England & Wales mortality monitor – COVID-19 update – week 53 of 2020

Important notes for this week's monitor:

- **We usually compare actual deaths in week "N" to expected deaths based on Standardised Mortality Rates for week "N" of 2019. However, 2020 is unusual in having 53 ISO weeks[1], so we have compared week 53 of 2020 to week 1 of 2020. There is more detail of this in the appendix.**

- **Results for weeks 52 and 53 of 2020 are not consistent with each other or with 2019 due to the timing of public holidays.**

Summary

There have been around 72,900 more deaths in the UK from the start of the pandemic to 1 January 2021 than if mortality rates were similar to those experienced in 2019. This estimate uses data from National Records Scotland (NRS) and the Northern Ireland Statistics and Research Agency (NISRA) as well as the Office for National Statistics (ONS).

During week 53 of 2020, there were 19% fewer deaths registered in England & Wales than would have been expected if Standardised Mortality Rates had been the same as in week 1 of 2020. The corresponding figure for week 52 was +51% more deaths than expected.

The cumulative mortality improvement in England & Wales for 2020 is –13.4% as at 31 December 2020, compared to +0.1% as at 20 March 2020, before the coronavirus pandemic had a material impact.

Background

During the coronavirus pandemic we have been publishing frequent updates to the CMI Mortality Monitor. This update shows the position as at 1 January 2021 (week 53 of 2020), based on provisional deaths data published by the Office for National Statistics (ONS) on 12 January 2021. We have also published our end-2020 quarterly mortality monitor, using the same data. We intend to publish the next monitor, for week 1 of 2021, on 19 January 2021. All updates are publicly available from the CMI pages of the Institute and Faculty of Actuaries website, together with software that we have made available to Authorised Users to carry out ad hoc analyses.

Notes

Full details of the methods used for results based on the ONS data are included in Working Paper 111. Our analysis is based on Standardised Mortality Rates (SMRs). These adjust the provisional weekly deaths data published by the ONS to control for changes in the size, age and gender distribution of the population over time. We note that mortality rates and mortality improvements vary by age, and the results shown are sensitive to the age distribution of the chosen standard population (the 2013 European Standard Population).

Our calculations rely on data for registered deaths, and we are conscious that in recent months deaths may have been registered earlier or later than in previous years. Consequently, comparisons of mortality between 2020 and earlier years may not be on a like-for-like basis. Also, results for individual weeks may not be consistent between years due to the timing of public holidays.

Use of this document

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 updates. Please also see the reliances and limitations, disclaimer, and copyright notice on the final page of this document.

TAS compliance

This paper is intended to analyse recent mortality in England & Wales. It complies with the principles in the Financial Reporting Council's Technical Actuarial Standard "TAS 100: Principles for Technical Actuarial Work". Any person using this paper should exercise judgement over its suitability and relevance for their purpose.

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[1] The publication of ONS data broadly follows ISO week numbers. Most years have 52 ISO weeks, but because a 52 week year has 364 days, less than a calendar year, some years, including 2020, have "leap weeks" under the ISO system.

Results – Standardised mortality rates

Chart 1 shows how SMRs in 2020 and 2019 compare to the range of SMRs in same week in the 2010-2019 period. (Note that most years do not have a week 53 – there was no week 53 in 2019, and the 2010-2019 range for week 53 only relates to 2015.)

In the latter part of the year, mortality in 2020 has been higher than in 2019, but not always higher than every year in the 2010-2019 period.

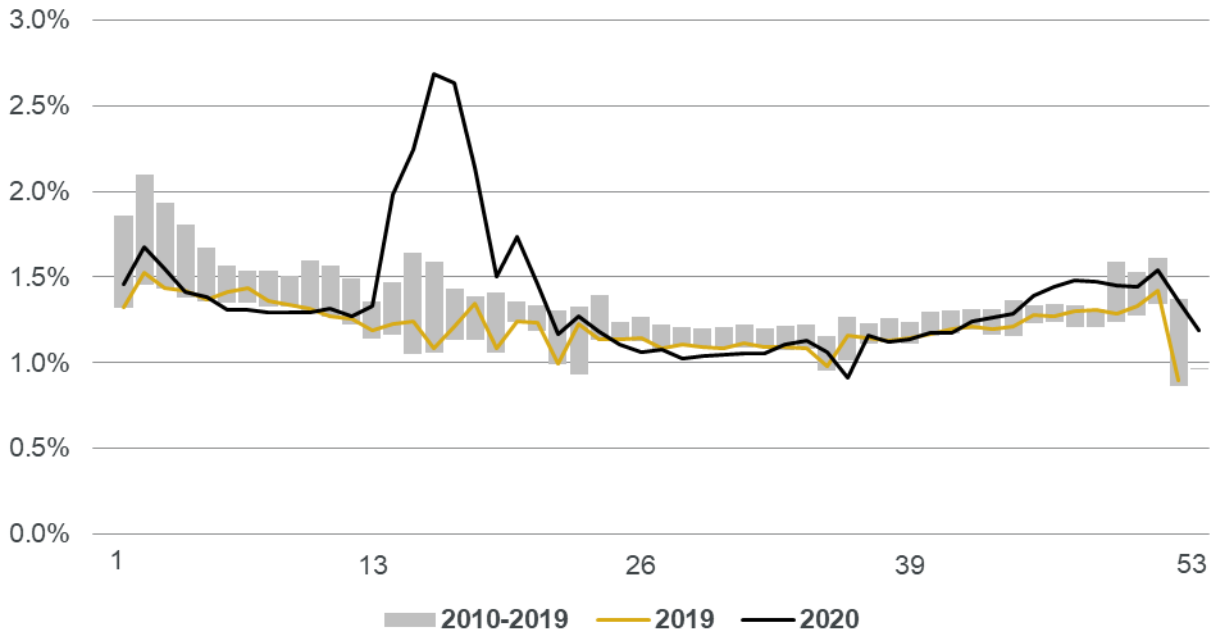**Chart 1: Weekly standardised mortality rates for 2010 to 2020**

