

Statistical bulletin

# Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK: 6 October 2021

Characteristics of people testing positive for COVID-19 from the Coronavirus (COVID-19) Infection Survey. 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.

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## Table of contents

1. [Main points](#)
2. [Reinfections of COVID-19, UK](#)
3. [Risk factors associated with COVID-19 reinfections, UK](#)
4. [Characteristics of people testing positive for COVID-19 data](#)
5. [Collaboration](#)
6. [Glossary](#)
7. [Measuring the data](#)
8. [Strengths and limitations](#)
9. [Related links](#)

# 1 . Main points

- The estimated number of reinfections in the UK between July 2020 and September 2021, is low overall (11.8 per 100,000 participant days at risk), and reinfections more likely to cause serious illness are even lower (5.5 per 100,000 participant days at risk).
- Between July 2020 and September 2021, the risk of reinfection was higher in the period after 17 May 2021 compared with the period before; this reflects a higher risk of reinfection during the period when the Delta variant of coronavirus (COVID-19) was the dominant strain.
- Participants who had a lower viral load in their initial infection were at a higher risk of reinfection compared with participants who had a higher viral load at their initial infection.

## About this bulletin

This fortnightly bulletin series presents the latest analysis on the characteristics of people testing positive for SARS-CoV-2, the coronavirus causing the COVID-19 disease in the UK. Our [analysis on the characteristics of people testing positive for COVID-19](#) is still available.

In this bulletin, we refer to the number of COVID-19 infections within the community population; this refers to private residential households, and excludes those in hospitals, care homes and other institutional settings in the UK. We include current COVID-19 infections, which we define as testing positive for SARS-CoV-2, with or without having symptoms, on a swab taken from the nose and throat.

### More about coronavirus

- Find the latest on [coronavirus \(COVID-19\) in the UK](#).
- [Explore the latest coronavirus data](#) from the ONS and other sources.
- All ONS analysis, summarised in our [coronavirus roundup](#).
- View [all coronavirus data](#).
- Find out how we are [working safely in our studies and surveys](#).

More information on our headline estimates of the overall number of positive cases in England, Wales, Northern Ireland and Scotland are available in our [latest weekly bulletin](#). Our [methodology article](#) provides more information on the methods used for our models.

Analysis in this bulletin is for a different time period to the headline figures presented in the weekly COVID-19 Infection Survey bulletin. Reference periods are clearly stated at the start of each section, with more detail on what the analysis covers.

## 2 . Reinfections of COVID-19, UK

This section looks at the rate of coronavirus (COVID-19) reinfections in the UK between 2 July 2020 and 25 September 2021. We first presented results of reinfection analysis in [Coronavirus \(COVID-19\) Infection Survey technical article: analysis of reinfections of COVID-19: June 2021](#), but have updated our methodology for analysis relating to reinfections since that time. Our [article](#) gives a more detailed explanation of the methods used.

This analysis is not directly comparable with reinfection analysis published on 29 June 2021. From the 25 August 2021 we updated our definition of reinfection to use a cut-off of 120 days rather than 90 days. Further methodological improvements have been made to our modelling approach as of 6 October 2021. Details are available in [Coronavirus \(COVID-19\) Infection Survey technical article: analysis of reinfections of COVID-19: June 2021](#).

Improvements to our modelling approach apply to reinfections analysis based on the COVID-19 Infection Survey, published from 6 October 2021 onwards. Previously, when the number of reinfections was low, we estimated the number of reinfections over time and were unable to consider factors, such as vaccination status, that can influence an individual's risk of experiencing a possible reinfection event. Since we first began monitoring reinfections, they have increased allowing us to estimate reinfection rates in the context of vaccination status, patient-facing occupations, and what type of variant was dominant at the time, as well as other factors. Details are available in [Coronavirus \(COVID-19\) Infection Survey technical article: analysis of reinfections of COVID-19: June 2021](#).

Tables 1a to 1e in the [accompanying dataset](#) to this bulletin provide the updated data.

The analysis presented in this section includes individuals who have had at least one positive test recorded in the survey and meet our criteria for being "at risk" of reinfection where:

- 120 days has elapsed since an individual's first positive test in the survey and their most recent test result was negative
- if 120 days has not passed since their first positive test in the survey, the individual's last positive test has been followed by four consecutive negative tests

An individual being classified as "at risk" reflects that it is possible for a test of theirs to be considered a reinfection if it turns out to be positive. The "at-risk period" refers to the period following the first time we could have defined a reinfection. A reinfection is therefore defined as when an individual who meets these criteria has a positive test.

