

Statistical bulletin

Deaths involving COVID-19 by vaccination status, England: deaths occurring between 1 January 2021 and 31 March 2022

Age-standardised mortality rates for deaths involving COVID-19 by vaccination status, broken down by age group. Deaths occurring between 1 January 2021 and 31 March 2022 in England.

Contact:
Health Statistics and Research
health.data@ons.gov.uk
+44 1633 582486

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1 . Main points

- Monthly age-standardised mortality rates (ASMRs) for deaths involving coronavirus (COVID-19) have been consistently lower for all months since September 2021 for people who had received a third dose or booster at least 21 days ago, compared with unvaccinated people and those with just a first or second dose.
- Breaking the ASMRs down by age group, those aged over 50 years who had received a booster at least 21 days ago had lower ASMRs in all months, compared with unvaccinated people; this has also been the case among younger age groups where rates can be calculated, although trends are now less clear because of lower mortality rates with large confidence intervals.
- Before March 2022, those who had received a second dose over six months ago had higher monthly ASMRs for deaths involving COVID-19 than those who had received a second dose less than six months ago; this indicates a possible waning protection from vaccination over time.
- The age-adjusted rates are not equivalent to measures of vaccine effectiveness; they account for differences in age structure and population size, but there may be other differences between the groups (particularly underlying health) that affect mortality rates.
- Changes in non-COVID-19 mortality by vaccination status are largely driven by the changing composition of the vaccination status groups; this is because of the prioritisation of people who are clinically extremely vulnerable or have underlying health conditions, and differences in timing of vaccination among eligible people.
- Non-COVID-19 mortality rates can also be affected by seasonal mortality and the healthy vaccinee effect.

2 . Background to the data

Comparing mortality across coronavirus (COVID-19) vaccination status is challenging because the size and age structure of vaccinated and unvaccinated populations change over time. This is because of vaccinations being offered according to priority groups set out by the Joint Committee on Vaccination and Immunisation (JCVI). To account for these differences, we calculated age-standardised mortality rates (ASMRs). However, there are other factors that can influence the mortality rates, such as:

- the health status of individuals
- changing infection levels
- changing dominant variants
- differing levels of immunity from prior infection

ASMRs are therefore not equivalent to measures of vaccine effectiveness. More information on this can be found in our [previous version of this release from December 2021](#).

The vaccination status is split by dose and time since vaccination, to allow for the increase in protection in the first few weeks after vaccination. The time since second dose is further split to allow investigation into waning protection. Booster doses (excluding spring boosters, see below) are defined as a third or booster dose received after 16 September 2021; this is the date from which booster doses were first administered. Therefore, vaccination status can be:

- unvaccinated
- vaccinated with first dose only, less than 21 days after first vaccination
- vaccinated with first dose only, at least 21 days after first vaccination
- vaccinated with first and second doses, less than 21 days after second vaccination
- vaccinated with first and second doses, at least 21 days but less than six months after second vaccination
- vaccinated with first and second doses, at least six months after second vaccination
- vaccinated with first, second and third dose and/or booster, less than 21 days after third or booster vaccination
- vaccinated with first, second and third dose and or booster, at least 21 days after third or booster vaccination

Because of low numbers, the "received only the first and second dose, at least 21 days ago but less than six months ago" and "received only the first and second dose, at least six months ago" are combined into "received only the first and second dose, at least 21 days ago."

The [Joint Committee on Vaccination and Immunisation \(JCVI\) advised in February 2022 a spring booster for the most vulnerable](#); this includes adults aged 75 years and over, residents in care homes for older adults, and those aged 12 years and over who are immunosuppressed. This is given to those who received their most recent vaccine dose (second, third or booster) over six months ago. This spring booster may be present in the National Immunisation Management Service (NIMS) dataset if it is the person's third dose or booster, but it is not being differentiated from a normal third dose or booster in our analysis. Future developments to the handling of spring boosters will be available in future publications.

This bulletin includes monthly ASMRs by vaccination status for deaths involving COVID-19, broken down by age group for the population in the Public Health Data Asset using provisional data on death occurrences for deaths registered by 27 April 2022. More information on the dataset can be found in the [Measuring the data section](#) and our [Deaths involving COVID-19 by vaccination status bulletin from December 2021](#). Annual data and ASMRs broken down by sex and age for deaths involving COVID-19, non-COVID-19 deaths, and all deaths are provided in the dataset for all vaccination statuses. This also includes counts of deaths by vaccination status and weeks since vaccination for all registered deaths.

The ASMRs are not equivalent to vaccine effectiveness and both the non-COVID-19 and COVID-19 ASMRs can be affected by various factors other than vaccination status, such as health status and changes in mortality rates over the year. We are undertaking further analysis to understand the relative impact of these effects.

