

Article

Coronavirus (COVID-19) Infection Survey technical article: Analysis of characteristics associated with vaccination uptake

Analysis of populations in the UK by likelihood of being vaccinated against COVID-19 using the Coronavirus (COVID-19) Infection Survey. This survey is being delivered in partnership with University of Oxford, University of Manchester, UK Health Security Agency and Wellcome Trust.

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1 . Main Points

- People of all ages were less likely to be vaccinated against coronavirus (COVID-19) if they had been infected with COVID-19 previously (more than 120 days ago).
- For those aged between 18 and 64 years, ethnic minorities (excluding White minorities) were less likely to be vaccinated than those reporting White ethnicity.
- Younger men in the 18- to 34-year age group were less likely to be vaccinated than younger women, however older men in this age group were more likely to be vaccinated than women.
- Those aged between 18 and 64 years were less likely to have received a vaccination against COVID-19 if they reported they were not working or were employed but not currently working, compared with those who were working.
- The likelihood of being vaccinated varied by work sector; people aged 18 to 64 years who worked in hospitality, personal services and transport sectors were less likely to have received a vaccination against COVID-19 than those working in other sectors.
- Across all age groups, those who lived in more deprived areas were less likely to have received a vaccination against COVID-19, than those who lived in less deprived areas.

About this article

This technical article presents the methods and results of analysis to identify characteristics related to vaccination uptake. We have used data from the period from 3 to 30 October 2021 in the analysis. The article uses a statistical model to examine which different characteristics of people sampled in our Coronavirus (COVID-19) Infection Survey (CIS) are associated with those who report having received a vaccine against COVID-19 and those who have not reported having received a vaccine.

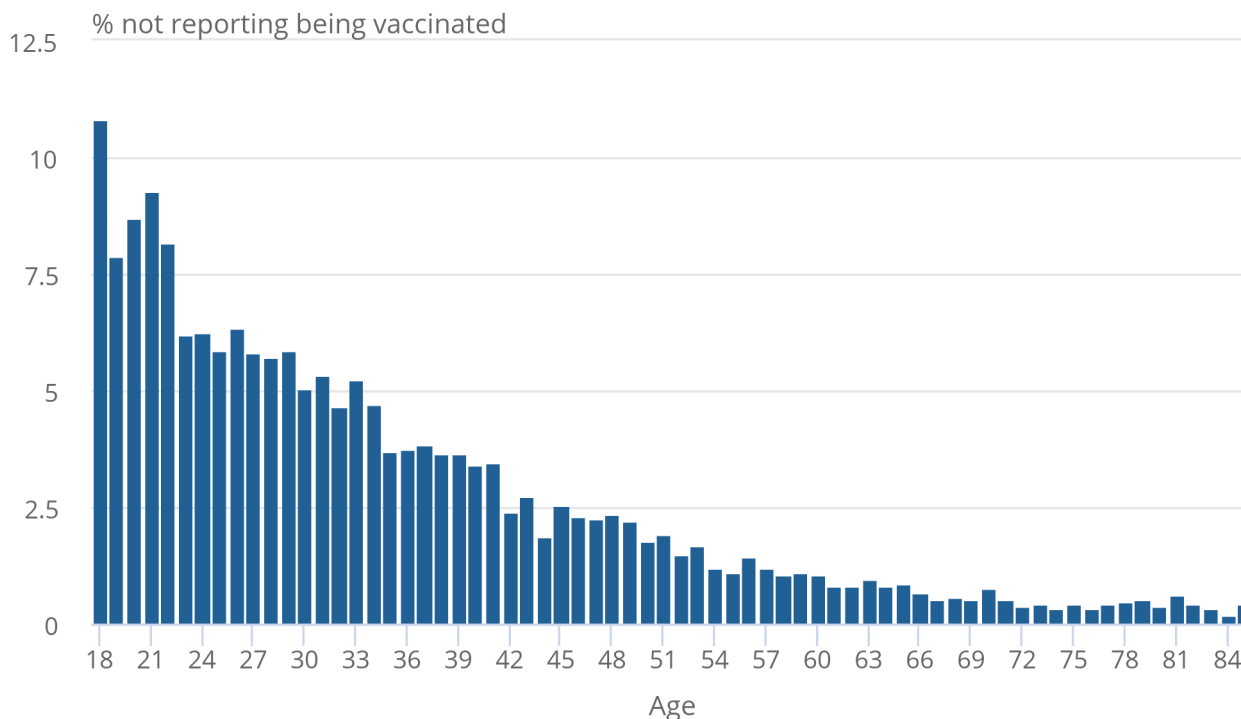
Vaccination rates differed considerably by age (Figure 1). For ease of analysis, we grouped ages into three standard age groups: 18- to 34-year-olds, 35- to 64-year-olds and those aged 65 years and over. The difference in vaccination rates by age was largely because vaccines were available to these populations at different times. Vaccine rollout varied between the countries of the UK, but in England, all 65-year-olds were eligible for vaccines based on age alone by 15 February 2021. Those over 35 years of age were eligible by 20 May 2021, and those over 18 years of age by 18 June 2021. Because of the time differences in vaccines being available to the different age groups, there may also be differences in the reasons why people have not been vaccinated, for example, preferences regarding vaccination or lack of access or eligibility.