All estimates of COVID-19 reinfections in this analysis are unweighted. The sample for this analysis includes only those who have tested positive for COVID-19 on a swab test, and so there is no known population of which weighted estimates could be representative.

The analysis includes 20,262 participants "at risk" of reinfection and 296 reinfections identified between 2 July 2020 and 25 September 2021. The median time between positive episodes in those with reinfections was 203 days (tables 1a and 1b in our [accompanying dataset](#)).

The number of reinfections is low overall, and reinfections with a high viral load (which are more likely to cause illness) are even lower. The estimated rate for all reinfections including those with a lower viral load was 11.8 per 100,000 participant days at risk (95% confidence interval: 10.5. to 13.2) over the entire at-risk period. The estimated rate for reinfections with a high viral load (strong positive test where Cycle Threshold (Ct values) were less than 30), was 5.5 per 100,000 participant days at risk (95% confidence interval: 4.6 to 6.5) over the entire at-risk period. Participant days at risk and Ct values are further defined in our [glossary](#).

After 17 May 2021 significant numbers of Delta infections were observed in the survey. Therefore, we have looked at the difference between initial infections and reinfections in terms of viral load before and from this time to understand more about the impact variants have on the viral load of those experiencing reinfections. Analysis of Ct values between the first infection episode and second infection episode for individuals with suspected reinfections, before 17 May 2021, show that the median Ct value was higher (indicating a lower viral load) at second infection than at first infection. However, after 17 May 2021, there appears to be less difference between Ct value distribution at the first and second infection episodes. These findings suggest viral loads at reinfection tend to be higher where reinfections are predominantly from the Delta variant, compared with other variants.

The estimated rate of COVID-19 reinfection according to additional Ct analysis can be found in the [accompanying dataset](#) for this bulletin.

Table 1: Rate of reinfections per 100,000 participant days at risk

Estimated rate of COVID-19 reinfections per 100,000 participant days at risk, averaged for entire at-risk period, 2 July 2020 to 25 September 2021, UK

Definition	Number of participants at risk	Number of identified reinfections	Estimated rate of reinfections (per 100,000 participant days at risk)	Lower 95% confidence interval	Upper 95% confidence interval
<b>All reinfections definition</b>	20,262	296	11.8	10.5	13.2
<b>Reinfections with Ct less than 30</b>	20,262	137	5.5	4.6	6.5

Source: Office for National Statistics – Coronavirus (COVID-19) Infection Survey

**Notes**

1. For the purposes of this analysis we define reinfection as a new positive test 120 days or more after an initial first positive test which was preceded by at least one negative test or where an individual has had a subsequent positive test following four consecutive negative tests regardless of the time since the first positive.
2. A confidence interval gives an indication of the degree of uncertainty of an estimate, showing the precision of a sample estimate. A wider interval indicates more uncertainty in the estimate.

### 3 . Risk factors associated with COVID-19 reinfections, UK

This section presents updated analysis of the risk factors associated with a COVID-19 reinfection identified among participants across the UK between 2 July 2020 and 20 September 2021. Previously, when the number of reinfections was low, we estimated the number of reinfections over time and were unable to consider factors, such as vaccination status, that can influence an individual's risk of experiencing a possible reinfection event. Since we first began monitoring reinfections, the number has increased allowing us to estimate reinfection rates in the context of vaccination status, patient-facing occupations, and the type of variant that was dominant at the time.

[Coronavirus \(COVID-19\) Infection Survey technical article: analysis of reinfections of COVID-19: June 2021](#) outlines the model used to investigate how the rate of reinfection varies over time and between individuals. This model explores multiple factors including age, sex, ethnicity, cycle threshold (Ct) value observed in the initial infection, deprivation, household size, work in patient-facing healthcare, long-term health conditions, vaccination status and the period during which an individual was at risk. We define the Alpha-dominant period as prior to 17 May 2021, and the Delta-dominant period from 17 May 2021.

For updated methodology, please refer to our [technical article](#).

#### Interpreting the charts

Results are presented as hazard ratios (see [glossary](#)) which give the risk of reinfection in a specified group compared with the risk of reinfection in a reference group. When a characteristic (for example, being female) has a hazard ratio greater than one, this means that there is an increased risk of reinfection compared with a reference category (for example, being male). A hazard ratio lower than one means that there is a decreased risk of reinfection compared with the reference category.