3 . Monthly age-standardised mortality rates by vaccination status, deaths involving coronavirus (COVID-19)

Figure 1: Monthly age-standardised mortality rates (ASMRs) for deaths involving COVID-19 are consistently lower for people who had a third dose or booster at least 21 days ago than unvaccinated people

ASMRs calculated for each month, by vaccine status, total and by age group, for deaths involving COVID-19, England, deaths occurring between 1 January 2021 and 31 March 2022

Notes:

1. Age-standardised mortality rates (ASMRs) per 100,000 person-years, standardised to the 2013 European Standard Population using five-year age groups from those aged 10 years and over. ASMRs are also presented for specific age groups. "Person-years" account for both the number of people and the amount of time spent in each vaccination status.
2. 95% confidence intervals are indicated by the shaded regions. Where the total number of deaths is less than 100, Dobson's method is used; otherwise, the normal approximation is used. Non-overlapping confidence intervals denote a statistically significant difference in ASMR.
3. Rates for all ages are not calculated where the total number of deaths is less than 10. Rates for age breakdowns are not calculated where the total number of deaths is less than three.
4. Age is defined on the first day of each month.
5. The month in which people in each age group first became eligible for the first vaccination is indicated on the plots, both for people with underlying health conditions and the general population (for the 80 to 89 years and 90 years and over age groups, this is December 2020). Within some age groups, there can be differences in the start of vaccination by age. Some people were vaccinated before the indicated months if they are frontline health and social care workers or people who are clinically extremely vulnerable. Booster vaccinations were first administered on 16 September 2021, indicated on the all-ages plot, initially to people aged over 50 or at higher risk because of occupation or comorbidities.
6. Different scales are used for the age-breakdown plots to allow trends of the mortality rates for the different vaccination status groups within the age groups to be compared.
7. These figures represent death occurrences for deaths registered by 27 April 2022; there can be a delay between the date a death occurred and the date a death was registered. See our [Impact of registration delays on mortality statistics in England and Wales: 2020 article](#).
8. Third dose or booster vaccinations are defined as a third or booster dose received after 16 September 2021, the date from which booster doses were first administered. Therefore, there is no data for third doses or boosters before September for "Third dose, less than 21 days ago" and "Third dose, at least 21 days ago", and within September for "Third dose, at least 21 days ago". Spring boosters have not yet been distinguished in this analysis.

Download the data

[.xlsx](#)

Age standardised mortality rates (ASMRs) for deaths involving COVID-19 for people who had a third dose or booster at least 21 days ago were significantly lower than those for unvaccinated people or those who had received just a first or second dose in all months since booster introduction in September 2021.

ASMR [confidence](#) is influenced by death occurrences and person-years in each vaccination status category. In March, 66% of person-years were attributed to those who had a third dose over 21 days ago, and 14% were attributed to unvaccinated people. The remaining categories have much less confidence, which can be seen as wider, and often overlapping, confidence intervals. This is also especially true for the age breakdowns because there are even fewer deaths per status.

Breaking the ASMRs down by age group, those aged over 50 years who had received a booster at least 21 days ago had lower ASMRs in all months, compared with unvaccinated people. This has also been the case among younger age groups where rates can be calculated, although trends are now less clear because of lower mortality rates with large confidence intervals.

There was a steady rise in the ASMR for COVID-19 deaths in October 2021 to January 2022 for people who had a second dose at least 21 days ago for most age groups. Overall, this increase in ASMR is lower for those who had a second dose less than six months ago, compared with at least six months ago. This changed in March, when the confidence intervals are much wider and now overlap. This is likely linked to decreased person-years in these categories. However, this higher rate for those who were vaccinated a long time ago may suggest they now have limited protection from vaccination. This may also suggest changes in composition of the groups, such as health status. After January 2022, these rates started to fall again.

The mortality rates at least six months after a second dose were similar to those for unvaccinated people from November 2021. However, these rose above the unvaccinated rate in January and remained above the unvaccinated rates as they both decreased. People who had the dose over six months ago may have had it a very long time ago and thus have minimal protection remaining. Similar trends were shown for those over 21 days after second vaccination in the older age groups.

This trend was also seen in the non-COVID-19 mortality rates, as shown in our [accompanying dataset](#). This could be because of a change in composition of the people who have had a second dose, but not a third dose or booster. This is similar to the effect seen in people who had the first dose at least 21 days ago, as discussed in our [Deaths involving COVID-19 by vaccination status bulletin from December 2021](#).

These trends are broadly reflected in the data broken down by age. The first dose ASMR is also slightly increased by the exclusion of people who had received a third dose or booster, but do not have a recorded second dose. This is because of incomplete vaccination records (see the [Strengths and limitations](#) section).