Chart 2 shows cumulative standardised mortality rates compared to the 2010-2019 average. Cumulative mortality to the end of 2020 is higher than cumulative mortality to the end of any year since 2008, and is 7.8% above the 2010-19 average. It was 1.9% below the 2010-19 average at week 12, before the coronavirus pandemic had a material impact.

Chart 2: Cumulative standardised mortality rate compared to the 2010-2019 average
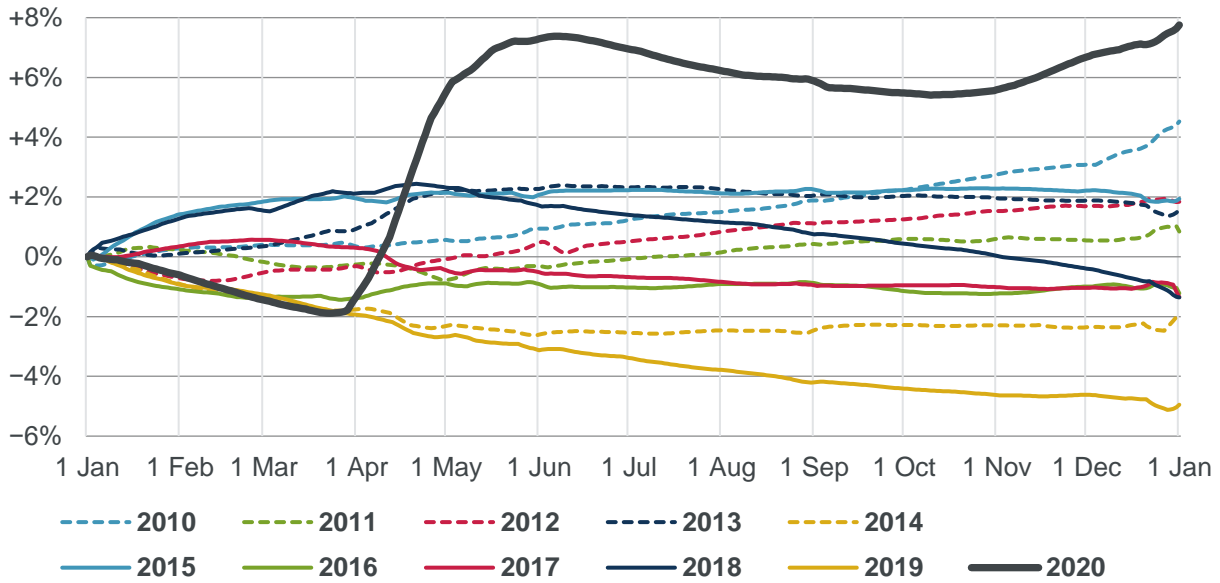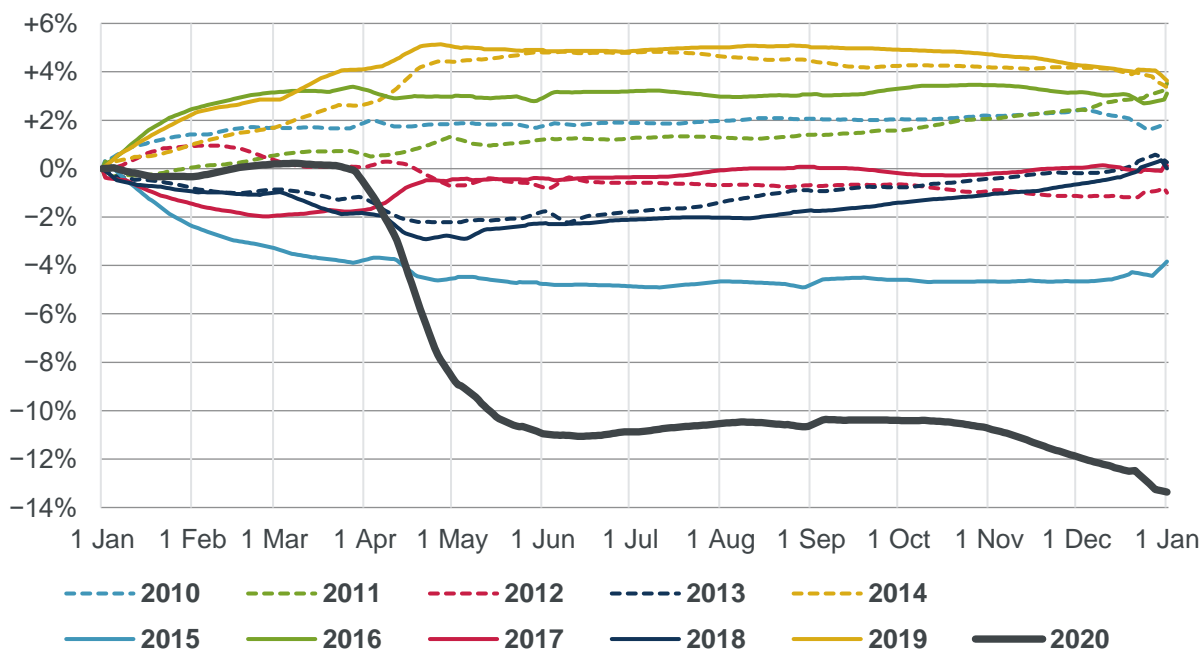
Chart 3 shows the cumulative annual standardised mortality improvement for 2020 and for the previous ten years. Note that Chart 3 shows cumulative improvements, so a higher value represents a higher improvement and lower mortality; whereas in Chart 2 a higher value represents higher mortality.