The analysis includes 20,155 participants "at risk" of reinfection and 285 reinfections identified between 2 July 2020 and 20 September 2021. The median time between positive episodes in those with reinfections was 201 days.

The risk of reinfection was higher in the period after 17 May 2021 compared with the period before, this reflects a higher risk of reinfection during the period when the Delta variant of COVID-19 was the dominant strain.

Overall, reinfections were more likely to happen the further a participant was from their initial infection and in those participants with a lower viral load (high Ct value) during their initial infection episode.

Tables 2a to 2c in the [accompanying dataset](#) to this bulletin provide relevant data.

**Figure 1: There was a higher risk of reinfection after 17 May 2021, during the period when the Delta variant of COVID-19 was the dominant strain compared with before 17 May 2021**

Reinfection hazard ratios for factors included in the model, 2 July 2020 to 20 September 2021, UK

Notes:

1. This figure includes hazard ratios for all factors in the model except for Ct value.
2. A hazard ratio of greater than 1 indicates more risk in the specified group compared with the reference group, and a hazard ratio of less than 1 indicates less risk.
3. Deprivation is based on an index of multiple deprivation (IMD) score in England or equivalent scoring method for the devolved administrations, from 1 which represents most deprived up to 100 which represents least deprived. The hazard ratio shows how a 10 unit increase in deprivation score, which is equivalent to 10 percentiles or 1 centile, affects the likelihood of testing positive for reinfection with COVID-19.
4. We define the Alpha dominant period as prior to 17 May 2021, and the Delta dominant period as after the 17 May 2021.
5. Although included in the model, the effect of Ct values is not included in this figure and are presented separately in Figure 2.

[Download the data](#)

## Risk of reinfection by viral load

Figure 2 shows that the risk of reinfection is higher in primary infections with higher Ct values (lower viral load); this may be because of a weaker immune response in "milder" primary infections. For example, individuals with an initial infection with a Ct value of 35 or more were twice as likely to get reinfected compared with those with a first infection with a Ct value of 20. Risk of reinfection and associated confidence intervals for Ct values below 20 as compared with the reference category are available in our [accompanying dataset](#). Confidence intervals for these values are wide owing to fewer reinfections within this group.

### **Figure 2: The risk of reinfection was higher if a participant had a low viral load (indicated as a high Ct value), during their initial infection**

Reinfection hazard ratios for Ct values 20 and above, across the initial infection episode, 2 July 2020 to 20 September 2021, UK

#### Notes

1. All hazard ratios are compared against a Ct value of 20.
2. A hazard ratio of greater than 1 indicates more risk in the specified group compared with the reference group, and a hazard ratio of less than 1 indicates less risk.
3. A confidence interval gives an indication of the degree of uncertainty of an estimate, showing the precision of a sample estimate. A wider interval indicates more uncertainty in the estimate.

[Download the data](#)

## Risk of reinfection over time

To show how a person's risk of reinfection changes over time, we focus on a "reference category" of person and present how the risk of reinfection has changed for individuals within that category. The rates presented here are for people aged 60 years, who are male, in a non-patient facing healthcare role, live in an area of median deprivation, a household size of 3, have no long-term health condition, a higher viral load in their first infection (Ct value of 20), have not received a second dose of the vaccine and are currently in the "Alpha" period (prior to 17 May 2021).

Overall, this analysis confirms that reinfections become more likely the longer participants are "at risk" for reinfection. Figure 3 shows how the estimated rate of reinfection increases as the number of days at risk increase.

### Figure 3: Estimated rates of reinfection for the reference category shows a general increase in risk of reinfections over time

Estimated rate of COVID-19 reinfection for the reference category used in the analysis according to time at risk per 100,000 participant days, 2 July 2020 to 20 September 2021, UK

#### Notes:

1. The reference category is those aged 60 years, male, in a non-patient facing healthcare role, median deprivation, household size of 3, no long-term health condition, first infection Ct value of 20, no second dose of the vaccine and currently in the "Alpha" period (prior to 17 May 2021).
2. A confidence interval gives an indication of the degree of uncertainty of an estimate, showing the precision of a sample estimate. A wider interval indicates more uncertainty in the estimate.