Figure 1: A higher percentage of young people have not been vaccinated compared with the percentage of older people

The percentage of people not reporting being vaccinated against COVID-19 by age, 30 October 2021, UK

Figure 1: A higher percentage of young people have not been vaccinated compared with the percentage of older people

The percentage of people not reporting being vaccinated against COVID-19 by age, 30 October 2021, UK



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

About this analysis: vaccination data

The analysis used reported vaccination status from participants from the Office for National Statistics' (ONS) Coronavirus (COVID-19) Infection Survey (CIS). CIS is a large household survey monitoring current COVID-19 infections within private households in the UK. It excludes those in hospitals, care homes and/or other communal establishments. Participants were asked about demographics, living environment, behaviours, work, and vaccination uptake. Further information on the study design can be found in [COVID-19 Infection Survey: methods and further information](#).

Daily official [government figures](#) provide the recorded actual numbers of vaccines against SARS-CoV-2 issued. Our vaccination estimates are likely to be different from the official figures, because they are estimates based on a sample survey of reported vaccine status. In addition, our sampling method for Northern Ireland is different to the other nations, inviting only people who have previously participated in a Northern Ireland Statistics and Research Agency (NISRA) survey, which could result in a sample of individuals who are more likely to get vaccinated.

Differences between official figures and the estimates from this survey may also differ in scale across each of the four UK nations (some survey estimates are closer to the official reported figures than others) because of differences in reporting dates and the inclusion of National Immunisation Management System (NIMS) data for England. We use NIMS data to [check our survey data](#), where participants do not report having received a vaccine in the survey, but are recorded to have done so in the administrative data. Adding this information improves the quality of the data we have for England. NIMS does not cover Wales, Scotland and Northern Ireland, so we use self-reported vaccination status alone in these countries. This means that vaccination estimates are likely to be lower for these countries because we rely on self-report alone. To make sure that comparisons of other characteristics are not affected by this, we control for region and country in all models.

About this analysis: regression models

In this analysis two logistic regression models were run for each of the three age groups: 18- to 34-year-olds, 35- to 64-year-olds and those aged 65 years and over. Our outcome was "Vaccinated" – defined as a participant having had at least one dose of a COVID-19 vaccine prior to their visit. We also treated someone as vaccinated if they have been recorded to have received a vaccination in the 21 days following their visit. We included data from the most recent visit per participant in the 28-day period from 3 to 30 October 2021. The models included all participants across the UK.

Because characteristics of people are sometimes related, we wanted to estimate the impact of each variable. For example, old people and young people tend to have different health statuses, so when we estimated the impact of health status on vaccination, we needed to control for the impact of age.

Our first model, Model 1 (the core model), estimated the likelihood of an individual being vaccinated for eight core demographic characteristics:

- sex
- ethnicity
- age
- geographical region
- urban or rural classification of their address
- deprivation percentile
- household size
- whether the household was multigenerational

Model 1 estimated the total effect of these core demographic characteristics on the likelihood of being vaccinated and included all participants. The model gives the overall effect of these factors and does not try to estimate how much of these overall effects might be explained by other factors such as health status.

The model also tested for interactions between the core demographic characteristics, including interactions between those variables that were significant at a 0.001 threshold. For example, we see that the effect of sex changes by age in the 18- to 34- years age group: in this group, younger men were less likely to be vaccinated than younger women, whereas older men in the age group were more likely be vaccinated than older women. The outputs of Model 1, which included all core variables and interactions, are presented in the accompanying dataset.

The core variables can affect the likelihood of being vaccinated directly as well as indirectly through other factors like work status, so for the second group of variables, we adjusted for these core demographic variables. Model 2 tested whether other factors that may change over time, such as work status, affected the likelihood of being vaccinated. This means that we can say, for example, that people aged 35 to 64 years were less likely to be vaccinated if they were not working, regardless of where in the UK they lived, or whether they were a man or a woman.