The cumulative mortality improvement is –13.4% as at the end of 2020, a new low, compared to +0.1% as at week 12, before the coronavirus pandemic had a material impact.

An annual mortality improvement of –13.4% is the lowest in recent history. Our calculations suggest that one would need to go back to 1929 to find the previous low of –14%. However, this should be treated with some caution as the recording of population and death statistics was not as robust in the past as it is now.

Chart 3: Cumulative annual standardised mortality improvement

Results – Excess and COVID-19 deaths

The ONS data shows 3,144 deaths registered during week 53 "where COVID-19 was mentioned on the death certificate". The overall impact of the coronavirus pandemic on total deaths may be different:

- There may have been some deaths that were wholly or partially due to COVID-19 but where COVID-19 was not mentioned on the death certificate.

- Some deaths where COVID-19 was mentioned on the death certificate may not be "excess" deaths, as the deceased might have died from another cause in the same period, in the absence of coronavirus.

- There may have been "forward mortality displacement": some deaths that occurred earlier in the pandemic would otherwise have occurred in this period.

- There may have been indirect impacts on deaths due to restrictions on movement and changes in behaviour during the pandemic. For example, access to healthcare, reductions in other infectious diseases, and changes in traffic, pollution and mental health.

To consider the possible impact of the pandemic on total deaths, we have estimated the number of deaths that we would have seen in each week of the pandemic if the SMRs for each gender and age-group had been the same in that week as in the corresponding week of 2019. As mortality in the first 12 weeks of 2019 and 2020 was similar, as seen in Charts 2 and 3, this gives a broad indication of "expected" mortality in the absence of the

coronavirus pandemic[2]. However, as there was no ISO week 53 in 2019, we have instead used week 1 of 2020 to calculate expected deaths for week of 2020. We discuss the motivation for this choice in the appendix.

We can then subtract the expected deaths from actual deaths to estimate the "excess" deaths that, in the absence of other likely causes, may be attributable to the pandemic.

We have not made any adjustment for differences in the timing of public holidays, but we note that there are material differences in the timing of Christmas, Boxing Day and New Year's Day holidays between the 2019/20 and 2020/21 holiday periods. These differences will particularly affect results for weeks 52 and 53 of 2020 and week 1 of 2021, and may also affect later weeks. We consider this further in the appendix. However, while such differences affect individual weeks, positive and negative impacts for different weeks should cancel out over time in cumulative results.

Table 1 shows results for week 53, compared to week 52, and for weeks 52 and 53 combined:

- Actual deaths in week 53 are 19% lower than expected: 15% lower than expected for males and 23% lower than expected for females.

- In the previous week, week 52, deaths were 63% higher than expected for males and 39% higher than expected for females.

- As noted above, comparisons between weeks 52 and 53 should be treated with caution, due to the different impact of public holidays in the two weeks. Excess deaths are likely to be higher in week 52 and lower in week 53 than if there were no bank holidays.

- The right-hand column shows results for weeks 52 and 53 combined. This partly mitigates the impact of bank holidays, but the figure of +7% for excess deaths is still lower than it would have been in the absence of bank holidays.

