. The “population data” impact is a combination of the change in the specific year and the previous year.

**Table A2.4: Components of changes in annual mortality improvements due to revised population data and methods**

| Year | Population data | SYOA method | Granular data | Total |
|---|---|---|---|---|
| 2011 | +0.0% | +0.2% | - | **+0.2%** |
| 2012 | +0.0% | +0.1% | - | **+0.1%** |
| 2013 | +0.0% | +0.2% | - | **+0.2%** |
| 2014 | +0.0% | +0.0% | - | **+0.1%** |
| 2015 | +0.1% | -0.1% | - | **-0.1%** |
| 2016 | +0.1% | -0.2% | - | **-0.1%** |
| 2017 | +0.0% | +0.1% | - | **+0.1%** |
| 2018 | +0.1% | +0.2% | - | **+0.2%** |
| 2019 | +0.0% | +0.0% | - | **+0.1%** |
| 2020 | +0.1% | +0.0% | -0.1% | **+0.0%** |
| 2021 | -1.1% | -0.3% | +0.1% | **-1.3%** |
| 2022 | -0.6% | +0.1% | -0.0% | **-0.6%** |
| 2023 | -0.2% | +0.1% | -0.1% | **-0.1%** |

## Appendix 3 – Estimated results on an occurrences basis

This appendix considers how the results of the monitor for England & Wales would differ if they were based on death occurrences rather than death registrations. It largely reproduces the appendix from the monitor for week 39 of 2023. We have not updated the analysis as the ONS has not published updated monthly occurrences data since July 2023, and the analysis has not been updated to reflect the revised population estimates published by the ONS in November 2023.

## Occurrences, registrations, and delays

Deaths data for a particular time period can be based on "occurrences" (when the deaths occurred) or based on "registrations" (when the death was registered).

There is typically a "registration delay" between the date of occurrence and date of registration. The registration delay is often short, as UK deaths should be registered within five days unless referred to a coroner, but delays of several years are possible in some cases.

## Why we use registrations

The number of deaths in a period on an occurrences basis is uncertain for some time after that period due to registration delays. While it is possible to estimate the number of occurrences sooner, based on typical registration delays, these estimates are themselves uncertain.

Registrations are a timely and reasonable proxy for occurrences, as long as registration delays are stable, or reasonably stable, over time.

The mortality data published weekly by the ONS provides much more detail on a registrations basis than on an occurrences basis. The registrations data provides splits by gender and five-year age band, while the occurrences data only provides a total figure.

## Registration delays

Chart A3A shows registration delays in the month following occurrence, based on monthly data published by the ONS[1]. For deaths occurring in each month, we show the number of deaths registered in the following month as a percentage of the number registered within the month of occurrence. For example, data to the end of December 2022 shows 48,164 deaths occurring in December 2022, while data to the end of January 2023 shows 61,286 deaths occurring in December 2022, which is 27% higher. A higher percentage indicates a longer delay in registering deaths.

**Chart A3A: Registration delays in the month following occurrence – see text for details**


The chart shows a fairly steady pattern for the first half of the period, but with the registration delay drifting upwards. The pattern changes dramatically in the later months shown, with large registration delays in December 2022, March 2023, and April 2023.

1 https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/monthlymortalityanalysisenglandandwales

We have also looked at registration delays for later periods (e.g. between the following month and three months later, or between three months later and a year later). These delays are smaller and show a more stable pattern, without the sharp peaks of recent months.

## Estimated recent occurrences and registrations

We have estimated the number of occurrences in each month based on the number of occurrences registered by 31 July 2023 with an allowance for a typical historical pattern of monthly registration delays after that point. These estimates are necessarily uncertain, particularly for more recent periods where registration delays form a larger proportion of the estimate.

Chart A3B compares monthly death registrations with our estimate of monthly occurrences. Registrations and estimated occurrences tend to show peaks and troughs at similar times, but there are some notable differences, particularly for December 2022.