Because the core demographic variables were included as controls in Model 2, when looking at results we do not draw conclusions about the core demographic characteristics from Model 1. Work status was included as an additional control in all models testing other factors associated with work.

Having tested the different variables, we only included in Model 2 characteristics that predicted whether someone reported being vaccinated independently of the other characteristics, using a technique called backward elimination with a significance threshold of 0.05. The sample was slightly smaller for Model 2 as participants with missing responses to the final variables used could not be included. The models were run for all three age groups and the final significant characteristics that were included in Model 2 were different for each age group. The outputs of Model 2 for each three age groups are presented in the [accompanying dataset](#).

2 . 18- to 34-year-olds

This analysis used data from 3 to 30 October 2021 with 36,281 (93.9%) participants vaccinated out of 38,651 participants from across the UK included in the model.

Model 1

Figure 2 presents findings from Model 1 for 18- to 34-year-olds.

Key findings presented in Figure 1 are:

- those from 3, 4 or 5 plus person households were less likely to be vaccinated
- ethnic minorities (excluding White minorities) were less likely to be vaccinated than those reporting White ethnicity
- those who lived in more deprived areas were less likely to have been vaccinated

Results for other characteristics included in the model can be found in the [accompanying dataset](#).

Figure 2: Those from 3, 4, or 5 plus person households were less likely to be vaccinated than those who lived in a single person household

The likelihood of being vaccinated against (COVID-19) by core demographic characteristic, 18 to 34-year-olds, UK, 3 to 30 October 2021

Notes:

1. Estimates are subject to uncertainty, given that a sample is only part of the wider population. The model provides 95% confidence intervals around the estimates.
2. 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 100, which represents least deprived. The odds ratio shows how a 10 unit increase in deprivation score, which is equivalent to 10 percentiles or 1 decile, affects the likelihood of testing positive for COVID-19.
3. An odds ratio indicates the likelihood of an individual having received a vaccination against 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 the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio greater than one indicates an increased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio less than one indicates a decreased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category.

Download the data

[.xlsx](#)

Interaction effect

For 18- to 34-year-olds, there was statistical evidence of an interaction between age and sex. This means that younger men in this age group were less likely to be vaccinated than younger women. However, this changed with age such that older men in this age group were more likely to be vaccinated than older women.

The interaction between age and sex is plotted in Figure 3. The y axis gives predicted probabilities of having been vaccinated calculated at a reference value for other core demographic factors (White ethnicity, household size of one, non-multigenerational household, living in a major urban area, 50th deprivation percentile). The predicted probabilities should not be used as population vaccination rates. Levels of vaccination in the population may be different because of other factors not included in the model and because this model is based on a sample.

Figure 3: Men aged 18 years were less likely to be vaccinated than women aged 18 years, but men in their mid-twenties and early thirties were more likely to be vaccinated than women of the same age

The predicted probability of being vaccinated against coronavirus (COVID-19) by age and sex, 18 to 34-year-olds, UK, 3 to 30 October 2021

Notes:

1. Probabilities are subject to uncertainty, given that a sample is only part of the wider population. The model provides 95% confidence intervals around the probabilities.
2. The y-axis shows predicted probabilities that give the trend across years of age calculated at a reference value for other factors (White ethnicity, household size of one, non-multigenerational household, living in a major urban area, 50th deprivation percentile) and should not be used as population vaccination rates. Levels of vaccination in the population may be different because of other factors not included in the model and because this model is based on a sample.

Download the data

[.xlsx](#)

Model 2

Figure 4 presents the effects of additional factors on the likelihood of having received a vaccination against COVID-19.

Key findings presented in Figure 4:

Those who were more likely to be vaccinated:

- had contact with a care home
- had a disability
- worked in a patient-facing healthcare role
- worked in the government sector
- had travelled abroad in the last 28 days
- were students

Those who were less likely to be vaccinated:

- were not working or were employed but not currently working
- smoked
- vaped
- had COVID-19 more than 120 days ago (had been previously infected)
- worked in the hospitality, manufacturing, personal services or transport sectors
- lived with a child

Figure 4: Those who were not working or employed but currently not working were less likely to be vaccinated than those who were employed and working

The likelihood of being vaccinated against coronavirus (COVID-19), by screened characteristic, 18 to 34-year-olds, UK, 3 to 30 October 2021

Notes:

1. Estimates are subject to uncertainty, given that a sample is only part of the wider population. The model provides 95% confidence intervals around the estimates.
2. The core demographic characteristics from Model 1 are included to adjust for these factors. We do not draw conclusions about the core demographic characteristics in this model.
3. 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 100, which represents least deprived. The odds ratio shows how a 10 unit increase in deprivation score, which is equivalent to 10 percentiles or 1 decile, affects the likelihood of testing positive for COVID-19.
4. An odds ratio indicates the likelihood of an individual having received a vaccination against 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 the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio greater than one indicates an increased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio less than one indicates a decreased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category.
5. Work sectors are included as binary variables, so the reference group for each category is the opposite of that category, for example the reference group for working in government is not working in government.

