

Statistical bulletin

# Deaths involving COVID-19 by vaccination status, England: deaths occurring between 2 January and 24 September 2021

Weekly age-standardised mortality rates and age-specific rates for deaths involving COVID-19 by vaccination status; deaths occurring between 2 January and 24 September 2021 in England.

Contact:  
Charlotte Bermingham, Jasper  
Morgan and Vahé Nafilyan  
health.data@ons.gov.uk  
+44 1633 582486

Release date:  
1 November 2021

Next release:  
To be announced

## Table of contents

1. [Main points](#)
2. [Age-standardised mortality rates by vaccination status](#)
3. [Weekly mortality rates for deaths involving coronavirus \(COVID-19\) by vaccination status](#)
4. [Use and interpretation of age-standardised mortality rates](#)
5. [Comparison to other studies](#)
6. [Deaths by vaccination status, England data](#)
7. [Glossary](#)
8. [Measuring the data](#)
9. [Strengths and limitations](#)
10. [Related links](#)

# 1 . Main points

- Between 2 January and 24 September 2021, the age-adjusted risk of deaths involving coronavirus (COVID-19) was 32 times greater in unvaccinated people than in fully vaccinated individuals.
- The weekly age-standardised mortality rates (ASMRs) for deaths involving COVID-19 were consistently lower for people who had received two vaccinations compared with one or no vaccinations.
- ASMRs take into account differences in age structure and population size to allow comparisons between vaccination status groups; however some differences between the groups such as health status may remain and partly explain the differences in ASMRs.

This bulletin is an update to our previous article "[Deaths involving COVID-19 by vaccination status, England: deaths occurring between 2 January and 2 July 2021](#)".

## 2 . Age-standardised mortality rates by vaccination status

Because vaccinations were being offered according to priority groups set out by the Joint Committee on Vaccination and Immunisation (JCVI), the characteristics of the vaccinated and unvaccinated populations are changing over time. To account for differences in population size and age structure of the vaccination status groups over time, we calculated age-standardised mortality rates (ASMRs) for deaths involving coronavirus (COVID-19) (Figure 1) using the Public Health Data Asset (PHDA) dataset (see [Measuring the data](#)). This is a dataset containing people who reside in England who could be linked to the 2011 Census and the GP Patient Register 2019, which covers approximately 79% of people aged 10 years and over living in England. ASMRs for all-cause deaths and age-specific rates for deaths involving COVID-19 are also included in the [accompanying dataset](#).

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 vaccination status is one of:

- unvaccinated
- received only the first dose, less than 21 days ago
- received only the first dose, at least 21 days ago
- received the second dose, less than 21 days ago
- received the second dose, at least 21 days ago

The ASMRs for deaths involving COVID-19 and all causes for vaccination status groups over the period 2 January to 24 September 2021 (Week 1 to Week 38) are shown in Table 1. These ASMRs are calculated in person-years at risk to account for the different time people spent in each vaccination state in the period.

Table 1: The age-standardised mortality rate for deaths involving COVID-19 is 32 times higher for unvaccinated people than for those who received the second dose

Age-standardised mortality rates for all deaths and deaths involving COVID-19, England, deaths occurring between 2 January and 24 September 2021

Vaccination status	Age-standardised mortality rate per 100,000 person-years (95% confidence interval)	
	Deaths involving COVID-19	All deaths
Unvaccinated	849.7 (840.3, 859.2)	2,187.1 (2,172.2, 2,202.0)
Received only the first dose, less than 21 days ago	192.4 (182.4, 202.4)	811.9 (793.4, 830.4)
Received only the first dose, at least 21 days ago	105.3 (102.8, 107.8)	1,124.3 (1,115.9, 1,132.7)
Received the second dose, less than 21 days ago	7.2 (6.1, 8.2)	464.6 (455.8, 473.4)
Received the second dose, at least 21 days ago	26.2 (25.4, 27.1)	783.6 (779.1, 788.0)

Source: Office for National Statistics – Public Health Data Asset, National Immunisation Management Service

#### Notes

1. Age-standardised mortality rates per 100,000 person-years, standardised to the 2013 European Standard Population using five-year age groups from those aged 10 years and over. "Person-years" take into account both the number of people and the amount of time spent in each vaccination status. For example, 100 people in a particular vaccination status for 0.5 years would be 50 person-years.
2. Office for National Statistics (ONS) figures based on death registrations up to 28 July 2021 for deaths that occurred between 2 January and 24 September 2021 (Week 1 to Week 38) and were registered by 6 October 2021.
3. ASMRs are calculated using the Public Health Data Asset, a linked dataset of people resident in England, who could be linked to the 2011 Census and GP Patient Register.
4. Deaths were defined using the International Classification of Diseases, tenth revision (ICD-10). Deaths involving the coronavirus (COVID-19) are defined as those with an underlying cause, or any mention of, ICD-10 codes U07.1 (COVID-19 virus identified) or U07.2 (COVID-19, virus not identified). Please note, this differs from the definition used in the majority of mortality outputs (see Glossary).
5. Non-overlapping confidence intervals denote a statistically significant difference in ASMR.
6. Low ASMRs for deaths in people who had received a dose less than 21 days prior could be resulting from people who had recently been infected or had another illness not receiving their dose.

