A national survey of attitudes towards and intentions to vaccinate against COVID-19: implications for communications

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NOTE: This preprint reports new research that has not been certified by peer review and should not be used to guide clinical practice.
Abstract

Background

Hesitancy about COVID-19 vaccination threatens comprehensive vaccination. It is important to examine vaccination acceptance when people are making real rather than hypothetical decisions, to identify whether targeted support is needed, and to identify implications for communications.

Methods

Cross-sectional online and telephone survey with probability-based sample (n=4,978) of British adults, conducted January-February 2021. Measures: socio-demographic characteristics (age, gender, ethnicity, education, financial status), COVID-19 status, vaccine acceptance, trust in COVID-19 vaccination information sources, perceptions of vaccination priority groups, and perceptions of importance of second dose.

Findings

Among 5,931 individuals invited, survey response rate was 84%. COVID-19 vaccine acceptance (83%) was associated with increasing age, higher level of education and having been invited for vaccination. Acceptance decreased with unconfirmed past COVID-19, greater financial hardship, and non-White British ethnicity; Black/Black British participants had lowest acceptance. Overall, healthcare and scientific sources of information were most trusted. Compared with White British participants, other ethnicities had lower trust in healthcare and scientific sources. Those with lower educational attainment or financial hardship had lower trust in healthcare and scientific sources. Those with no qualifications had higher trust in media and family/friends. While trust was low overall in community or faith leaders it was higher among those with Asian/Asian British and Black/Black British ethnicity compared with White British participants. Views of vaccine prioritisation were mostly consistent with UK official policy but there was support for prioritising additional groups. There was high support for having the second vaccine dose.

Conclusions

Targeted engagement is needed to address COVID-19 vaccine hesitancy in non-White British ethnic groups, in younger adults, and among those with lower education, greater financial hardship.
and unconfirmed past infection. Healthcare professionals and scientific advisors should play a
central role in communications and tailored messaging is needed for hesitant groups. Careful
communication around vaccination prioritisation continues to be required.
Key words

COVID-19, Vaccine, Acceptance, Probability sampling, Adults, Great Britain
1. Introduction

Widespread vaccination is likely to be one of the most effective ways of controlling the COVID-19 pandemic, and is central to the UK government’s recovery strategy. The UK vaccine programme began in December 2020, prioritising older adults in care homes and their carers, those aged over 80, and frontline health and social-care workers [1]. Administration of first doses of vaccination to the adult population, by decade of age, is to be completed by July 2021. Uncertainty or unwillingness to accept vaccination – ‘vaccine hesitancy’ [2] – threatens comprehensive vaccination [3,4]. Before the introduction of a COVID-19 vaccine, UK surveys reported that 64% to 82% of adults were willing to be vaccinated [5-12]. Most of these studies used non-probability samples, introducing selection bias and limiting generalisability. Increased vaccine confidence has been reported since vaccination commenced [13]; possibly due to increased COVID-19 cases and deaths, a further UK lockdown in early 2021, and, increasingly, vaccination becoming the social norm. It is important to examine vaccine acceptance when people are making active, rather than hypothetical, decisions about vaccination. This also provides insight into potential acceptance of repeat COVID-19 vaccination [14].

UK uptake has been high (94% of adults surveyed in April reported uptake or intention to accept vaccination) [13], but there remain concerns about uptake in subpopulations, such as younger adults and some ethnic minorities [15], giving rise to initiatives such as social media campaigns featuring non-White celebrities [16]. Robust, timely data are needed to identify the characteristics of groups with lower acceptance and the information sources they trust, to inform targeted interventions. It is also important to assess whether attitudes towards COVID-19 vaccination have been affected by specific events and media coverage. Two issues in the UK merit particular attention. First, the government followed recommendations to offer the vaccine to priority groups [1]. If this approach is continued, it is important to examine its acceptability and any implications for communications. Secondly, the government decided, on 30th December 2020, to deviate from recommended protocols for the Pfizer-BioNTech vaccine by extending the interval between doses to
up to 12 weeks [1]; this precipitated concerns that it may lead to reduced willingness to be vaccinated or to have a second dose [17].

We conducted a survey in early 2021, using probability sampling, to examine public views on COVID-19 vaccination and consider the implications for communications. During this period most people aged over 80 had been invited to have a vaccine and invitations were being extended to those aged over 70, with other age groups advised they would be invited in the coming months.

2. Methods

We administered a cross-sectional survey with adults (aged 18+) in Great Britain (GB) in January and February 2021. This paper follows the STROBE Statement for reporting cross-sectional studies (see checklist in Supplementary Material).

2.1 Questionnaire development and testing

The questionnaire was informed by a review of studies on public attitudes towards and experiences of vaccines and COVID-19. Existing measures were adapted [5,18,19] and new questions developed.

The questionnaire was cognitively tested to ensure understandability [20]. Interviews were conducted with 20 individuals with a mix of genders, ages, parental status, likelihood of accepting a COVID-19 vaccination, and experiences of shielding. The questionnaire was subsequently revised based on these interviews. Final revisions reflected changes in the UK’s vaccine rollout. The questionnaire covered: vaccine acceptance, trust in vaccine information sources, perception of priority groups, COVID-19 status, and perceived importance of a second dose.
2.2 Sample and data collection

The survey was administered to the probability-based NatCen Panel [21], recruited from the 2018, 2019, and 2020 waves of the British Social Attitudes survey, with participants randomly selected from England, Wales and Scotland. Data were collected through online and telephone interviews (conducted January 14th to February 7th 2021). Panellists were sent reminders and offered a small financial sum in recognition of their contribution. Among 5,931 panellists invited, the survey response rate was 84%, with 4,978 completing it (4,776 online, 202 by telephone). Supplementary Material, Table S1 details overall response rate, accounting for non-response at the panel recruitment stage and panel attrition. Data were weighted for non-response and to be representative of the GB adult population.