Table 1: Comparison of COVID-19 deaths and "excess" deaths

Description	Week 53 of 2020			Week 52	Weeks 52-53
	Male	Female	Total	Total	Total
"Expected" registered deaths	6,022	6,438	**12,460**	7,652	**20,112**
Actual registered deaths, from all causes	5,125	4,944	**10,069**	11,520	**21,589**
"Excess" registered deaths (actual minus expected)	−897	−1,494	**−2,391**	+3,868	**1,477**
Registered deaths where COVID-19 was mentioned on the death certificate	1,690	1,454	**3,144**	2,912	**6,056**
Excess as a proportion of expected	−15%	−23%	**−19%**	+51%	**+7%**

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[2] Our calculation of excess deaths depends on the historical period that we use to estimate expected deaths. If we had used the average standardised mortality rates for 2015-19 rather than only 2019 to calculate expected deaths, without allowing for mortality improvements, then this would have increased excess deaths by 834 (from −2,391 to −1,557) in week 53, and reduced the cumulative excess to week 53 (shown in Chart 5) from 66,224 to 54,625, a difference of 18%. We reiterate our preference for using SMRs for 2019 to estimate expected deaths in the absence of a pandemic, as 2019 and 2020 had similar mortality experience for weeks 1 to 12, and discuss this further in the appendix.

Chart 4A compares three measures of COVID-19 mortality during the pandemic: our calculation of "excess" registered deaths, ONS data for registered deaths where COVID-19 was mentioned on the death certificate, and Public Health England (PHE) data for deaths of people within 28 days of a positive test result for COVID-19. While there were some deaths from COVID-19 before week 13, the level of excess deaths in those weeks is small compared to typical weekly volatility in deaths, so cannot be reliably estimated. Chart 4B is similar to Chart 4A, but shows figures since week 38, to allow the detail of the "second wave" to be seen more clearly.

The relationship between the three measures has varied considerably during the pandemic. In weeks 13 to 17, the number of excess deaths was much higher than for the other two measures, but this has not been the case since then. In recent weeks the ONS and PHE measures have shown similar results. The PHE deaths increased from under 100 deaths in week 37 to 3,686 in week 53. In recent weeks (apart from weeks 52 and 53, where the timing of bank holidays affects the excess deaths) excess deaths have been about one-third of the ONS and PHE figures, indicating that non-COVID deaths have been lower than would have been expected in the absence of the pandemic. We noted possible reasons for such differences on page 3.

Chart 4A: Comparison of weekly measures of COVID-19 deaths (see text for details)
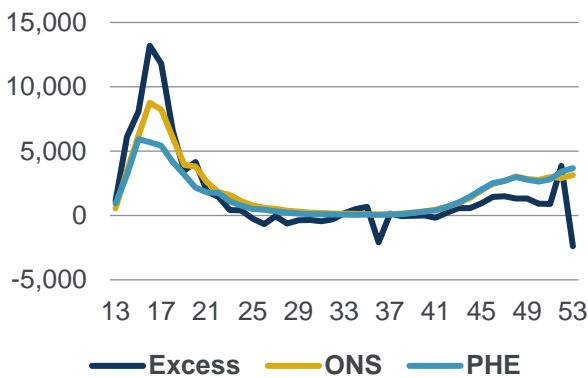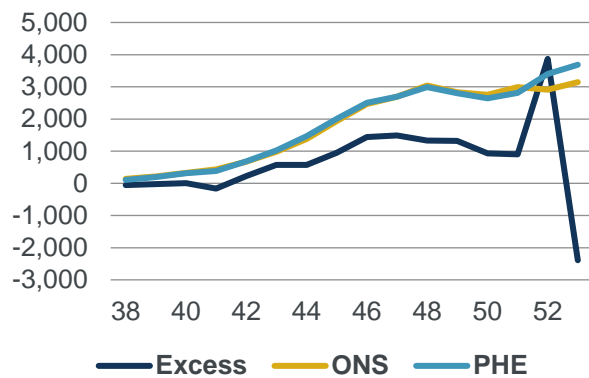

Chart 4B: Version of Chart 4A for recent weeks

Charts 5A and 5B are similar to Charts 4A and 4B, but show cumulative numbers of deaths since week 10[3]. For most of the period shown, the cumulative number of excess deaths was higher than both the cumulative number of deaths where COVID-19 was mentioned on the death certificate, and the cumulative number of deaths within 28 days of a positive test. However, cumulative excess deaths are now lower than both of those measures. This is a consequence of weekly excess deaths being lower than the other measures in recent weeks.

Chart 5A: Comparison of cumulative measures of COVID-19 deaths (see text for details)
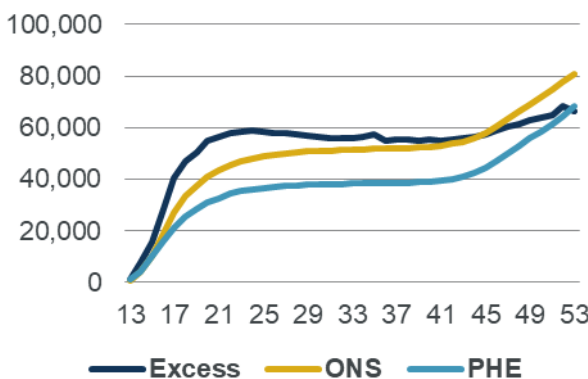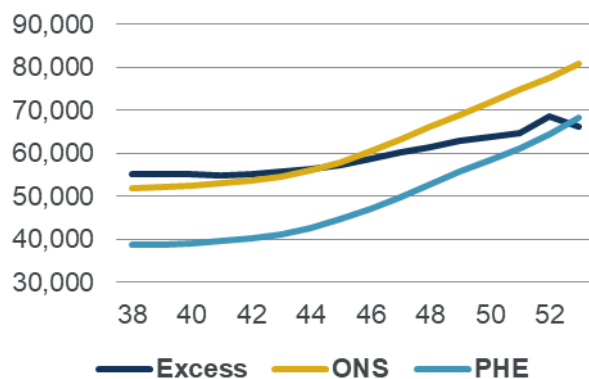

