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

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

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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 booster introduction in September 2021 for people who had received at least a third dose or booster at least 21 days ago, compared with unvaccinated people and those with just a first or second dose.

- The ASMRs for first and second vaccine doses have been similar to those for unvaccinated people from March to December 2022; however, the confidence limits are wide for these groups because of lower populations in these vaccination statuses.

- The ASMRs 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.

- People who have received at least a third dose or booster may have subsequently received further booster doses, however this is not recorded in our data.

- Non-COVID-19 mortality rates for people who have had at least a third dose or booster at least 21 days ago have been broadly consistent and more similar to those for the unvaccinated population in the latter half of 2022 than in earlier months; in younger people, the boosters were initially targeted at people who were clinically extremely vulnerable, hence why younger people who had received boosters initially had higher non-COVID-19 mortality rates.

- A high proportion of the general population has received three doses, therefore non-COVID-19 mortality rates are similar, though slightly lower, in people who have had at least a third dose or booster compared with unvaccinated people in the latter half of 2022.

- Non-COVID-19 mortality rates for first and second doses are more likely to be affected by confounding factors in the latter half of 2022, as these are people who did not receive a booster when eligible and therefore may differ from the general population.

Statistician's comment

"People who had received at least a third dose, or booster, of a COVID-19 vaccine have been less likely to die from COVID-19 since September 2021 compared with people who are unvaccinated."

"When looking at deaths from other causes, mortality rates are broadly consistent between those who have received at least a third dose or booster and those who have not received any."

"Today's data are not as a measure of vaccine effectiveness as many other factors can affect mortality rates."

Vahé Nafilyan, senior statistician for the Data and Analysis for Social Care and Health division, Office for National Statistics.

2 . Deaths by vaccination status, England data

Deaths by vaccination status, England
Dataset | Released 21 February 2023
Age-standardised mortality rates for deaths involving coronavirus (COVID-19), non-COVID-19 deaths and all deaths by vaccination status, broken down by age group.

3 . 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. For more information see Section 4: Measuring the data.

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.

Confounding factors

Factors that are related both to an outcome (for example, death) and an exposure (for example, vaccination), and therefore must be controlled for in order to find the impact of the exposure on the outcome. For example, age is a confounding factor for analyses of mortality by vaccination status. This is because older people have higher mortality rates in general and were also more likely to be vaccinated earlier because of age-based prioritisation and differences in uptake. Therefore, if age is not controlled for, mortality rates of the vaccinated population can be inflated because of age rather than the impact of vaccination.

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.

4 . Measuring the data

To compare mortality across coronavirus (COVID-19) vaccination statuses, age-standardised mortality rates (ASMRs) are calculated. 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.

Our accompanying dataset includes monthly ASMRs by vaccination status for deaths involving COVID-19, non-COVID-19 deaths, and all deaths. These are broken down by age group and sex for the population in the linked dataset using data on death occurrences between 1 April and 31 December 2022 for deaths registered by 4 January 2023. The dataset also includes counts of deaths by vaccination status for all registered deaths.

Other strengths and limitations, and further information can be found in our previous Deaths involving COVID-19 by vaccination status bulletins.

This release contains changes compared with previous releases. The methodology used to calculate the rates has not changed. The changes are:

- the population used to calculate the mortality rates is based on the Census 2021 linked dataset, not the 2011 Census

- the third dose or booster vaccination categories cover people who have had at least a third dose or booster, but may have had more booster doses

- the back series is produced from April 2021 rather than January 2021 because of the requirement for individuals to be alive on Census Day, 21 March 2021

- we no longer produce data for the "period to date", only monthly, as the length of time elapsed makes the whole period data less interpretable because of changes within this period, such as infection rates

- in previous publications the date of birth was the day of birth; this is now set to day 15 of the month of birth because of Census 2021 data availability for analysis

The Census 2021 linked dataset

The Census 2021 linked dataset is based on the population in the Census 2021. This allows for analyses to be carried out that require a known living population with known characteristics. We linked deidentified Census 2021 records to NHS numbers using the personal demographics service to obtain NHS numbers for census identification numbers. People with no NHS number or multiple entries are not included, and imputed individuals are not included.