2.3 Measures

Sociodemographic and other characteristics

Data on age, gender, ethnicity, education, country, urban/rural status, and financial status were obtained from existing information on NatCen panellists. Full details of sub-groups of each variable are provided in Tables 1 and 2. Age was categorised into bands from 18-29 years then ten-year bands up to 80+. Self-assigned ethnicity was recorded in six categories, and education in five categories according to highest qualification. As indices of multiple deprivation were not available, self-reported financial status was used. COVID-19 status was derived from two items: 1) “Have you officially been diagnosed with the coronavirus (COVID-19)” (yes/no/don’t know); those answering other than ‘yes’ were asked: 2) “Do you think you have ever had the coronavirus (COVID-19)” (yes-definitely/yes-probably/no-probably not/no-definitely not/don’t know).

Vaccine measures

Vaccine acceptance was derived from five items: 1) “Have you been offered a vaccine for COVID-19?” (yes/no). Those answering ‘yes’ were asked: 2) “And have you had that vaccine?” (yes/no). Participants who had been offered but not yet had the vaccine were then asked: 3) “And do you intend to have that vaccine?” (yes/no/not sure). Participants who had not yet been offered the
vaccine were asked: 4) “Would you accept the vaccine for yourself if it is offered to you?” (yes/no/not sure). Those answering ‘not sure’ were asked: 5) “If you had to choose, if a COVID-19 vaccine became publicly available and you were offered it, would you accept the vaccine for yourself?” (yes/no/I’m really not sure). Participants were classed as: ‘Accepted/accepting’ if they answered ‘yes’ to any of items 2, 3, 4, or 5; ‘Uncertain’ if they answered ‘not sure’ to item 3 or ‘I’m really not sure’ to item 5; and ‘Refused/refusing’ if they answered ‘no’ to items 3, 4, or 5.

Trust in information sources was assessed for 13 sources: “To what extent, if at all, would you trust information about a COVID-19 vaccine from each of the following sources?” (see Table 3): completely (1); a great deal (2); somewhat (3); very little (4); not at all (5).

Perceptions of vaccine priority groups were assessed across 11 groups (see Table 4): “Below are some groups that some people say should be the first to be offered a COVID-19 vaccine. For each one, how high a priority do you think it is that they get a COVID-19 vaccine, or do you not think they should be offered the vaccine at all?”: 1 ‘One of the first’, 5 ‘One of the last’, with an additional option “They should not be offered a vaccine”.

Perceived importance of receiving the second dose of the vaccine was assessed with: “How important, if at all, do you think it is for people to get the second injection of the COVID-19 vaccine?”: very important (1); fairly important (2); not very important (3); not at all important (4).

2.4 Data analysis

Descriptive data, including bivariate analyses, were weighted to be representative of British adult population. Initial bivariate analyses, using chi-square tests, examined correlates of vaccine acceptance and trust in sources of information about COVID-19 vaccination. Multivariate logistic regression was conducted to examine differences in vaccine acceptance controlling for socio-demographic variables, vaccine offer, and COVID-19 status. The dependent variable dichotomised those classed as accepted/intending to accept vs uncertain/refused/intend to refuse. Age was entered as a categorical variable and the ‘difference’ contrast within SPSS logistic regression was
used to test influence of each increasing age group, relative to younger ages (e.g. 30-39 vs 18-29; 80+ vs 18-79) (see Table 2). Sociodemographic variation in trust in information sources was examined using multivariate logistic regressions. For each information source, the dependent variable dichotomised the 5-point scale into trusting completely or a great deal vs somewhat/very little/not at all. Cases were excluded from the logistic regressions if they had missing data on the dependent or any independent variables. All logistic regressions were conducted on unweighted data as sociodemographic variables were included as control variables. For each information source, logistic regression analysis examined likelihood of trust (completely/a great deal v somewhat/very little/not at all) by sociodemographic characteristics (Supplementary Material, Tables S2-S14). Data were analysed using SPSS v27.

3. Findings

3.1 Sample characteristics

The weighted sample comprised adults aged 18 and over (see Table 1). Over half (52%) were female and 81% were White British. Around two-thirds reported ‘living comfortably’/‘doing alright’, while one in ten rated their financial status as ‘quite’ or ‘very difficult’. Just over two-fifths were educated to degree level or above, while for almost a quarter their highest qualification was A level or equivalent. A minority (12%) had no qualifications. A minority indicated having been diagnosed with COVID-19 (6%); nearly two-thirds thought they probably or definitely had not had COVID-19; 11% were unsure.

3.2 Vaccine offer and acceptance

At the time of the survey, 14% (n=716) had been offered the vaccine. Of these, 92% (n=658) had accepted or intended to, 4% (n=29) were uncertain, and 4% (n=29) had refused or intended to refuse.
Among those not yet offered the vaccine, 82% (n=3479) intended to accept, while 11% (n=471) were uncertain and 7% (n=311) indicated they would refuse. Overall, the acceptance level was 83% (n=4137), with 10% (n=502) uncertain and 7% (n=340) refusing.

Multivariate logistic regression, with vaccine acceptance as the outcome variable (accepted/accepting v refused/refusing/uncertain), indicated likelihood of acceptance increased with age (Table 2). For example, those aged 40-49 were more likely than 18-39-year-olds to indicate acceptance (AOR=1.43, 95%CI (1.12, 1.83, p=0.004) as were 70-79-year-olds compared with 18-69-year-olds (AOR=3.31, 95%CI (2.22, 4.95, p<0.001). Acceptance was also positively associated with education. Those with at least a degree were three times as likely to indicate acceptance (AOR=3.03, 95%CI (2.17, 4.23), p<0.001) and those educated to A level or equivalent nearly twice as likely (AOR=1.80, 95%CI (1.27, 2.55), p<0.001), compared with people without qualifications.