Chart 5B: Version of Chart 4A for recent weeks

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[3] In previous monitors we showed cumulative figures since week 13 in this chart, but used cumulative figures since week 10 in the "Excess deaths for the United Kingdom" section. In this monitor, and future monitors, we have harmonised our approach and use week 10 as the starting point of the pandemic.

Charts 6A, 6B, 7A and 7B show excess deaths as a proportion of expected deaths by age band for each week. This tended to be higher for older age bands earlier in the pandemic. We do not show results for ages below 45 as the relatively low numbers of deaths at those ages means that estimates of expected deaths would be unreliable.

Chart 6A: Excess as a proportion of expected in each week – males (see text for details)
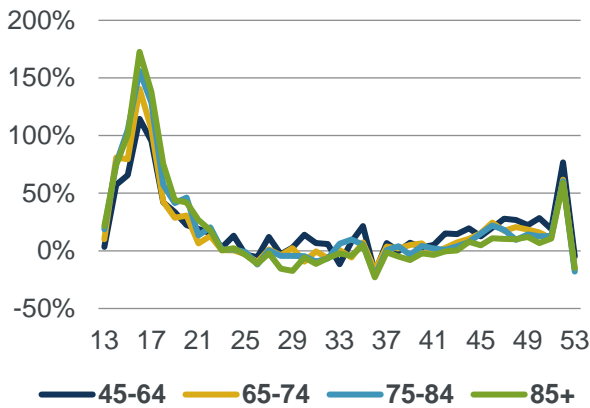

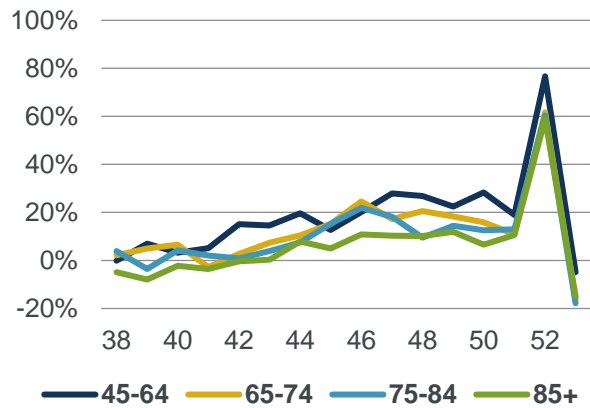**Chart 6B: Version of Chart 5A for recent weeks**

Chart 7A: Excess as a proportion of expected in each week – females (see text for details)
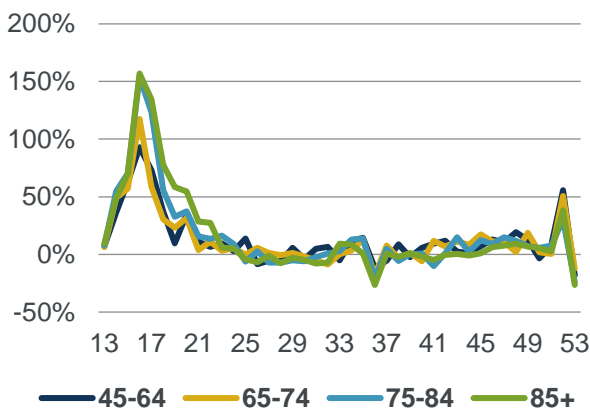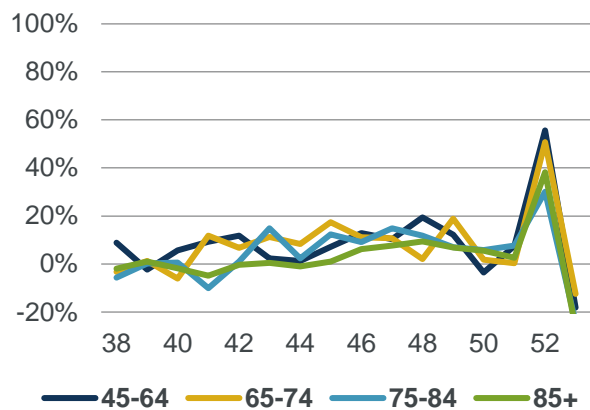

Chart 7B: Version of Chart 6A for recent weeks

Results – Excess deaths for the United Kingdom

The previous sections of this report are based on registered deaths data for England & Wales to 1 January 2021, published by the ONS. In this section we extend our analysis to the United Kingdom as a whole.