The ASMRs for total deaths and deaths involving COVID-19 are significantly higher among people who are unvaccinated than people who had received either one or two doses. The ASMR for deaths involving COVID-19 for unvaccinated people is 32 times greater than that of people who had received two doses at least 21 days ago.

Age-standardised mortality rates (ASMRs) can be affected by differing characteristics of the population in the vaccination status groups and the changing COVID-19 infection rate. Therefore, the ASMRs do not show causal links between vaccines and risk of mortality.

### 3 . Weekly mortality rates for deaths involving coronavirus (COVID-19) by vaccination status

## Figure 1: Age-standardised mortality rates for deaths involving COVID-19 are consistently lower for people who have received two vaccinations

Weekly age-standardised mortality rates for deaths involving COVID-19 by vaccination status, England, deaths occurring between Week 1 (week ending 8 January 2021) and Week 38 (week ending 24 September 2021)

**Source: Office for National Statistics – Public Health Data Asset, National Immunisation Management Service**

### Notes:

1. Age-standardised mortality rates per 100,000 people per week, standardised to the 2013 European Standard Population using five-year age groups from those aged 10 years and over.
2. Office for National Statistics (ONS) figures based on death registrations up to 28 July 2021 for deaths that occurred between 2 January and 24 September 2021 (Week 1 to Week 38) and were registered by 6 October 2021.
3. ASMRs are calculated using the Public Health Data Asset, a linked dataset of people resident in England, who could be linked to the 2011 Census and GP Patient Register.
4. Deaths were defined using the International Classification of Diseases, tenth revision (ICD-10). Deaths involving the coronavirus (COVID-19) are defined as those with an underlying cause, or any mention of, ICD-10 codes U07.1 (COVID-19 virus identified) or U07.2 (COVID-19, virus not identified). Please note, this differs from the definition used in the majority of mortality outputs (see [Glossary](#)).
5. Age and vaccination status are defined on the date of death where a death has occurred, and on the last day of the week if not.
6. 95% confidence intervals are indicated by the shaded regions. Non-overlapping confidence intervals denote a statistically significant difference in ASMR.
7. Rates are not calculated where the total number of deaths is less than 10.
8. Data may differ from that previously published in “Deaths involving COVID-19 by vaccination status, England: deaths occurring between 2 January and 2 July 2021” as more deaths have since been registered.

### [Download the data](#)

As shown in Figure 1, the weekly age-standardised mortality rates (ASMRs) for people who had received two vaccination doses are lower than those for people who have received one dose or are unvaccinated in every week of the period. The weekly ASMRs for people who had received only one dose are in general lower than the ASMRs for people who were unvaccinated but higher than those for people who had received two vaccination doses.

Weekly age-specific mortality rates were calculated for aggregated age groups rather than the usual five-year age groups because of low numbers of deaths in some age groups which could pose a risk of disclosure of the vaccination status of individuals and result in unstable estimates. The age-specific rates are included in the [accompanying dataset](#) and can be used to highlight which age groups are driving changes in the age-standardised mortality rates.

The weekly counts of total deaths and deaths involving COVID-19 will not equal those in other Office for National Statistics publications because we use the Public Health Data Asset (PHDA) as the population for the ASMRs. See [Glossary](#).

## 4 . Use and interpretation of age-standardised mortality rates

Age-standardised mortality rates (ASMRs) allow for comparison of mortality rates of populations with different age structures, as the population is standardised in five-year age groups to a standard population. Information on how ASMRs are calculated can be found in our [Methodology article](#). Age standardisation is important when comparing mortality rates of different vaccination status groups, as the age structures of the populations differ greatly between the groups and over time.

While the ASMRs provide evidence that vaccinated individuals have a lower risk of dying of coronavirus (COVID-19) than unvaccinated individuals, they cannot be used to determine vaccine effectiveness. This is because the populations in each vaccine status group are likely to differ in ways other than population size and age because of the [selective roll out of the vaccination programme](#) and differences in [vaccine uptake](#). Care should be taken in interpreting trends in the ASMRs as these cannot be causally linked to vaccinations. Differences between the groups and over time, such as health status, can have a particularly large effect on the ASMRs, especially when the population becomes unrepresentative of the age group in general. This can happen if people with particular characteristics, such as poor health, remain in a particular vaccination status group.

For example, the total mortality rate for the "21 days or more after first dose" group increases sharply from approximately week 13 to week 19 (Table 2 of the [accompanying dataset](#)). However, looking at the percentage of elderly people who are in this vaccination status group (Table 4 of the [accompanying dataset](#)), we see that this drops to very low levels around the same weeks, therefore the mortality rates are based on a very small percentage of the elderly population, which may not be representative of the elderly population in general. For example, this group may include people who did not receive a second vaccination after receiving the first because of being hospitalised for a serious condition. Similar patterns are observed for the "unvaccinated" and "within 21 days of first dose" groups at earlier times of the year. This effect is much reduced as age decreases.