[Download the data](#)

## 4 . Characteristics of people testing positive for COVID-19 data

[Coronavirus \(COVID-19\) Infection Survey, characteristics of people testing positive for COVID-19, UK](#)

Dataset | Released 6 October 2021

Characteristics of people testing positive for coronavirus (COVID-19) taken from the COVID-19 Infection Survey.

## 5 . Collaboration

The Coronavirus (COVID-19) Infection Survey analysis was produced by the Office for National Statistics (ONS) in partnership with the University of Oxford, the University of Manchester, Public Health England and Wellcome Trust. Of particular note are:

- Sarah Walker - The University of Oxford, Nuffield Department for Medicine: Professor of Medical Statistics and Epidemiology and Study Chief Investigator
- Koen Pouwels - The University of Oxford, Health Economics Research Centre, Nuffield Department of Population Health: Senior Researcher in Biostatistics and Health Economics
- Thomas House - The University of Manchester, Department of Mathematics: Reader in mathematical statistics

## 6 . Glossary

### Confidence interval

A confidence interval gives an indication of the degree of uncertainty of an estimate, showing the precision of a sample estimate. The 95% confidence intervals are calculated so that if we repeated the study many times, 95% of the time the true unknown value would lie between the lower and upper confidence limits. A wider interval indicates more uncertainty in the estimate. Overlapping confidence intervals indicate that there may not be a true difference between two estimates.

## Cycle threshold (Ct) values

The strength of a positive coronavirus (COVID-19) test is determined by how quickly the virus is detected, measured by a cycle threshold (Ct) value. The lower the Ct value, the higher the viral load and stronger the positive test. Positive results with a high Ct value can be seen in the early stages of infection when virus levels are rising, or late in the infection, when the risk of transmission is low.

## Hazard ratio

A measure of how often a particular event happens in one group compared with how often it happens in another group, over time. When a characteristic (for example, being male) has a hazard ratio of one, this means that there is neither an increase nor a decrease in the risk of reinfection compared with a reference category (for example, being female).

## Participant days at risk

The risk of reinfection varies from person to person, depending on when they were first infected. People who were first infected in the early part of the survey have had more opportunity to become reinfected compared with someone who has experienced their first infection more recently. Therefore, this analysis uses "participant days at risk" to determine the number of reinfections.

## Median

The median is the middle number in a sorted, ascending or descending, list of numbers.

For more information, see our [methodology page on statistical uncertainty](#).

## 7 . Measuring the data

Additional information on strengths, limitations, appropriate uses, and how the data were created is available in the [Coronavirus \(COVID-19\) Infection Survey Quality Methodology Information \(QMI\)](#). Our [methodology article](#) provides further information around the survey design, how we process data and how data are analysed.

## 8 . Strengths and limitations

More information on [strengths and limitations](#) is available in the [Coronavirus \(COVID-19\) Infection Survey statistical bulletin](#).

Further information on test accuracy can be found in our blog: [Accuracy and confidence: why we trust the data from the COVID-19 infection survey](#).



## 9 . Related links

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

Bulletin | Updated weekly

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

### [Coronavirus \(COVID-19\) Infection Survey: antibody and vaccination data for the UK](#)

Article | Updated fortnightly

Antibody and vaccination data by UK country and regions in England from the Coronavirus (COVID-19) Infection Survey. This analysis has been produced 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 Laboratories to collect and test samples.

### [COVID-19 Infection Survey: methods and further information](#)

Methods article | Updated 24 August 2021

Information on the methods used to collect the data, process it, and calculate the statistics produced from the COVID-19 Infection Survey pilot.

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

Interactive tool | Updated as and when data become available

Explore the latest data and trends about the coronavirus (COVID-19) pandemic from the ONS and other official sources.

### [Coronavirus \(COVID-19\) roundup](#)

Web page | Updated as and when data become available

Catch up on the latest data and analysis related to the coronavirus pandemic and its impact on our economy and society.

### [COVID-19 Infection Survey \(CIS\)](#)

Article | Updated regularly

Whether you have been invited to take part or are just curious, find out more about our COVID-19 Infection Survey and what is involved.

### [Coronavirus \(COVID-19\) Infection Survey technical article: analysis of reinfections of COVID-19: June 2021](#)

Article | Updated 6 October 2021

This release provides data and methodological information about analysis of reinfections of COVID-19 from the COVID-19 Infection Survey. This analysis has been produced in partnership with University of Oxford.