We estimate that the numbers of excess deaths from the start of the pandemic to 1 January 2021 are:

- 66,200 for England & Wales[4]; and
- 72,900 for the United Kingdom.

Of these, 11,000 excess deaths for England & Wales and 12,100 for the United Kingdom have occurred since the start of the second wave[5].

The figure shown for cumulative excess deaths to week 53 is lower than that to week 52. This is because the impact of bank holidays led to a larger figure for excess deaths in week 52 than in the absence of bank holidays and a negative figure for excess deaths in week 53. We expect that bank holidays will lead to excess deaths in week 1 of 2021 being higher than would otherwise be the case.

As in earlier sections, excess deaths compare registered deaths in 2020 to those that we would have seen if standardised mortality rates were the same as in the corresponding period in 2019. Our calculations use data for all-cause mortality from National Records Scotland (NRS) and the Northern Ireland Statistics and Research Agency (NISRA) in addition to the ONS data. We note that the week 53 figure for Northern Ireland is not yet available, so we have assumed that excess deaths in Northern Ireland in this week are the same as in week 52.

The figures above do not include deaths that occurred after 1 January 2021. We note that Public Health England (PHE) publishes daily data published for deaths of people within 28 days of a positive test result for COVID-19. The PHE data shows 5,665 COVID-19 deaths reported for the UK in week 1 of 2021 (2 to 8 January 2021), compared to 3,919 in week 53 of 2020.

Data sources

The provisional weekly deaths are available from:

- ONS (England & Wales)
  https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/weeklyprovisionalfiguresondeathsregisteredinenglandandwales
- NRS (Scotland)
  https://data.gov.scot/coronavirus-covid-19/data.html
- NISRA (Northern Ireland)
  https://www.nisra.gov.uk/sites/nisra.gov.uk/files/publications/Weekly_Deaths.xls

The daily PHE data for deaths of people within 28 days of a positive test result for COVID-19 are available from https://coronavirus.data.gov.uk/details/deaths

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[4] The cumulative figures, since the start of the pandemic, are from week 10 onwards.
[5] For this purpose, we treat the second wave as being week 38 onwards, i.e. from 12 September 2020.

Appendix: Expected and excess deaths, and the impact of bank holidays

Out calculations of excess deaths require us to form a view on expected deaths. For mortality monitors up to and including week 52 of 2020, we have calculated expected deaths for week N of 2020 by using the SMR for week N of 2019. In this appendix we consider:

- alternative methods for calculating expected deaths;
- how to calculate expected deaths for 2021;
- how to calculate expected deaths for week 53 of 2020; and
- the impact of bank holidays over the 2020/21 holiday period.

Alternative methods

We have calculated expected deaths using the SMR for the corresponding week of 2019, but we note that others have used different methods to assess excess deaths.

In this section we compare calculations of excess deaths using three different measures of expected deaths:

- SMRs for 2019 (the CMI's method)
- Crude (i.e. unadjusted) counts of deaths averaged over 2015-2019 (like the ONS bulletins that accompany the publication of weekly provisional deaths data)[6]
- SMRs averaged over 2015-2019 (like the ONS's "Comparisons of all-cause mortality between European countries and regions: January to June 2020")[7]

All figures in this section are for England & Wales apart from those in Table 3.

Charts 8 and 9 show weekly and cumulative excess deaths from the three measures since week 10 of 2020. The three lines of Chart 8 have similar shapes, as the large variations in actual weekly deaths affects all of measures of excess deaths. However, Chart 9 shows that modest differences in weekly excess deaths can lead to material differences in cumulative figures.

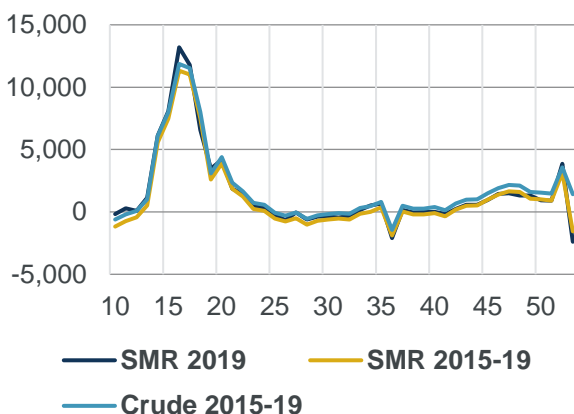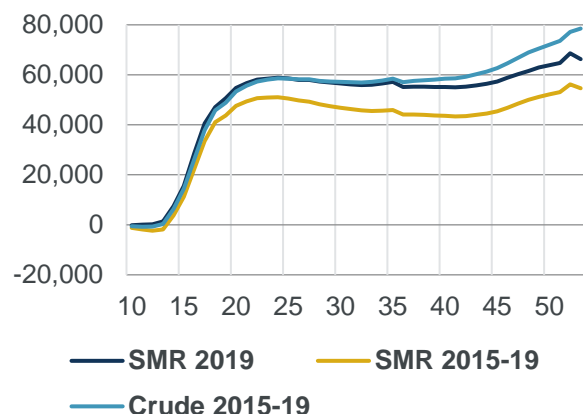**Chart 8: Weekly excess deaths, using different methods for expected deaths**

Chart 9: Cumulative excess deaths, using different methods for expected deaths

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[6] When calculating the 2015-2019 average for crude death counts for week 53 we have used the same method as the ONS; i.e. we have used week 52 of each year.