Download the data

[.xlsx](#)

3 . 35- to 64-year-olds

This analysis used data from 3 to 30 October 2021 with 156,005 (98.1%) participants vaccinated out of 159,079 participants from across the UK included in the model.

Model 1

Figure 5 presents findings from Model 1 for 35- to 64-year-olds.

Key findings presented in Figure 5 are:

- people living in more deprived areas were less likely to have been vaccinated
- those from 2, 3 or 4 person households were more likely to be vaccinated
- ethnic minorities (excluding White minorities) were less likely to be vaccinated than those reporting White ethnicity

Results for other characteristics included in the model can be found in the [accompanying dataset](#).

Figure 5: Ethnic minorities (excluding White minorities) were less likely to be vaccinated than those reporting White ethnicity.

The likelihood of being vaccinated against coronavirus (COVID-19) by core demographic characteristic, 35 to 64-year-olds, UK countries, 3 to 30 October 2021

Notes:

1. Estimates are subject to uncertainty, given that a sample is only part of the wider population. The model provides 95% confidence intervals around the estimates.
2. 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 100, which represents least deprived. The odds ratio shows how a 10 unit increase in deprivation score, which is equivalent to 10 percentiles or 1 decile, affects the likelihood of testing positive for COVID-19.
3. An odds ratio indicates the likelihood of an individual having received a vaccination against 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 the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio greater than one indicates an increased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio less than one indicates a decreased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category.

Download the data

[.xlsx](#)

Model 2

Figure 6 presents the effects of additional factors on the likelihood of having received a vaccination against COVID-19.

Key findings presented in Figure 6:

Those who were more likely to be vaccinated:

- had contact with a care home
- had contact with a hospital
- worked in a patient-facing healthcare role
- worked in the finance sector
- had travelled abroad in the last 28 days
- used public transport to travel to work

Those who were less likely to be vaccinated:

- smoked
- had COVID-19 more than 120 days ago (were previously infected)
- worked in the hospitality, retail, personal services or transport sectors
- were not working or were employed but not currently working
- lived with a child

Results for other characteristics included in the model can be found in the [accompanying dataset](#).

Figure 6: Those who had previously been infected with COVID-19 (more than 120 days ago) were less likely to be vaccinated than other 35 to 64-year-olds

The likelihood of being vaccinated against coronavirus (COVID-19), by screened characteristic, 35 to 64-year-olds, UK, 3 to 30 October 2021

Notes:

1. Estimates are subject to uncertainty, given that a sample is only part of the wider population. The model provides 95% confidence intervals around the estimates.
2. The core demographic characteristics from model 1 are included to adjust for these factors. We do not draw conclusions about the core demographic characteristics in this model.
3. An odds ratio indicates the likelihood of an individual having received a vaccination against 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 the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio greater than one indicates an increased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio less than one indicates a decreased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category.
4. Work sectors are included as binary variables, so the reference group for each category is the opposite of that category, for example, the reference group for working in Finance is not working in Finance.

Download the data

[.xlsx](#)

4 . 65 years and over

This analysis used data from 3 to 30 October 2021 with 104,517 (99.5%) participants vaccinated out of 105,060 participants from across the UK included in the model.

Model 1

Figure 7 presents findings from Model 1 for those aged 65 years and over. Key findings presented in Figure 7 are:

- people living in more deprived areas were less likely to have been vaccinated.
- those from 2 or 3 person households were more likely to be vaccinated

There are fewer statistically significant findings in the older age group because there are far fewer people who have not been vaccinated compared with other age groups (see Figure 1). As a result, the model has less power to detect effects, and the findings that it does produce have greater uncertainty, as indicated by wider confidence intervals in Figure 7.

Results for other characteristics included in the model and results for earlier time periods can be found in the [accompanying dataset](#).

