Statistical bulletin

Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK: 3 November 2021

Characteristicsof 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, UK Health Security Agency andWellcomeTrust.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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1 . Main points

Reinfections between July 2020 and October 2021:

- The estimated rate of reinfections in the UK is low overall (11.9 per 100,000 participant days at risk), and reinfections with a high viral load are even lower (6.1 per 100,000 participant days at risk).

- The risk of reinfection was higher in the period from 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, but the risk of reinfection remains low.

- 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.

Predictors of positivity between 4 and 17 October 2021:

- Those living in a household of multiple occupancy continued to be more likely to test positive than single occupancy households.

- People working in the education sector continued to be more likely to test positive in comparison with those working in other sectors; this is likely related to the continuing higher infection levels among school-aged children.

- Those who work in a care or nursing home were less likely to test positive in comparison to those who do not.

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. This is part of our series of analysis on the characteristics of people testing positive for COVID-19.

In this bulletin, we refer to the number of current COVID-19 infections within the population living in private residential households. We exclude those in hospitals, care homes and/or other communal establishments. In communal establishments, rates of COVID-19 infection are likely to be different.

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 with COVID-19, UK

This section looks at the rate of coronavirus (COVID-19) reinfections in the UK between 2 July 2020 and 23 October 2021. We first presented results of reinfection analysis in our Coronavirus (COVID-19) Infection Survey technical article: analysis of reinfections of COVID-19: June 2021. The technical article provides a more detailed explanation of the methods used, some of which have since been updated. Improvements to our modelling approach apply to data published from 6 October 2021 onward.

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.

Tables 1a to 1e in the Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK dataset 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 "at risk" individual has a positive test.

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

The analysis included 20,757 participants "at risk" of reinfection and 358 reinfections identified between 2 July 2020 and 23 October 2021. The median time between positive episodes in those with reinfections was 224 days (tables 1a and 1b in the [Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK dataset](#)).

The rate 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 11.9 per 100,000 participant days at risk (95% confidence interval: 10.7 to 13.2) over the entire at-risk period. We identify viral load by how quickly the virus can be detected. This is measured by Cycle Threshold (Ct values) which are lower with a high viral load. Lower viral loads take more time to detect, so the Ct value will be higher. The estimated rate for reinfections with a high viral load (strong positive test where Ct values were less than 30), was 6.1 per 100,000 participant days at risk (95% confidence interval: 5.3 to 7.1) over the entire at-risk period. Participant days at risk and Ct values are further defined in our [glossary](#).

From 17 May 2021 significant numbers of Delta infections were observed in the survey. We looked at the difference between initial infections and reinfections in terms of viral load both before and after this time to examine the impact variants had on the viral load of 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, from 17 May 2021, the median Ct value was lower (indicating a higher viral load) at second infection than at first infection. These findings indicate that viral loads at reinfection are higher where reinfections are predominantly from the Delta variant, compared with other variants.

Before 17 May 2021, the likelihood of an individual having symptoms of COVID-19 and a higher Ct value (lower viral load) in their second infection is lower compared with their first infection. This was not seen for individuals infected from 17 May 2021 where people are just as likely to have symptoms of COVID-19 and a low Ct value (high viral load) in their second infection as their first infection.

The estimated rate of COVID-19 reinfection according to additional Ct analysis can be found in the [Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK 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 23 October 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
All reinfections definition	20,757	358	11.9	10.7	13.2
Reinfections with Ct less than 30	20,757	184	6.1	5.3	7.1

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 coronavirus (COVID-19) reinfection identified among participants across the UK between 2 July 2020 and 18 October 2021. Previously, when the number of reinfections was low, we estimated the rate of reinfections over time and were unable to consider factors, such as vaccination status, that may 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 as well as other factors.

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

This analysis included 20,606 participants "at risk" of reinfection and 340 reinfections identified between 2 July 2020 and 18 October 2021. The median time between positive episodes in those with reinfections was 214 days.

The risk of reinfection continued to be higher in the period from 17 May 2021 compared with the period before. This is measured by a hazard ratio of 1.74 (95% confidence interval: 1.26 to 2.40), which implies a 74% higher risk (95% confidence interval: 26% to 140%). This reflects a higher risk of reinfection during the period when the Delta variant of COVID-19 was the dominant strain.