[7] When calculating the 2015-2019 average for SMRs for week 53 we have used week 53 of 2015 and week 1 of 2016-2019 inclusive, consistent with our approach to the SMR for 2019.

Table 2 shows total excess deaths during different parts of the pandemic. Under our definitions:

- The first wave starts in week 10, the first week in which the PHE data records a death within 28 days of a positive test for COVID-19.

- The "summer lull" starts in week 25, the first week since the start of the pandemic in which we see negative excess deaths under our method.

- The second wave starts in week 38. This reflects increasing numbers of COVIS-19 deaths, and avoids distortions in registered deaths in weeks 36 and 37 caused by the bank holiday in week 36.

Table 2 also shows COVID-19 deaths during this period, using the ONS figures (where COVID-19 was mentioned on the death certificate) and PHE figures (for deaths within 28 days of a positive test for COVID-19) from Charts 4 and 5.

Table 2: Comparison of different measures of excess and COVID-19 deaths

Weeks	Description	Excess using SMR 2019	Excess using SMR 2015-19	Excess using Crude 2015-19	COVID-19 PHE	COVID-19 ONS
10-24	First wave	58,900	51,000	58,600	36,300	48,200
25-37	Summer lull	-3,600	-6,900	-1,000	2,300	3,700
38-53	Second wave	11,000	10,500	21,600	29,700	28,900
10-53	**Total**	**66,200**	**54,600**	**79,200**	**68,200**	**80,800**

Calculating expected deaths based on SMRs allows for changes in the population, whereas calculating expected deaths based on crude deaths does not. In recent years, the population of England & Wales has grown and its average age has increased. This would have led to deaths in England & Wales increasing by around 1.5% between 2019 and 2020 if mortality rates did not change. In such conditions, calculating expected deaths based on crude deaths understates expected deaths and hence overstates excess deaths.

Mortality rates tend to improve (i.e. reduce) over time, although the rate of improvements has been relatively low in recent years. Because of this, calculating expected deaths based on the 2015-19 average tends to give higher expected deaths than using 2019, leading to lower excess deaths; although the relationship between mortality in 2015-19 and 2019 varies by week. While we would expect that using the 2015-19 period would lead to slightly less volatile excess deaths figures, we prefer to use 2019 as the benchmark for expected deaths, given the similarity between mortality in early-2019 and early-2020.

Table 3 is similar to Table 2, but shows results for the UK, comparing our approach to excess deaths with the use of crude deaths for 2015-19 to calculate expected deaths.

We note that the ONS and PHE figures were lower than all measures of excess deaths during the first wave, but have been higher than all measures of excess deaths since then. If the ONS and PHE figures understated COVID-19 deaths during the first wave, perhaps because some cases of COVID-19 were not recognised as such early in the pandemic, then the best estimate of COVID-19 deaths may be given by a combination of excess deaths for the first wave and ONS/PHE figures for later periods. If this is the case, then the total number of COVID-19 deaths will be greater than any of the totals shown in Tables 2 or 3.

Table 3: Comparison of different measures of excess deaths

Weeks	Description	England & Wales Excess using SMR 2019	England & Wales Excess using Crude 2015-19	United Kingdom Excess using SMR 2019	United Kingdom Excess using Crude 2015-19
10-24	First wave	58,900	58,600	64,600	64,300
25-37	Summer lull	-3,600	-1,000	-3,800	-700
38-53	Second wave	11,000	21,600	12,100	24,100
10-53	**Total**	**66,200**	**79,200**	**72,900**	**87,800**

Expected deaths for 2021

We have calculated expected deaths for week N of 2020 by using the SMR for week N of 2019. We justify this decision by the similarity of SMRs between 2019 and 2020 in the period before the pandemic.

We also intend to use SMRs for 2019 to calculate expected deaths for 2021, as 2019 is the last full calendar year before the pandemic. i.e. we will calculate expected deaths for week N of 2021 by using the SMR for week N of 2019.

Expected deaths for week 53 of 2020, and the impact of bank holidays

There are 53 ISO weeks in 2020, but 52 ISO weeks in most years, including 2019. Because of this, we cannot calculate expected deaths for week 53 of 2020 by using the SMR for the corresponding week of 2019, as there is no week 53 of 2019. We have instead calculated expected deaths for week 53 of 2020 by using the SMR for week 1 of 2020.

To inform this decision, we considered mortality in the 2018-19 and 2019-20 holiday periods, which show similar patterns of mortality due to similar timing of bank holidays, shown in Table 4. (We note that Scotland has an additional bank holiday during in week 1 of each year shown.)

Table 4: Timing of bank holidays in England & Wales.