Lower acceptance was also associated with financial hardship and ethnicity. For example, compared with those ‘living comfortably’, people ‘finding it very difficult’ were much less likely to accept the vaccine (AOR=0.35, 95%CI (0.22, 0.55), p<0.001). Compared with White British participants, those from other ethnic groups were less likely to accept the vaccine. Black/Black British participants had the lowest likelihood of accepting (AOR=0.25, 95%CI (0.14, 0.43), p<0.001).

This is illustrated in the descriptive data too, with 87% of White British participants indicating vaccine acceptance compared with 58% among Black/Black British, 61% among mixed/multiple ethnic groups and 61% among Asian/Asian British.

After controlling for demographic variables, vaccine acceptance was positively associated with having been invited for vaccination (AOR=1.73, 95%CI (1.24, 2.43), p=0.001), but negatively associated with COVID-19 status. Compared with those who had ‘probably not’ or ‘definitely not’ had COVID-19, those who thought they had ‘definitely’ or ‘probably’ had COVID-19 were less likely to indicate acceptance (AOR = 0.40, 95%CI (0.26, 0.60), p<0.001 and AOR=0.71, 95%CI (0.56, 0.91), p=0.006 respectively). Confirmed diagnosis with COVID-19 was not significantly associated with vaccine acceptance, after controlling for demographic variables.
3.3 Trust in information sources

The three most trusted information sources were: the NHS; doctors/nurses/other healthcare professionals; and scientific and medical advisers. These groups were trusted 'completely/a great deal' by around 80% of participants (Table 3). Only 44% trusted the UK government 'completely/a great deal'. The three least trusted sources were celebrities and social media influencers, social media, and faith or community leaders; around two-thirds indicated they would have no trust in each. A majority (61%) indicated they had very little/no trust in the media (e.g. newspapers/magazines/television/radio).

Trust did not differ by gender except for drug companies and the WHO, with females more likely to indicate trust in these sources (Tables S5 and S9 respectively).

Trust was higher among older participants for five sources (doctors/nurses/other healthcare professionals, NHS, UK government, media, and family/friends; Tables S2, S4, S6, S10, S13). For example, trust in the UK government was higher among those aged 50-59 than 18-49-year-olds (Table S6).

Trust varied by education. Compared with those without qualifications, other participants were more likely to trust five sources (doctors/nurses/other healthcare professionals, pharmacists, NHS, scientists, WHO; Tables S2-S4, S8, S9) and less likely to trust another five (drug companies, media, social media, celebrities/social media influencers, family/friends; Tables S5, S10-S13). Compared with those ‘living comfortably’ participants in more difficult financial situations were less likely to trust the seven sources most closely aligned with scientific or clinical expertise (doctors/nurses/other healthcare professionals, pharmacists, NHS, drug companies, UK government, scientists, WHO; Tables S2-S6, S8, S9). Similarly, participants from minority ethnic groups were less likely to trust scientific or clinical sources than White British participants (Tables S2-S4, S8, S9). Whilst lack of trust in faith or community leaders was low overall, Asian/Asian British participants were more likely
than White British to trust faith/community leaders (AOR=4.82, 95%CI (2.76, 8.42), p<0.001) as were Black/Black British participants (AOR=4.52, 95%CI (2.04, 9.99), p<0.001).

3.4 Views on prioritisation

Nine in ten participants rated healthcare professionals as highest priority for vaccination. Over 70% indicated those with serious health conditions/heightened vulnerability to COVID-19, care home workers and residents, and over 80s should be 'one of the first' to be vaccinated (Table 4). Priority was also given to social care workers, schoolteachers, and those directly working with the public. Over a third considered each of these groups should be 'one of the first' to be vaccinated, and 70% or more rated them in the top two priority levels. People aged under 18 were rated as lowest priority, and 6% considered the vaccine should not be offered to this group.

3.5 Importance of second dose

Nearly all participants (96%, n=4,761) considered it 'very' or 'fairly important' to receive the second vaccine dose. This increased to 99% (n=4,096) amongst those who intended to accept the vaccine.

4. Discussion

4.1 Principal findings

Overall, acceptance was high, with 83% having received or intending to have the vaccine. While this suggests acceptance will be high in future vaccination programmes, it may change if perceived vulnerability to or severity of infection, vaccine efficacy, or side-effects alters. Acceptance increased with age and education, and if invited for vaccination. It decreased with financial hardship, and among non-White British ethnicities and those with unconfirmed past COVID-19. Clinical and scientific information was most trusted, with sociodemographic differences for different sources. Policy on a second dose and vaccination priority groups [1] was supported.
4.2 Comparison with other studies

We confirmed lower acceptance in younger groups [6-8,10,11]; acceptance was higher if invited for vaccination, a finding observed in other populations [22]. Confirmation of lower acceptance in non-White British ethnicities [5,6,9,23] is concerning given increased risk of infection and poorer outcomes [24]. We confirmed lower acceptance in those with lower educational attainment and greater financial hardship [6,8-10,12,25], leaving these groups at risk of infection and increasing likelihood of emergence of variants [26].

Those with unconfirmed but suspected COVID-19 had lower acceptance. This suggests infection is thought to confer immunity, or recovery fosters a perception of decreased severity. However, past infection does not guarantee protection and people may still be infectious [27,28]. Messaging should target those with prior infection.