As well as the ASMRs for COVID-19 deaths, the ASMRs for non-COVID-19 deaths and all deaths are provided in our accompanying dataset. These rates can be affected by composition effects, such as the prioritisation of younger people with comorbidities for earlier vaccination than other people in their age group. This also includes the poorer health of people who do not go on to receive subsequent vaccinations when eligible. These effects are discussed in our Deaths involving COVID-19 by vaccination status bulletin from December 2021. Seasonal mortality may also be influencing the rates.

We now include an age breakdown of counts of COVID-19 and non-COVID-19 deaths by weeks since vaccination in our accompanying dataset. Low counts of deaths in the first few weeks after vaccination are indicative of the healthy vaccinee effect, whereby people are less likely to get vaccinated (more likely to delay vaccination) if they are in poor health or unwell. This effect will be explored in future publications. The low counts of deaths involving COVID-19 in the first few weeks post-vaccination are offset by the decreased protection from vaccination. After three weeks post-vaccination, the counts of deaths involving COVID-19 decrease, which is indicative of the protection from vaccination, whereas the counts of non-COVID-19 deaths plateau. These are raw counts and may be affected by factors such as the calendar time when people in the age group received a vaccination and the doses received.

4 . Deaths by vaccination status, England data

[Deaths by vaccination status, England](#)

Dataset | Released 16 May 2022

Age-standardised mortality rates and age-specific mortality rates for deaths involving coronavirus (COVID-19), non-COVID-19 deaths and all deaths by vaccination status.

5 . Glossary

Age-standardised mortality rates

Age-standardised mortality rates (ASMRs) are used to allow comparisons between populations that may contain different proportions of people of different ages. The 2013 European Standard Population is used to standardise rates. In this bulletin, the ASMRs are calculated for each month and for the whole period from 1 January 2021 to 31 March 2022. For more information, see the [Measuring the data](#) section.

Coronaviruses

The World Health Organization (WHO) defines coronaviruses as "a large family of viruses that are known to cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS)". Between 2001 and 2018, there were 12 deaths in England and Wales because of a coronavirus infection, with a further 13 deaths mentioning the virus as a contributory factor on the death certificate.

Coronavirus (COVID-19)

COVID-19 refers to the "coronavirus disease 2019" and is a disease that can affect the lungs and airways. It is caused by a type of coronavirus. Further information is available from the [World Health Organization](#) (WHO).

Statistical significance

The term "significant" refers to statistically significant changes or differences. Significance has been determined using the 95% confidence intervals, where instances of non-overlapping confidence intervals between estimates indicate the difference is unlikely to have arisen from random fluctuation.

95% confidence intervals

A confidence interval is a measure of the uncertainty around a specific estimate. If a confidence interval is 95%, it is expected that the interval will contain the true value on 95 occasions if repeated 100 times. As intervals around estimates widen, the level of uncertainty about where the true value lies increases. The size of the interval around the estimate is strongly related to the number of deaths, prevalence of health states and the size of the underlying population. At a national level, the overall level of error will be small compared with the error associated with a local area or a specific age and sex breakdown. More information is available on our [uncertainty pages](#).

Deaths involving COVID-19

For this analysis, we define a death as involving COVID-19 if either of the ICD-10 codes U07.1 (COVID-19, virus identified) or U07.2 (COVID-19, virus not identified) is mentioned on the death certificate. In contrast to the definition used in the weekly deaths release, deaths where the ICD-10 code U09.9 (post-COVID condition, where the acute COVID-19 had ended before the condition immediately causing death occurred) is mentioned on the death certificate and neither of the other two COVID-19 codes are mentioned are not included. This is because they are likely to be the result of an infection caught a long time previously, and therefore not linked to the vaccination status of the person at date of death. Deaths involving U10.9 (multisystem inflammatory syndrome associated with COVID-19) where U07.1 or U07.2 are not mentioned are also excluded. This is a rare complication affecting children, and there are no such deaths in our dataset.

Out of the 69,386 deaths involving COVID-19 that occurred between 1 January 2021 and 31 March 2022 in our dataset, 84.0% were due to COVID-19 (U07.1 or U07.2 was the underlying cause of death). This is lower for people who have received at least one vaccine dose (79.2%) than unvaccinated people (88.0%).

6 . Measuring the data

Methodological information on the calculation of age-standardised mortality rates can be found in our [accompanying Methodology article](#).