**Chart A3B: Estimated occurrences and registrations**

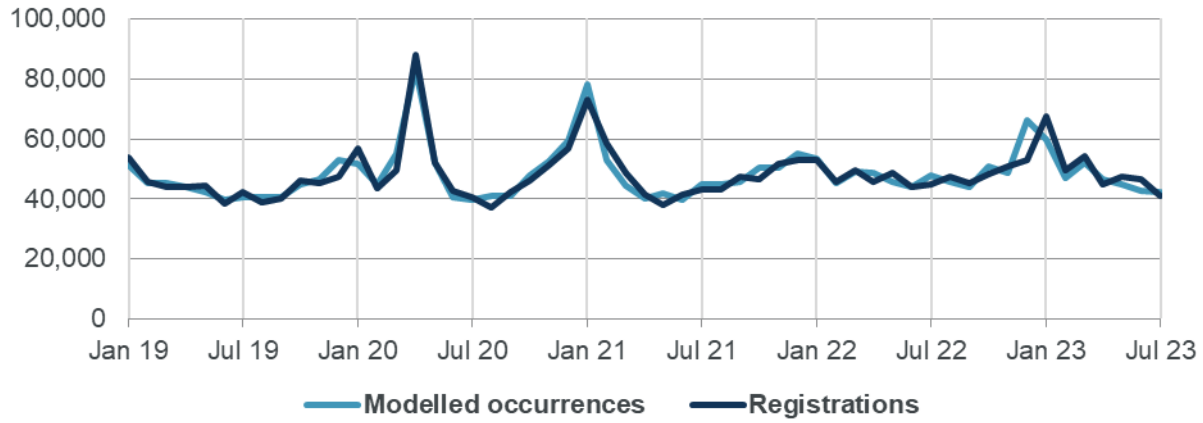



Table A3.1 considers the difference between modelled occurrences and registrations for calendar years 2019 to 2022 and for 1 January 2023 to 31 July 2023.

**Table A3.1: Comparison of modelled occurrences and registration by year**

| Period | Modelled occurrences minus registrations | | |
|---|---|---|---|
| | Number | Relative to 2019 | Relative to 2019 (%) |
| 2019 | +4,800 | - | - |
| 2020 | +1,600 | −3,200 | −0.6% |
| 2021 | +3,000 | −1,800 | −0.3% |
| 2022 | +13,400 | +8,700 | +1.6% |
| 2023 – to 31 July | −16,200 | −12,700 | -2.4% |

In 2019, 2020 and 2021 the difference between modelled occurrences and registrations was less than 1%. The differences are more material for 2022 and for 2023, due to the unusual registration delays shown in Chart 6.

We have not calculated ASMRs on an occurrences basis, due to a lack of detailed occurrences data by age and gender. If registration delays had the same impact on ASMRs as on deaths, then:

- The cumulative ASMR for 2022 relative to 2019, would be 1.6% higher, so around +5.7% rather than +4.1%.

- The cumulative ASMR for 2023 relative to 2019 would depend on the difference between registrations and occurrences after 31 July 2023. If the difference was the same as in the corresponding part of 2019, then the cumulative ASMR to date would be 2.4% lower, so around +0.6% rather than +3.0%.
- We emphasise that these figures are uncertain as we do not know how registration delays may have varied by age and gender, and what registration delays have been after 31 July 2023.

## Reliances and limitations

The purpose of the mortality monitor is to provide regular updates on standardised mortality in England & Wales, adjusting ONS data to allowing for changes in the size and age of the population. This can be used to inform a view on the outcome of the next version of the CMI Model, in the absence of any change in method.

The CMI aims to produce high-quality outputs and takes considerable care to ensure that the mortality monitor and the accompanying spreadsheet of results are accurate. However:

- We cannot guarantee their accuracy (see the Disclaimer).
- There is a reliance on the underlying data, published by the ONS and described as provisional.
- We have also applied judgement and assumptions in deciding on the calculation methods and the presentation of results.
- Anyone using the results of the mortality monitor should ensure that it is appropriate for their particular use, and note that care is needed when estimating full year experience from partial year experience. This is particularly true during the coronavirus pandemic.
- Population estimates for the latest years reflect our own estimates and are less certain than published ONS figures for earlier years.



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