There are other implications for communications. While high acceptance suggests communications are effective, identifying barriers in hesitant groups is a priority for developing interventions [3, 15, 18, 29]. Trusted information sources are needed. The most trusted were the NHS, healthcare professionals, and scientific and medical advisers. This suggests that healthcare professionals have a central role in promoting vaccination in initiatives and during consultations. That government and media are less trusted has implications for acceptance [7,8,25,30]. Without sophisticated tailoring and evaluation, social media and celebrities may fail to promote vaccination; initiatives using ethnic minority celebrities and opinion leaders show promise [16].

Differences in trust varied by socio-demographics. Compared with White British participants, other ethnicities had lower trust in healthcare and scientific sources. Although trust in faith/community leaders was low, it was higher in Asian and Black British participants, suggesting a role for these leaders [15]. Those with lower educational attainment or financial hardship had lower trust in healthcare and scientific sources. Those with no qualifications had higher trust in media and
family/friends. This suggests a need for a mix of sources for these groups. Mainstream media may have a role to play, despite lower trust [25].

Reassuringly for further campaigns, prioritisation was considered acceptable and there was support for additional prioritisation of schoolteachers and others in direct contact with the public. As planning begins for further vaccination, careful communication regarding prioritisation should continue. We found high support for a second dose, suggesting the UK’s decision to extend the period between doses has not dented public confidence.

4.3 Strengths and limitations
Strengths include the large probability-based nationally representative sample, ability to analyse by ethnicity and surveying during vaccine roll-out. Our findings can be generalised to GB’s adult population, however global contexts for COVID-19 and vaccination vary. Although not generalisable to them, the findings are still informative for other countries. The study has limitations. As it is cross-sectional, we cannot infer causality; although we included variables likely to be important in vaccine acceptance, these results are exploratory. Our qualitative studies will deepen understanding of associations. A survey repeated when COVID-19 cases and deaths are low, and without lockdown, might yield different responses. We did not survey individuals who are institutionalised (e.g. prisoners), notably difficult to reach (e.g. homeless), or those not speaking English (therefore, our ethnic minority sample may underrepresent certain views); specific surveys are needed for these groups. We investigated vaccination intention. Actual uptake may be lower, although it is likely that factors associated with intention will influence uptake.

5. Conclusions
COVID-19 vaccination acceptance is high in GB. Targeted engagement is needed to address hesitancy in non-White British ethnic groups, those with lower education, those younger, those with greater financial hardship and those with unconfirmed but suspected past infection. Healthcare
professionals and scientific advisors should lead communications and tailoring is needed. Work is needed to rebuild trust in government information. There is high support for having the second vaccine dose. Views of vaccine prioritisation are mostly consistent with UK official policy but there was support for prioritising additional groups and careful communication around vaccination prioritisation should continue.
| Table 1 Sample characteristics | Unweighted | Weighted |
|-------------------------------|-----------|----------|
|                               | n         | %        | n         | %        |
| **Age**                       |           |          |           |          |
| 18-29                         | 464       | 9.4%     | 824       | 16.7%    |
| 30-39                         | 772       | 15.6%    | 852       | 17.3%    |
| 40-49                         | 848       | 17.1%    | 806       | 16.3%    |
| 50-59                         | 904       | 18.3%    | 867       | 17.6%    |
| 60-69                         | 1011      | 20.4%    | 711       | 14.4%    |
| 70-79                         | 773       | 15.6%    | 657       | 13.3%    |
| 80+                           | 178       | 3.6%     | 218       | 4.4%     |
| **Gender**                    |           |          |           |          |
| Male                          | 2136      | 42.9%    | 2402      | 48.3%    |
| Female                        | 2830      | 56.9%    | 2567      | 51.6%    |
| Other                         | 10        | 0.2%     | 7         | 0.1%     |
| **Ethnicity**                 |           |          |           |          |
| White British                 | 4261      | 86.3%    | 3999      | 81.2%    |
| Any other White background    | 319       | 6.5%     | 335       | 6.8%     |
| Mixed or multiple ethnic groups | 64       | 1.3%     | 100       | 2.0%     |
| Asian or Asian British        | 164       | 3.3%     | 306       | 6.2%     |
| Black or Black British        | 67        | 1.4%     | 101       | 2.1%     |
| Other                         | 62        | 1.3%     | 81        | 1.6%     |
| **Country**                   |           |          |           |          |
| England                       | 4369      | 87.9%    | 4291      | 86.3%    |
| Scotland                      | 390       | 7.8%     | 442       | 8.9%     |
| Wales                         | 212       | 4.3%     | 237       | 4.8%     |
| **Urban/rural status**        |           |          |           |          |
| Urban                         | 3789      | 76.2%    | 4006      | 80.6%    |
| Rural                         | 1182      | 23.8%    | 965       | 19.4%    |
| **Highest educational qualification** | | | | |
| Degree or equivalent, and above | 2503 | 50.4% | 2077 | 41.8% |
| A levels or vocational level 3 or equivalent and above, but below degree | 1005 | 20.2% | 1131 | 22.8% |
| Other qualifications below A levels or vocational level 3 or equivalent | 788 | 15.9% | 838 | 16.9% |
| Other qualification           | 256       | 5.2%     | 304       | 6.1%     |
| No qualifications             | 416       | 8.4%     | 618       | 12.4%    |
| **Subjective Financial Status** | | | | |
| Living comfortably            | 1552      | 31.2%    | 1289      | 26.0%    |
| Doing alright                | 2028      | 40.8%    | 2035      | 40.9%    |
| Just about getting by         | 975       | 19.6%    | 1132      | 22.8%    |
| Finding it quite difficult    | 271       | 5.5%     | 337       | 6.8%     |
| Finding it very difficult     | 142       | 2.9%     | 175       | 3.5%     |
| **COVID-19 Status**           |           |          |           |          |
| Diagnosed with COVID-19       | 241       | 4.8%     | 294       | 5.9%     |
| Perception                                      | England | Wales | Scotland | Other |
|------------------------------------------------|---------|-------|----------|-------|
| Think definitely had COVID-19                  | 140     | 2.8%  | 172      | 3.5%  |
| Think probably had COVID-19                    | 710     | 14.3% | 755      | 15.2% |
| Think probably not had COVID-19                | 1945    | 39.1% | 1880     | 37.8% |
| Think definitely not had COVID-19              | 1393    | 28.0% | 1305     | 26.2% |
| Don't know if had COVID-19                     | 547     | 11.0% | 566      | 11.4% |