Data sources

The data for the age-standardised mortality rates (ASMRs) are created using the Public Health Data Asset (PHDA), a linked dataset combining the 2011 Census, the General Practice Extraction Service (GPES) data for coronavirus (COVID-19) pandemic planning and research, and the Hospital Episode Statistics (HES). We linked vaccination data from the National Immunisation Management Service (NIMS) to the PHDA based on NHS number.

The PHDA dataset contains a subset of the population. It allows for analyses to be carried out that require a known living population with known characteristics (such as for ASMRs by vaccination status) and the use of variables such as health conditions and census characteristics.

7 . Strengths and limitations

Provisional data are used

Provisional death registrations and death occurrences data are used in this bulletin. This enables timely analysis to be completed to monitor mortality trends. However, as the data for 2021 and 2022 are provisional, they are subject to change.

Use of death occurrences rather than registrations

This publication uses death occurrences registered up to 27 April 2022, rather than death registrations. Because of registration delays, more deaths may be registered at later dates, leading to an increase in the death occurrences. This is especially true for more recent deaths.

Data coverage

The data are for England only, as vaccinations data for Wales are not yet available and the Public Health Data Asset (PHDA) covers England only.

The PHDA dataset was used to calculate the age-standardised mortality rates (ASMRs) by vaccination status. One of the main strengths of the linked PHDA is that it combines a rich set of demographic and socio-economic factors from the 2011 Census and 2019 Patient Register with pre-existing conditions based on clinical records. This unique dataset was linked to the data from the National Immunisation Management Service (NIMS) to allow us to analyse how ASMRs differ by vaccination status. The NIMS data in our dataset cover the period up to 3 May 2022; however, there may be some additional lag in reporting the data.

People with erroneous or inconsistent vaccination data were removed from the analysis. This includes 70,784 people who have a recorded first and third dose or booster but not a second dose. This ensures that deaths are not incorrectly assigned to the wrong vaccination status. However, it also has the effect of reducing the population, therefore increasing the mortality rates for people who received a first dose.

In rare cases, a vaccination may not be recorded if the person has died soon after vaccination and before the record is entered into the system. We therefore include in our dataset an extract of people who died soon after vaccination and do not have a record in NIMS up to 15 February 2022. There were 2,044 people who were vaccinated but not included in the NIMS data as their vaccine record was entered after they had died. Of these, 1,393 linked to our PHDA dataset.

The PHDA contains data on approximately 79% of the population of England aged 10 years and over. It includes 85.9% of all deaths of residents in England that occurred between 1 January 2021 and 31 March 2022 as published in our [Monthly Mortality Analysis, England and Wales dataset](#). This includes all ages and deaths that were registered by 7 April 2022.

The PHDA data contains lower proportions of deaths for the younger age groups because of migration since the 2011 Census. The proportion of deaths of unvaccinated people included in the PHDA is lower than for vaccinated people. This is because younger people are more likely to be unvaccinated and therefore less likely to link to the PHDA than vaccinated, older people. The percentage of all deaths that are in the PHDA is decreasing slightly over time as there are more deaths of people who were not in the 2011 Census or GP patient register. This decrease is especially prominent in the deaths of younger and unvaccinated people. This effect does not affect the quality of the estimates portrayed in this bulletin as the rate uses the same population for numerator and denominator and therefore is not biased by this change. Decreasing numbers in particular groups result in wider confidence intervals for our estimates.

8 . Related links

[Weekly COVID-19 age-standardised mortality rates by vaccination status, England: methodology](#)

Methodology | Released 13 September 2021

Detailed quality and methodology information for coronavirus (COVID-19) age-standardised mortality rates by vaccination status, initially published for Weeks 1 to 26 2021 in "Deaths involving COVID-19 by vaccination status and vaccine manufacturer, England: deaths occurring between 2 Jan and 2 July 2021".

[Coronavirus \(COVID-19\) latest insights](#)

Interactive tool | Updated regularly

A live roundup of the latest data and trends about the coronavirus (COVID-19) pandemic from the Office for National Statistics (ONS) and other sources.

[Deaths registered weekly in England and Wales](#)

Bulletin | Released 10 May 2022

Provisional counts of the number of deaths registered in England and Wales, including deaths involving coronavirus (COVID-19), in the latest weeks for which data are available.

[Coronavirus and vaccination rates in people aged 50 years and over by socio-demographic characteristic, England: 8 December 2020 to 12 December 2021](#)

Bulletin | Released 24 December 2021

First, second, third dose and booster COVID-19 vaccination rates among people aged 50 years and older who live in England, including estimates by socio-demographic characteristic.

[Coronavirus \(COVID-19\) Infection Survey, UK](#)

Bulletin | Released 6 May 2022

Percentage of people testing positive for coronavirus (COVID-19) in private residential households in England, Wales, Northern Ireland and Scotland, including regional and age breakdowns.