## 5 . Comparison to other studies

To calculate age-specific mortality rates and age-standardised mortality rates (ASMRs), we need to know both the number of deaths and the number of living people in each age group and their vaccination status. There are different approaches to determining the population, which affect the reported mortality rates and ASMRs. If the population is estimated using the National Immunisation Management System (NIMS) or people registered with a GP, this can result in an overestimate of the unvaccinated population because of the inclusion of people who have died or moved away. Conversely, using Office for National Statistics (ONS) population estimates and deriving the unvaccinated population as the difference to the number of vaccinated people, could result in underestimating the unvaccinated population if the ONS population estimates are lower than the true value.

We used the Public Health Data Asset, a dataset based on the 2011 Census, linked to mortality data and NIMS vaccination data, to obtain both the numerators and denominators for mortality rates. This covers approximately 79% of all people aged 10 years and over and the use of the census linked to GP records means there should be minimal overestimation of the unvaccinated population.

Estimates of ASMRs by vaccination status are also published by [Public Health England](#). In addition to the use of a different population, these estimates define vaccination status at the date of infection rather than the date of death and therefore are not equivalent to the rates in this bulletin.

Published studies have calculated vaccine effectiveness using observational methods, taking into account known differences in characteristics of vaccinated and unvaccinated people, and confirming the [lack of bias because of remaining unobserved differences between the groups](#). All three vaccines have reported vaccine effectiveness of [over 90% against coronavirus \(COVID-19\) mortality \(PDF, 2.29MB\)](#).

## 6 . Deaths by vaccination status, England data

### [Deaths by vaccination status, England](#)

Dataset | Released 1 November 2021

Weekly age-standardised mortality rates and age-specific rates for deaths involving COVID-19 and all deaths by vaccination status. This updated dataset also includes a comparison of populations and counts of deaths in different sources that can be used to calculate the rates.

## 7 . 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 week and for the whole period from 2 January to 24 September 2021. For more information see [Section 8: 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](#).

## 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 mentioned are also excluded. This is a rare complication affecting children, and there are no such deaths in our dataset for the data released in Deaths involving COVID-19 by vaccination status, England: deaths occurring between 2 January and 24 September 2021.

## 8 . 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 and 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.

## 9 . 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 are provisional, they are subject to change.

### Use of death occurrences rather than registrations

This publication uses death occurrences registered up to 6 October 2021, 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 is not yet available and the Public Health Data Asset (PHDA) covers England only.

The PHDA dataset was used in order 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 PHDA contains data on approximately 79% of the population of England aged 10 years and over and includes 85.7% of all deaths of residents in England that occurred between 2 January 2021 and 24 September 2021 and were registered by 6 October 2021. Comparative numbers of deaths between the PHDA and all deaths can be found in Tables 5 and 6 of the [accompanying dataset](#).

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 slightly lower than for vaccinated people, because younger people are more likely to be unvaccinated and unlinked people (who would be classed as unvaccinated) are not included in the PHDA. The proportions of the population in each vaccination status in the PHDA are similar to NIMS if Office for National statistics population estimates are used for the total population (Table 7 of the [accompanying dataset](#)). If, however, the NIMS data uses a total population also from NIMS, the unvaccinated proportion is much higher than in the PHDA because of overestimation of the unvaccinated population. The NIMS data in our dataset cover the period up to 13 October 2021; however, there may be some additional lag in reporting the data.

## Acknowledgement

We would like to thank Dr. James Doidge, Senior Statistician at Intensive Care National Audit & Research Centre (ICNARC), for assisting in the interpretation of results.

## 10 . Related links

### [Deaths involving COVID-19 by vaccination status, England: deaths occurring between 2 January and 2 July 2021](#)

Article | Released 13 September 2021

An analysis of deaths involving COVID-19 that occurred between 2 January and 2 July 2021 in England, by vaccination status. Includes weekly age-standardised mortality rates for deaths involving COVID-19 by vaccination status and a detailed analysis of deaths involving COVID-19 that occurred in fully vaccinated individuals.

### [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 25 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 ONS and other sources.

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

Bulletin | Released 26 October 2021

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

### [Coronavirus and vaccination rates in people aged 70 years and over by socio-demographic characteristic, England: 8 December 2020 to 9 May 2021](#)

Bulletin | Released 7 June 2021

First and second dose COVID-19 vaccination rates among people aged 70 years and older who live in England, both in private households and communal establishments. Includes estimates by socio-demographic factor such as ethnic group, religious group, and those identified as disabled.

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

Bulletin | Released 22 October 2021

Estimates for England, Wales, Northern Ireland and Scotland. This survey is being delivered in partnership with University of Oxford, University of Manchester, Public Health England and Wellcome Trust. This study is jointly led by the ONS and the Department for Health and Social Care (DHSC) working with the University of Oxford and Lighthouse laboratory to collect and test samples.