* England and Wales, based on Office for National Statistics (ONS) definition of urban as population greater than 10,000. Scotland based on Scottish Government definition of urban as population greater than 3,000.
|                | (a) Bivariate associations between vaccine acceptance and sociodemographics | (b) Logistic regression of vaccine acceptance |
|----------------|-------------------------------------------------------------------------------|---------------------------------------------|
|                | % Accepted/Intend to Accept (weighted)                                       | 1 = Accepted/Intend to Accept (4294); 0 = Uncertain/Refused/Intend to Refuse (600) |
|                | $\chi^2$ (df) P                                                               | N AOR*  95% CI Lower  95% CI Upper P         |
| Gender         |                                                                               | n   %          | 2.154 (2) .341 | 2097 ref | 2788 0.82 0.67 0.99 0.036 | 0.085 |
| Male           |                                                                               | 2012 83.8     |               |         |                         |      |
| Female         |                                                                               | 2117 82.5     |               |         |                         |      |
| Other          |                                                                               | 5 71.4       |               |         |                         |      |
| Age            |                                                                               | 274.733 (6) <.001 |                 |         |                         | <.001 |
| 18-29          |                                                                               | 613 74.4     |               | 459 ref | 9 0.47 0.09 2.45 0.369 |      |
| 30-39 v 18-29  |                                                                               | 618 72.5     |               | 761 0.89 0.66 1.20 0.448 |      |
| 40-49 v 18-39  |                                                                               | 640 79.3     |               | 835 1.43 1.12 1.83 0.004 |      |
| 50-59 v 18-49  |                                                                               | 745 85.9     |               | 896 1.92 1.49 2.46 <.001 |      |
| 60-69 v 18-59  |                                                                               | 659 92.7     |               | 1003 3.21 2.37 4.34 <.001 |      |
| 70-79 v 18-69  |                                                                               | 629 95.7     |               | 763 3.31 2.22 4.95 <.001 |      |
| 80+ v 18-79    |                                                                               | 209 95.9     |               | 177 2.19 0.92 5.21 0.078 |      |
| Education/Highest qualification |                                                                               | 56.056 (4) <.001 |                 |         |                         | <.001 |
| No qualifications |                                                                               | 495 80.1     |               | 411 ref |                         |      |
| Degree or equivalent and above |                                                                               | 1811 87.2   |               | 2454 3.03 2.17 4.23 <.001 |      |
| A levels / Vocational level 3 or equivalent |                                                                               | 909 80.4     |               | 990 1.80 1.27 2.55 <.001 |      |
| Other qual'ns below |                                                                               | 694 82.7     |               | 784 1.50 1.05 2.15 0.026 |      |
| A level / Voc level 3 |                                                                               | 223 73.4     |               | 255 0.90 0.58 1.39 0.632 |      |
| Other qualification |                                                                               |               |               |         |                         |      |
| Financial Status |                                                                               | 168.660 (4) <.001 |                 |         |                         | <.001 |
| Living comfortably |                                                                               | 1162 90.1    |               | 1533 ref |                         |      |
| Doing alright  |                                                                               | 1749 86.0    |               | 1998 0.89 0.69 1.15 0.383 |      |
| Just about getting by |                                                                               | 848 74.9     |               | 959 0.52 0.39 0.69 <.001 |      |
| Finding it quite difficult |                                                                               | 261 77.2     |               | 266 0.74 0.50 1.10 0.139 |      |
| Finding it very difficult |                                                                               | 111 63.4     |               | 138 0.35 0.22 0.55 <.001 |      |
| Country         |                                                                               | 3.171 (2) .205 |                 |         |                         | 0.326 |
| England        |                                                                               | 3581 83.5    |               | 4302 ref |                         |      |
| Scotland       |                                                                               | 356 80.5     |               | 384 0.82 0.59 1.13 0.220 |      |
| Wales          |                                                                               | 192 81.0     |               | 208 0.80 0.51 1.26 0.345 |      |
| Urban/rural    |                                                                               | 34.517 (1) <.001 |                 |         |                         | <.001 |
| Urban          |                                                                               | 3266 81.5    |               | 3729 ref |                         |      |
| Rural          |                                                                               | 863 89.4     |               | 1165 1.28 1.00 1.65 0.051 |      |
| Ethnicity      |                                                                               | 246.434 (5) <.001 |                 |         |                         | <.001 |
| White British  |                                                                               | 3482 87.1    |               | 4226 ref |                         |      |
| Any other white background |                                                                               | 254 75.8    |               | 318 0.55 0.40 0.76 <.001 |      |
| Mixed or multiple ethnic groups |                                                                               | 62 61.4     |               | 62 0.39 0.21 0.71 0.002 |      |
| Asian or Asian British |                                                                               | 188 61.4    |               | 161 0.41 0.28 0.61 <.001 |      |
| Black or Black British |                                                                               | 59 58.4     |               | 67 0.25 0.14 0.43 <.001 |      |
| Other          |                                                                               | 59 72.8     |               | 60 0.42 0.23 0.79 0.007 |      |
| Whether been offered vaccine |                                                                               | 45.924 (1) <.001 |                 |         |                         | <.001 |
| No            |                                                                               | 3479 81.6    |               | 4227 ref |                         |      |
| Yes           |                                                                               | 658 91.9     |               | 667 1.73 1.24 2.43 0.001 |      |
| COVID-19 Status |                                                                               | 72.865 (4) <.001 |                 |         |                         | <.001 |
| Think probably or definitely not had COVID-19 |                                                                               | 2741 86.1 |         | 3288 ref |                         |      |
| Diagnosis                          | Cases | % | AOR | 95% CI          | p-value |
|-----------------------------------|-------|---|-----|-----------------|---------|
| Diagnosed with COVID-19           | 218   | 74.4 | 240 | 0.89, 0.60, 1.33 | .575    |
| Think definitely had COVID-19     | 118   | 68.2 | 140 | 0.40, 0.26, 0.60 | <.001   |
| Think probably had COVID-19       | 598   | 79.1 | 691 | 0.71, 0.56, 0.91 | .006    |
| Don’t Know if had COVID-19        | 462   | 81.5 | 535 | 0.73, 0.55, 0.97 | .031    |