People with a long-term health condition were more likely to be reinfected, shown by a hazard ratio of 1.36 (95% confidence interval: 1.05 to 1.77). People who reported symptoms within 35 days of the first positive test in their first infection were less likely to be reinfected, with a hazard ratio of 0.73 (95% confidence interval: 0.57 to 0.93). Older people were less likely to reinfected, shown by a hazard ratio of 0.91 (95% confidence interval: 0.85 to 0.97) for every 10 year increase in age.

Tables 2a to 2c in the Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK dataset provide relevant data.

Figure 1: There was a higher risk of reinfection from 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, UK, 2 July 2020 to 18 October 2021

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 10 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 from 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.

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Risk of reinfection by viral load

Figure 2 shows that the risk of reinfection is higher in individuals who had a higher Ct value (lower viral load) at their first infection; 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 as compared with the reference category (Ct value of 20) are available in the Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK 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 across the initial infection episode, UK, 2 July 2020 to 18 October 2021

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 to 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.

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Risk of reinfection over time

To show how a person's risk of reinfection changes over time, we focus on a "reference category" and present how the risk of reinfection has changed for individuals within that category. The rates presented here are for people who:

- are aged 60 years

- are male

- are in a non-patient facing healthcare role

- are living in an area of median deprivation

- are in a household size of three

- have no long-term health conditions

- had a higher viral load in their first infection (Ct value of 20)

- have not received a second dose of the vaccine

- susceptible during the "Alpha" period (prior to 17 May 2021)

Overall, this analysis shows 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: Risk of reinfection increases over time

Estimated rate of COVID-19 reinfection per 100,000 participant days for the reference category used in the analysis according to time at risk, UK, 2 July 2020 to 18 October 2021

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.

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4 . Predictors of positivity, UK

We have updated our analysis on the characteristics of people who are more likely to test positive for coronavirus (COVID-19), presenting data from the two weeks up to 17 October 2021. This analysis is an update of previous results last published on 21 October 2021 and first presented in the Coronavirus (COVID-19) Infection Survey technical article: analysis of populations in the UK by risk of testing positive for COVID-19, September 2021, which provides a more detailed explanation of the methods used. The updated data can be found in tables 1a to 3b of the Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK dataset. A longer time series covering 19 April to 17 October 2021 is also available.

Our latest data continue to show similar conclusions to our last publication, namely:

- those who have received at least one dose of a coronavirus vaccine have continued to be less likely to test positive for COVID-19 than those not vaccinated

- those living in a household of multiple occupancy continued to be more likely to test positive than single occupancy households

- people working in the education sector continued to be more likely to test positive in comparison with those working in other sectors; this is likely related to the continuing higher infection levels among school-aged children

- those who have had a COVID-19 infection previously continued to be less likely to test positive than those who had not

- individuals who regularly carry out lateral flow tests continued to be more likely to test positive than those who did not; this is consistent with lateral flow tests being carried out by those who are otherwise at higher risk

- the relationship between deprivation and positivity has continued to differ between people of white and non-white ethnicities; for white individuals, those who live in less deprived areas were less likely to test positive, while the opposite was true for non-white individuals, as those who live in less deprived areas were more likely to test positive

In addition, these latest data also show that those who work in a care or nursing home were less likely to test positive in comparison with those who do not.

Notes:

1. Work sectors are self-reported and cover a wide variety of occupations; for example, someone working in the education sector could be a teacher at a primary school or could be a chef at a college.

2. Estimates of the likelihood of some specific characteristics affecting an individual testing positive can fluctuate from one fortnight to another, meaning that findings which were significant in one period may not necessarily be significant in another period. This may be because the effect of a characteristic is genuinely changing or because we do not have sufficient individuals with that characteristic in a particular fortnight to exclude any differences we find being down to chance.