The individuals were then linked by their NHS number to vaccination data from the National Immunisation Management Service (NIMS) and the Office for National Statistics (ONS) death registrations. The population was restricted to people in England, alive on 1 April 2021 (51,786,812 people). This is 91.6% of the England population on Census Day 2021.

Previous Deaths by vaccination status publications have used the 2011 Census population as a base population for the analysis. By updating to the Census 2021, we can cover a larger proportion of the population and the data are not affected so much by migration since the census. The NIMS data in our dataset cover the period up to 8 February 2023; however, there may be some additional lag in reporting the data.

Mortality Data

This publication uses death occurrences registered up to 4 January 2023, 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. More information can be found in our Impact of registration delays on mortality statistics in England and Wales: 2020 article. Finalised death data for 2021 are used so no additional death registrations for 2021 will be added but some 2021 death occurrences may yet be registered in 2022. However, provisional death registrations for 2022 are used to enable timely analysis to be completed to monitor mortality change but may be subject to change.

The data for the more recent months, particularly for December 2022, is subject to change as more deaths are registered, and therefore should be interpreted more cautiously.

Of the 895,135 deaths that occurred in England between 1 April 2021 and 31 December 2022 and were registered by 4 January 2021, 90.5% (810,399) could be linked to individuals in the Census 2021.

Vaccination data

Vaccination status is based on the number of doses received (one, two or three or more) and the time since that dose. From the day of vaccination, the individual will be classed as vaccinated.

The Joint Committee on Vaccination and Immunisation (JCVI) advised in February 2022 a spring booster for the most vulnerable, and an autumn booster for those aged 50 years and over and those more at risk because of their occupation or health. People who are in the "at least third dose or booster" category may have received further booster doses, which are not recorded in our dataset. Further developments to the handling of spring and autumn boosters will be available in future publications.

People with erroneous or inconsistent vaccination data were removed from the analysis. This includes 199,772 people who have multiple entries for the same dose or 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 1 November 2022. There were 1,027 new vaccination entries for people who linked to our Census 2021 linked dataset who were vaccinated but not included in the NIMS data as their vaccine record was entered after they had died.

Age-Standardised Mortality Rates (ASMRs)

ASMR confidence is influenced by death occurrences and person-years in each vaccination status category. In December 2022, 66% of person-years were attributed to those who had a third dose over 21 days ago, and 15% 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.

Non-COVID-19 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, England: deaths occurring between 1 January and 31 October 2021 bulletin. Seasonal mortality and the healthy vaccinee effect may also be influencing the rates.

5 . Related links

Coronavirus (COVID-19) latest insights
Interactive tool | Updated regularly
The latest data and trends about the coronavirus (COVID-19) pandemic from the Office for National Statistics and other sources.

Deaths registered weekly in England and Wales, provisional: week ending 3 February 2023
Bulletin | Released 14 February 2023
Provisional number of deaths registered in England and Wales, including deaths involving coronavirus (COVID-19), in the latest weeks.

Coronavirus and vaccination rates in people aged 18 years and over by socio-demographic characteristic, region and local authority, England
Bulletin | Released 9 December 2022
Coronavirus (COVID-19) vaccination rates for people aged 18 years and over in England. Estimates by socio-demographic characteristic, region and local authority.

Coronavirus (COVID-19) Infection Survey, UK: 10 February 2023
Bulletin | Released 10 February 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. Thissurveyis delivered in partnership with University of Oxford, University of Manchester,UK Health Security Agency (UKHSA)and WellcomeTrust, working with the University of Oxfordand partner laboratories tocollect and test samples.

6 . Cite this statistical bulletin

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