Hosmer & Lemeshow $\chi^2 = 7.444, \text{df}=8, p=0.490$.
Final model $\chi^2 = 497.429, \text{df}=29, p<0.001$.
Nagelkerke = 0.184.
Cases correctly classified: 88.1%.
84 cases excluded due to missing data on one or more independent variables.

* adjusted for all other variables in the model, AOR, adjusted odds ratio; ref, reference category; 95%CI, 95% confidence interval.
| Source:                                      | Level of Trust (trust completely [1]…not at all [5]) |               |               |               |               |               | Mean | Std Dev |
|---------------------------------------------|-----------------------------------------------------|---------------|---------------|---------------|---------------|---------------|------|---------|
|                                             | n         | %            | n         | %            | n         | %            | n         | %            |               |
| The NHS                                     | 2084      | 41.9%        | 1902      | 38.3%        | 701       | 14.1%        | 155       | 3.1%         | 127           | 2.5%          | 1.86          | 0.95          |
| Doctors, nurses or other healthcare         | 1918      | 38.6%        | 2092      | 42.1%        | 714       | 14.4%        | 154       | 3.1%         | 90            | 1.8%          | 1.87          | 0.90          |
| professionals                               |           |               |           |               |           |               |           |               |               |               |               |               |
| Scientific and medical advisers             | 1798      | 36.2%        | 2101      | 42.3%        | 792       | 15.9%        | 160       | 3.2%         | 121           | 2.4%          | 1.94          | 0.93          |
| The World Health Organisation (WHO)         | 1313      | 26.4%        | 2016      | 40.6%        | 1070      | 21.6%        | 310       | 6.2%         | 256           | 5.1%          | 2.23          | 1.07          |
| Pharmacists                                 | 999       | 20.1%        | 1973      | 39.7%        | 1434      | 28.8%        | 341       | 6.9%         | 226           | 4.5%          | 2.36          | 1.02          |
| The UK Government                           | 654       | 13.2%        | 1542      | 31.1%        | 1739      | 35.1%        | 614       | 12.4%        | 402           | 8.1%          | 2.71          | 1.10          |
| Scottish Govt/Welsh Assemblya               | 118       | 17.4%        | 189       | 27.9%        | 207       | 30.5%        | 88        | 13.1%        | 75            | 11.1%         | 2.72          | 1.21          |
| Drug companies who manufacture vaccines     | 406       | 8.2%         | 1064      | 21.4%        | 2065      | 41.6%        | 771       | 15.5%        | 661           | 13.3%         | 3.04          | 1.11          |
| Family and friends                          | 343       | 6.9%         | 876       | 17.6%        | 2230      | 44.9%        | 977       | 19.7%        | 542           | 10.9%         | 3.10          | 1.04          |
| The media (e.g. newspapers, magazines,      | 86        | 1.7%         | 302       | 6.1%         | 1567      | 31.5%        | 1433      | 28.9%        | 1580          | 31.8%         | 3.83          | 1.00          |
| television, radio)                          |           |               |           |               |           |               |           |               |               |               |               |               |
| Faith or community leaders                  | 131       | 2.6%         | 124       | 2.5%         | 619       | 12.5%        | 827       | 16.7%        | 3264          | 65.7%         | 4.40          | 0.98          |
| Social media (e.g. Twitter, Facebook,       | 65        | 1.3%         | 69        | 1.4%         | 506       | 10.2%        | 1267      | 25.5%        | 3056          | 61.6%         | 4.45          | 0.83          |
| Instagram etc)                              |           |               |           |               |           |               |           |               |               |               |               |               |
| Celebrities and social media                | 60        | 1.2%         | 71        | 1.4%         | 493       | 9.9%         | 1175      | 23.6%        | 3170          | 63.8%         | 4.47          | 0.82          |
influencers                                  |           |               |           |               |           |               |           |               |               |               |               |               |