Figure 4: Characteristics of people associated with being more or less likely to test positive for COVID-19 in the two weeks ending 17 October 2021

Estimated likelihood of testing positive for coronavirus (COVID-19) on nose and throat swabs by screened characteristic, UK, 4 to 17 October 2021

Notes:

1. The core demographic variables (as explained in the [Coronavirus (COVID-19) Infection Survey technical article: analysis of populations in the UK by risk of testing positive for COVID-19, September 2021](#)) are included as controls to make sure the analysis adjusts for these factors. We do not draw conclusions about the core demographic variables in this model.

2. An odds ratio indicates the likelihood of an individual testing positive for COVID-19 given a particular characteristic/variable. When a characteristic/variable has an odds ratio of one, this means there is neither an increase nor a decrease in the likelihood of testing positive for COVID-19 compared with the reference category. An odds ratio greater than one indicates an increased likelihood of testing positive for COVID-19 compared with the reference category. An odds ratio less than one indicates a decreased likelihood of testing positive for COVID-19 compared with the reference category.

3. Only characteristics that show a statistically significant difference to the reference category are included. Data for all variables included in the model can be found in the [Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK dataset](#).

4. Odds ratios for those that have received 2 doses of Moderna vaccine more than 14 days ago suggest they are less likely to test positive than those that were not vaccinated, but are not included in the chart. Results can be found in the [Coronavirus (COVID-19) Infection Survey, characteristics of people testing positive for COVID-19, UK dataset](#).

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About this analysis

This analysis is based on models that are fitted at the UK level and include all participants aged two years and over. Key demographic variables were age, region, sex, ethnicity, deprivation, household size, multi-generational household, and urban or rural classification. Additional variables are included only if found to be significant in the two weeks presented in the bulletin. More information on the methods used in this analysis can be found in our [Coronavirus (COVID-19) Infection Survey technical article: analysis of populations in the UK by risk of testing positive for COVID-19, September 2021](#).

5 . 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 3 November 2021
Characteristics of people testing positive for coronavirus (COVID-19) taken from the COVID-19 Infection Survey.

6 . 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, UK Health Security Agency 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

7 . 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 ratios

Hazard ratios 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.

Odds ratio

An odds ratio indicates the likelihood of an individual testing positive for COVID-19 given a particular characteristic or variable. When a characteristic or variable has an odds ratio of one, this means there is neither an increase nor a decrease in the likelihood of testing positive for COVID-19 compared with the reference category. An odds ratio greater than one indicates an increased likelihood of testing positive for COVID-19 compared with the reference category. An odds ratio less than one indicates a decreased likelihood of testing positive for COVID-19 compared with the reference category.

Deprivation

Deprivation is based on an index of multiple deprivation (IMD) score or equivalent scoring method for the devolved administrations, from 1, which represents most deprived, up to 10, which represents least deprived. The odds ratio/coefficient shows how a one unit increase in deprivation score, which is equivalent to 10 percentiles, affects the likelihood of testing positive for COVID-19.

Multigenerational household

A household was classed as multigenerational if it included individual(s) aged school Year 11 or younger and individual(s) aged school Year 12 to age 49 years and individual(s) aged 50 years or over.

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

8 . Measuring the data

More information on measuring the data is available in the Coronavirus (COVID-19) Infection Survey statistical bulletin.

Our methodology article provides further information around the survey design, how we process data and how data are analysed.

9 . Strengths and limitations

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

10 . 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 University of Oxford, 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, UK Health Security Agency, 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.

Coronavirus (COVID-19) Infection Survey technical article: predictors of positivity across countries of the UK, 28 October 2021
Technical article | Released 28 October 2021
Data about predictors of coronavirus positivity from the Coronavirus (COVID-19) Infection Survey. This analysis has been produced in partnership with the University of Oxford.

Coronavirus (COVID-19) Infection Survey technical article: analysis of reinfections of COVID-19: June 2021
Technical article | Released 29 June 2021
Data about reinfections from the Coronavirus (COVID-19) Infection Survey. This analysis has been produced in partnership with the University of Oxford.

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 Symptom Study - what are the new top 5 COVID symptoms?
Web page | Updated 23 June 2021
Daily reports on the ZOE COVID Study app used to identify the current top five symptoms that have emerged in recent weeks, which differ depending on if you've been vaccinated, and how many doses you've had.