Figure 7: As with other ages, people aged 65 and over living in more deprived areas were less likely to have been vaccinated against COVID-19

The likelihood of being vaccinated against coronavirus (COVID-19) by core demographic characteristic, 65 years old and over, UK, 3 to 30 October 2021

Notes:

1. Estimates are subject to uncertainty, given that a sample is only part of the wider population. The model provides 95% confidence intervals around the estimates.
2. 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 100, which represents least deprived. The odds ratio shows how a 10 unit increase in deprivation score, which is equivalent to 10 percentiles or 1 decile, affects the likelihood of testing positive for COVID-19.
3. An odds ratio indicates the likelihood of an individual having received a vaccination against 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 the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio greater than one indicates an increased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio less than one indicates a decreased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category.

Download the data

[.xlsx](#)

Model 2

Figure 8 presents the effects of additional factors on the likelihood of having received a vaccination against COVID-19.

Key findings presented in Figure 8 are:

Those who were less likely to be vaccinated:

- had a disability which impacted their abilities “A lot”
- smoked
- had COVID-19 more than 120 days ago (were previously infected)

Figure 8: Those who had a disability, which impacted their abilities “a lot”, were less likely to be vaccinated than those who didn’t report a disability

The likelihood of being vaccinated against coronavirus (COVID-19), by screened characteristic, 65 years old and over, UK, 3 to 30 October 2021

Notes:

1. Estimates are subject to uncertainty, given that a sample is only part of the wider population. The model provides 95% confidence intervals around the estimates.
2. The core demographic characteristics from model 1 are included to adjust for these factors. We do not draw conclusions about the core demographic characteristics in this model.
3. An odds ratio indicates the likelihood of an individual having received a vaccination against 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 the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio greater than one indicates an increased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category. An odds ratio less than one indicates a decreased likelihood of the participant having received a vaccination against COVID-19 compared with the reference category.

Download the data

[.xlsx](#)

5 . Coronavirus (COVID-19) Infection Survey data

[Coronavirus \(COVID-19\) Infection Survey technical article: analysis of characteristics associated with vaccination uptake](#)

Dataset | Released 15 November 2021

Analysis of populations in the UK at risk of COVID-19 from the Coronavirus (COVID-19) Infection Survey.

6 . Collaboration

This Coronavirus (COVID-19) Infection Survey analysis was produced by the Office for National Statistics (ONS) in collaboration with our research partners at the University of Oxford. Of particular note are:

University of Oxford – Emma Pritchard and Sarah Walker

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.

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

Coefficient

A coefficient indicates the likelihood of an individual testing positive for COVID-19 given a particular characteristic or variable. When a characteristic or variable has a coefficient of zero, this means there is neither an increase nor a decrease in the likelihood of testing positive for COVID-19 compared with the reference category. A coefficient greater than zero indicates an increased likelihood of testing positive for COVID-19 compared with the reference category. A coefficient less than zero indicates a decreased likelihood of testing positive for COVID-19 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 100, which represents least deprived. The odds ratio shows how a 10 unit increase in deprivation score, which is equivalent to 10 percentiles or 1 decile, 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.

Vaccinated

A participant is counted as vaccinated if they have had at least one dose of a COVID-19 vaccine prior to their visit.

Personal Services

Personal services workers provide personal services related to travel, housekeeping, catering and hospitality, hairdressing and beauty treatment, animal care grooming and training, companionship and other services of a personal nature.

8 . Data sources and quality

Our [methodology article](#) provides further information around the survey design and how we process data. A recent [pre-print paper](#) provides further information on the methods presented in this publication.

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

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, University of Manchester, Public Health England and Wellcome Trust.

[Coronavirus \(COVID-19\) Infection Survey: characteristics of people testing positive for COVID-19 in England](#)

Bulletin | Updated fortnightly

Characteristics of people testing positive for COVID-19 from the Coronavirus (COVID-19) Infection Survey, including antibody data by UK country, and region and occupation for England. Antibodies data published before 3 February 2021 are available in this series.

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

Methodology article | Updated 24 August 2021

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

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

QMI | Released 16 July 2021

Quality and Methodology Information for the Coronavirus (COVID-19) Infection Survey (CIS), detailing the strengths and limitations of the data, methods used, and data and users.

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

Article | Updated fortnightly

Antibody and vaccination data by UK country and English regions from the Coronavirus (COVID-19) Infection Survey. This survey is being delivered in partnership with the University of Oxford, University of Manchester, Public Health England and Wellcome Trust.

[Coronavirus \(COVID-19\) Infection Survey technical article: analysis of positivity after vaccination](#)

Technical article | Released 17 June 2021

Data about positivity after vaccination from the Coronavirus (COVID-19) Infection Survey. This analysis has been produced in partnership with the University of Oxford.