Base: All participants (weighted). Missing cases range from n=3 to n=27. *Base: all participants in Scotland or Wales, n=679 (weighted). List order was randomised for each participant.
### Table 4 Views on priority groups for vaccination: who should be first and last groups vaccinated

| View of priority groups | Should not be offered | One of the first (1) | One of the last (5) | Mean | Std Dev |
|-------------------------|-----------------------|----------------------|---------------------|------|---------|
|                         | n  | %    | n  | %   | n  | %   | n  | %   |      |         |
| Doctors, nurses and other healthcare professionals | 33 | 0.7% | 4472 | 90.0% | 280 | 5.6% | 83 | 1.7% | 15 | 0.3% | 83 | 1.7% | 1.17 | 0.63 |
| People with serious health conditions which mean they are vulnerable to COVID-19 | 35 | 0.7% | 4017 | 80.9% | 671 | 13.5% | 129 | 2.6% | 35 | 0.7% | 77 | 1.6% | 1.27 | 0.69 |
| Care home workers | 36 | 0.7% | 3926 | 79.0% | 683 | 13.8% | 197 | 4.0% | 58 | 1.2% | 66 | 1.3% | 1.31 | 0.72 |
| Residents in a care home | 47 | 0.9% | 3593 | 72.4% | 734 | 14.8% | 337 | 6.8% | 123 | 2.5% | 131 | 2.6% | 1.47 | 0.93 |
| People aged 80 or over | 49 | 1.0% | 3613 | 72.9% | 706 | 14.2% | 304 | 6.1% | 118 | 2.4% | 168 | 3.4% | 1.48 | 0.96 |
| Social care workers | 33 | 0.7% | 2683 | 54.0% | 1348 | 27.2% | 683 | 13.8% | 143 | 2.9% | 75 | 1.5% | 1.70 | 0.92 |
| Schoolteachers | 47 | 0.9% | 2098 | 42.2% | 1621 | 32.6% | 886 | 17.8% | 223 | 4.5% | 94 | 1.9% | 1.90 | 0.97 |
| People with jobs that involve direct contact with members of the public | 45 | 0.9% | 1864 | 37.5% | 1603 | 32.3% | 1157 | 23.3% | 228 | 4.6% | 70 | 1.4% | 1.99 | 0.96 |
| People aged 31-50 | 43 | 0.9% | 154 | 3.1% | 614 | 12.4% | 2096 | 42.2% | 1486 | 30.0% | 568 | 11.4% | 3.35 | 0.95 |
| People aged 18-30 | 102 | 2.0% | 123 | 2.5% | 289 | 5.8% | 943 | 19.0% | 1375 | 27.7% | 2130 | 42.9% | 4.05 | 1.05 |
| People aged under 18 | 282 | 5.7% | 148 | 3.0% | 253 | 5.1% | 657 | 13.3% | 831 | 16.8% | 2788 | 56.2% | 4.25 | 1.08 |

Base: All participants (weighted). "Missing cases range from n=11 to n=21. Excludes ‘should not be offered’, missing cases range from n=45 to n=301. List order was randomised for each participant.
Author contributions

MS, CJ, HB, KH, and AMM conceived the study, supported by AF, DE, and AM. MS, CJ, KA, HB, and AMM designed the questionnaire, supported by MU, AF, DE, AM, and KH. CJ and AMM acquired and analysed the data, which was interpreted by MS, CJ, HB, MU, KH and AMM. MS and AMM drafted the manuscript supported by CJ, HB, MU, and KH. KA, HB, MU, and KH critically revised the article, supported by MS, CJ, AF, DE, AM, and AMM. All authors read the final version of the manuscript and gave approval for it to be published. AMM, CJ, and MS had access to the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. MS is the guarantor.

Data availability

After completion of the study, the survey dataset will be deposited in the UK Data Archive.

Ethical approval

The study received ethical approval from NatCen’s Research Ethics Committee (ID P14307). Participants gave informed consent before taking part.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
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References

[1] UK Government Department of Health and Social Care. Joint Committee on Vaccination and Immunisation: advice on priority groups for COVID-19 vaccination, 30 December 2020. Jan 6, 2021. https://www.gov.uk/government/publications/priority-groups-for-coronavirus-covid-19-vaccination-advice-from-the-jcvi-30-december-2020/joint-committee-on-vaccination-and-immunisation-advice-on-priority-groups-for-covid-19-vaccination-30-december-2020.

[2] MacDonald NE, SAGE Working Group on Vaccine Hesitancy. Vaccine hesitancy: definition, scope and determinants. Vaccine 2015;33:4161-4.

[3] Larson HJ, Jarrett C, Eckersberger E, Smith DMD, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007-2012. Vaccine 2014;32:2150-9.

[4] Lane S, MacDonald NE, Marti M, Dumolard L. Vaccine hesitancy around the globe: analysis of three years of WHO/UNICEF Joint Reporting Form data—2015–2017. Vaccine 2018;36:3861-7.

[5] Bell S, Clarke R, Mounier-Jack S, Walker JL, Paterson P. Parents’ and guardians’ views on the acceptability of a future COVID-19 vaccine: A multi-methods study in England. Vaccine 2020;38:7789-98.

[6] Freeman D, Loe BS, Chadwick A, Vaccari C, Waite F, Rosebrock L, et al. COVID-19 vaccine hesitancy in the UK: the Oxford coronavirus explanations, attitudes, and narratives survey (Oceans) II. Psychol Med 2020; published online Dec 11. https://dx.doi.org/10.1017/S0033291720005188.

[7] Lazarus JV, Ratzan SC, Palayew A, Gostin LO, Larson HJ, Rabin K, et al. Extended data fig. 1: ‘If a COVID-19 vaccine is proven safe and effective and is available, I will take it’. In: A global survey of potential acceptance of a COVID-19 vaccine. Nat Med 2021;27:225-8. https://doi.org/10.1038/s41591-020-1124-9.

[8] Murphy J, Vallières F, Bentall RP, Shevlin M, McBride O, Hartman TK, et al. Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. Nat Commun 2021;12:29.
Robertson E, Reeve KS, Niedzwiedz CL, Moore J, Blake M, Green M, et al. Predictors of COVID-19 vaccine hesitancy in the UK household longitudinal study. *Brain Behav Immun* 2021;94:41-50.