ISO Week	2018	2019	2020	2021
1	Mon 1 Jan 2018	Tue 1 Jan 2019	Wed 1 Jan 2020	None
…	…	…	…	…
52	Tue 25 Dec 2018 Wed 26 Dec 2018	Wed 25 Dec 2019 Thu 26 Dec 2019	Fri 25 Dec 2020	Mon 27 Dec 2021 Tue 28 Dec 2021
53	n/a	n/a	Mon 28 Dec 2020 Fri 1 Jan 2021	n/a

Chart 10 shows our estimate of how death registrations in ISO weeks during these periods compare to what we might have expected under a counterfactual with no holidays but an allowance for seasonality of mortality rates. For example, death registrations for week 51 are unaffected by bank holidays, but those for week 52 are around a third lower due to Christmas and Boxing Day holidays. Note that across weeks 51 to 5 combined, relative death registrations average 100%, by design.

Chart 10: Relative death registrations during the 2018-19 and 2019-20 holiday periods (actual relative to "no holidays" counterfactual)
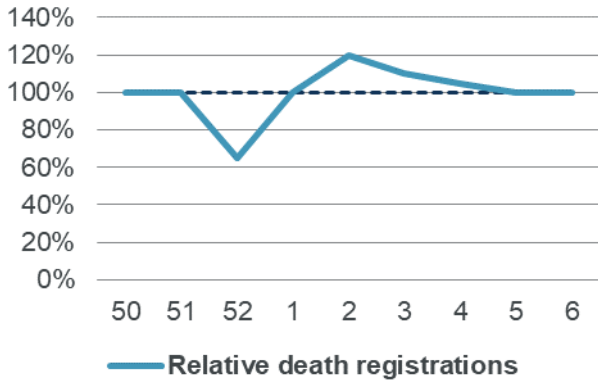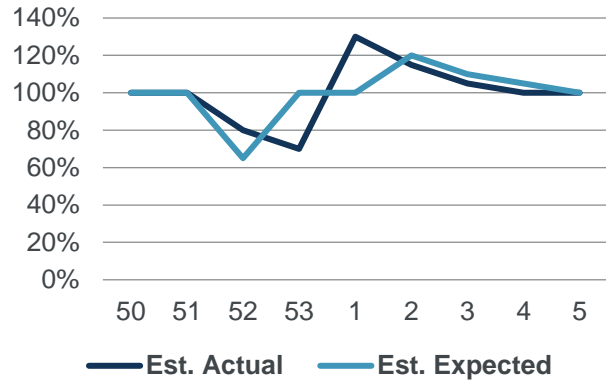

Chart 11: Estimates of Actual and Expected relative death registrations during the 2020-21 holiday period

We similarly want relative death registrations to have an average of 100% over the weeks that we use to calculate expected deaths for the 2020-21 holiday period. If this were not the case then we would not be making a like-for-like comparison.

In order to have average death registrations of 100% for the expected deaths, we would need the week used to calculate expected deaths for week 53 of 2020 to have death registrations of 100%. A natural choice for the comparator is week 1 of 2020 – it gives sensible results for expected death registrations across the holiday period, and also follows week 52 of 2019, which is the comparator for week 52 of 2020.

Although this approach would make actual and expected death registrations consistent across the holiday period, they will not be consistent for individual weeks. Chart 11 shows our somewhat speculative estimate of relative death registrations during the 2020-21 holiday period, compared to the relative death registrations for expected deaths. The thinking behind the estimates of relative death registrations for the 2020-21 holiday period is:

- Week 52 of 2020 – There are only four days in which to register deaths and no opportunity for a "catch-up" as the bank holiday falls on the Friday.

- Week 53 of 2020 – There are only three days in which to register deaths, but some opportunity for a catch-up from the previous week.

- Week 1 of 2021– There are no bank holidays, and a material catch-up from previous weeks.

- Weeks 2 and 3 of 2021 – A continued catch-up, ensuring average relative mortality of 100% for the holiday period as a whole.

Table 5 shows the differences between Actual and Expected relative death registrations, and hence the potential impact of bank holidays on our calculations of excess mortality. There are material differences for weeks 52 and 53 of 2020 and week 1 of 2021, and the potential for continued smaller differences for a further three weeks.

Table 5: Estimates of Actual, Expected and Excess relative death registrations during the 2020-21 holiday period

ISO week	2020-52	2020-53	2021-01	2021-02	2021-03	2021-04
Estimated Actual relative death registrations (A)	80%	70%	130%	115%	105%	100%
Estimated Expected relative death registrations (E)	65%	100%	100%	120%	110%	105%
Estimated Excess relative death registrations (A-E)	+15%	-30%	+30%	-5%	-5%	-5%
Estimated Excess relative death registrations (A÷E-1)	+23%	-30%	+30%	-4%	-5%	-5%

Reliances and limitations

The purpose of the weekly mortality monitor is to provide regular updates on standardised mortality in England & Wales during the coronavirus pandemic, adjusting ONS data to allowing for changes in the size and age of the population.

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 data published by third parties, particularly the ONS data which is 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.

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