Paul E, Steptoe A, Fancourt D. Attitudes towards vaccines and intention to vaccinate against COVID-19: Implications for public health communications. *Lancet Reg Health Eur* 2021;1:100012. https://doi.org/10.1016/j.lanepe.2020.100012

Sherman SM, Smith LE, Sim J, Amlôt R, Cutts M, Dasch H, et al. COVID-19 vaccination intention in the UK: results from the COVID-19 Vaccination Acceptability Study (CoVAccS), a nationally representative cross-sectional survey. *Hum Vaccin Immunother* 2020;26:1-10.

Williams L, Flowers P, McLeod J, Young D, Rollins L. The Catalyst Project Team. Social patterning and stability of intention to accept a COVID-19 vaccine in Scotland: will those most at risk accept a vaccine? *Vaccines (Basel)* 2021;9:17.

Office for National Statistics. Coronavirus (COVID-19) latest insights. Apr 16, 2021. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19/latestinsights#vaccinations.

Mahase E. Covid-19: Booster vaccine to be rolled out in autumn as UK secures 60m more Pfizer doses. *BMJ* 2021;373:n1116.

Razai MS, Chaudhry UAR, Doerholt K, Bauld L, Majeed A. Covid-19 vaccination hesitancy. *BMJ* 2021;373:n1138.

Mohdin A. BAME groups urged to have Covid vaccine in UK TV ad campaign. *The Guardian*, Feb 18, 2021. https://www.theguardian.com/world/2021/feb/18/bame-groups-urged-to-have-covid-vaccine-in-uk-tv-ad-campaign.

Sewell HF, Robertson JFR, Stewart M, Kendrick D, Bird SM. Revisiting the UK’s strategy for delaying the second dose of the Pfizer covid-19 vaccine. Jan 20, 2021. https://blogs.bmj.com/bmj/2021/01/20/revisiting-the-uk-s-strategy-for-delivering-the-second-dose-of-the-pfizer-covid-19-vaccine/.

World Health Organization Regional Office for Europe. Survey Tool and Guidance. Rapid, simple, flexible behavioural insights on COVID-19. Copenhagen: WHO Regional Office for Europe;
[19] Gallup. Ch 5 Attitudes to vaccines. In: Gallup. Wellcome Global Monitor. How does the world feel about science and health? London: Wellcome Trust, 2019: 104-25.
https://cms.wellcome.org/sites/default/files/wellcome-global-monitor-2018.pdf.

[20] Collins D. Cognitive Interviewing Practice. London: SAGE Publications Ltd, 2014.

[21] Jessop C. The NatCen Panel: developing an open probability-based mixed-mode panel in Great Britain. Soc Res Pract 2018;6:2-14. https://thesra.org.uk/Common/Uploaded%20files/Social%20Research%20Practice%20Journal/social-research-practice-journal-issue-06-summer-2018.pdf.

[22] Jacobson Vann JC, Jacobson RM, Coyne-Beasley T, Asafu-Adjei JK, Szilagyi PG. Patient reminder and recall interventions to improve immunization rates. Cochrane Database Syst Rev 2018;1:CD003941.

[23] Thorneloe R, Wilcockson H, Lamb M, Jordan CH, Arden M. Willingness to receive a COVID-19 vaccine among adults at high-risk of COVID-19: a UK-wide survey. PsyArXiv 2020; published online Jul 20. https://psyarxiv.com/fs9wk (preprint).

[24] Mathur R, Rentsch CT, Morton CE, Hulme WJ, Schultze A, MacKenna B, et al. Ethnic differences in SARS-CoV-2 infection and COVID-19-related hospitalisation, intensive care unit admission, and death in 17 million adults in England: an observational cohort study using the OpenSAFELY platform. Lancet. 2021;397:1711-24.

[25] Allington D, McAndrew S, Moxham-Hall V, Duffy B. Coronavirus conspiracy suspicions, general vaccine attitudes, trust and coronavirus information source as predictors of vaccine hesitancy among UK residents during the COVID-19 pandemic. Psychol Med 2021; published online April 12. https://doi.org/10.1017/s0033291721001434

[26] Sah P, Vilches TN, Moghadas SM, Fitzpatrick MC, Singer BH, Hotez PJ, et al. Accelerated vaccine rollout is imperative to mitigate highly transmissible COVID-19 variants. EClinical Medicine 2021;35:100865.
[27] Hansen CH, Michlmayr D, Gubbels SM, Mølbak K, Ethelberg S. Assessment of protection against reinfection with SARS-CoV-2 among 4 million PCR-tested individuals in Denmark in 2020: a population-level observational study. *Lancet* 2021;397:1204-12.

[28] Hall VJ, Foulkes S, Charlett A, Atti A, Monk EJM, Simmons R, et al. SARS-CoV-2 infection rates of antibody-positive compared with antibody-negative health-care workers in England: a large, multicentre, prospective cohort study (SIREN). *Lancet* 2021;397:1459-69.

[29] Lockyer B, Islam S, Rahman A, Dickerson J, Pickett K, Sheldon T, et al. Understanding COVID-19 misinformation and vaccine hesitancy in context: Findings from a qualitative study involving citizens in Bradford, UK. *Health Expect* 2021; published online May 4. https://dx.doi.org/10.1111/hex.13240

[30] Williams L, Gallant AJ, Rasmussen S, Brown Nicholls LA, Cogan N, et al. Towards intervention development to increase the uptake of COVID-19 vaccination among those at high risk: Outlining evidence-based and theoretically informed future intervention content. *Br J Health Psychol* 2020;25:1039-54.