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The UPTAKE study: a cross-sectional survey examining the insights and beliefs of the UK population on COVID-19 vaccine uptake and hesitancy

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ABSTRACT

Objective A key challenge towards a successful COVID-19 vaccine uptake is vaccine hesitancy. We examine and provide novel insights on the key drivers and barriers towards COVID-19 vaccine uptake.

Design This study involved an anonymous cross-sectional online survey circulated across the UK in September 2020. The survey was designed to include several sections to collect demographic data and responses on (1) extent of agreement regarding various statements about COVID-19 and vaccinations, (2) previous vaccination habits (eg, if they had previously declined vaccination) and (3) interest in participation in vaccine trials. Multinominal logistic models examined demographic factors that may impact vaccine uptake. We used principle component analysis and text mining to explore perception related to vaccine uptake.

Setting The survey was circulated through various media, including posts on social media networks (Facebook, Twitter, LinkedIn and Instagram), national radio, news articles, Clinical Research Network website and newsletter, and through 150 West Midlands general practices via a text messaging service.

Participants There were a total of 4884 respondents of which 9.44% were black, Asian and minority ethnic (BAME) group. The majority were women (n=3416, 69.9%) and of white ethnicity (n=4127, 84.5%).

Results Regarding respondents, overall, 3873 (79.3%) were interested in taking approved COVID-19 vaccines, while 677 (13.9%) were unsure, and 334 (6.8%) would not take a vaccine. Participants aged over 70 years old (OR=4.63) and the BAME community (OR=5.48) were more likely to take an approved vaccine. Smokers (OR=0.45) and respondents with no known illness (OR=0.70) were less likely to accept approved vaccines. The study identified 16 key reasons for not accepting approved vaccines, the most common (60%) being the possibility of the COVID-19 vaccine having side effects.

Conclusions This study provides an insight into focusing on specific populations to reduce vaccine hesitancy. This proves crucial in managing the COVID-19 pandemic.

Strengths and limitations of this study

- This is the largest and first cross-sectional online survey in the UK that allows examination of the various factors influencing the uptake of a potential approved COVID-19 vaccine.
- This survey has allowed us to gain a deeper insight and a snapshot into the uptake of a COVID-19 vaccine, at a time prior to vaccine launch.
- This study was generally inclusive across all demographic groups, including age and ethnicity, with similar numbers to the UK population.
- The participant cohort could have benefitted from greater black, Asian and minority ethnic group diversity and representation.
- There is likely to be selection bias among the respondents completing the survey, and it provides a snapshot of the views at the time of response.

INTRODUCTION

COVID-19 is an infectious disease that is caused by the SARS-CoV-2, initially detected in Wuhan, China, in November 2019.[1] The WHO declared the COVID-19 epidemic a Public Health Emergency of International Concern on 30 January 2020.[2] This highly infectious disease has led to worldwide curfews and social distancing restrictions to prevent further spread of COVID-19.[3] Although social distancing measures have been identified as one of the primary tools to reduce the transmission of COVID-19,[4] this has led to insurmountable effects on the economy and the social and mental well-being of people's health.[5]

There is little evidence to suggest that the spread of COVID-19 will stop naturally through population immunity, that is, 'herd immunity'.[6] Population immunity takes place when a sufficiently large proportion of immune individuals exists in a population.

With an estimated 0.3%–1.3% infection fatality ratio, the cost of reaching population immunity through natural infection would be very high.[7] Men, older individuals and those with comorbidities are disproportionately affected, with an infection fatality ratio as high as 3.3%.[8] Additionally, Public Health England revealed the death rate from COVID-19 in England to be four times higher for black people and three times higher for Asian people than for their white counterparts.[9] Thus, an effective vaccine may offer the safest way to reach population immunity, particularly if immunity boosts are needed with virus variant formation or reinfections.[6] The BioNTech–Pfizer vaccine has now been approved by the Medicines and Healthcare products Regulatory Agency, and on 8 December, the UK became the first country to roll out a national vaccination programme for COVID-19.[10] Shortly following this, the Oxford–AstraZeneca vaccine was approved for use in the UK, while the Moderna vaccine has been mainly administered in the USA.[11]

A further challenge for successful vaccine uptake, particularly with COVID-19, is vaccine hesitancy. Despite previous successful vaccines, there has been a greater shift of attention given to 'vaccine hesitancy', described as those people who have concerns about vaccine safety, efficacy or need.[12] This can include those who are unsure about taking the vaccine and may have concerns or those who would refuse to take the vaccine. Obstacles to vaccination can include lack of trust towards public health authorities or government strategies and access to rumours and myths, particularly around safety. This is largely influenced by the media.[13] Vaccine uptake rates can also vary across different communities and ethnicities, with significantly lower uptake rates in the black, Asian and minority ethnic (BAME) community.[14 15] Furthermore, recently cited adverse outcomes in the ongoing trials could discourage the public from participating in a COVID-19 vaccine programme.

With the newly approved vaccines now being rolled out to the public, this study has explored the key drivers and barriers to COVID-19 vaccine uptake at this pivotal time. The insights from this study could be valuable in delivering, supporting and promoting adequate uptake for the population-wide vaccine programme in other countries that are in their planning or initial stages of vaccine roll out.

METHODS

Study design

This study involved a national anonymous cross-sectional online survey. The survey was created in English via Google forms. The survey was open from 4 September 2020 to 9 October 2020. The survey was circulated across the UK through various media. These included posts on social media networks (Facebook, Twitter, LinkedIn and Instagram), national radio, news articles, Clinical Research Network West Midlands (CRN WM) website and newsletter and through 150 West Midlands general practices via a text messaging service. The social media networks were used to target the general population with multiple posts during the month of September. The radio and news articles were centred on targeting BAME-specific individuals who are notoriously known to be under-represented in studies. The general practices sent a generic text to all patients in their practice asking for participation with a link to access the survey. Those without a mobile phone or internet service were unable to participate in the survey.

The interview questions were collated, reviewed and refined internally by a group of researchers. This was followed by an external review and further refinement by the CRN WM Equality, Diversity and Inclusion Research Champions Group. Feedback from this group was used to modify questions prior to the survey going live.

The survey (online supplemental appendix A) was designed to include several sections to collect demographic data and responses on (1) extent of agreement regarding various statements about COVID-19 and vaccinations, (2) previous vaccination habits (eg, if they had previously declined vaccination) and (3) level of interest in participation in vaccine trials.

Patient and public involvement

Patient and public involvement was through review of our research questions by the CRN WM Equality, Diversity and Inclusion Research Champions Group. This consists of a group of volunteers made up of patients and public and user groups.

Ethical approval and patient consent

This study was approved by local approval processes by the CRN WM. No ethical-related issues were identified. The Health Research Authority decision tool also indicated that there was not a need for National Health Service (NHS) Research Ethics Committee review (online supplemental appendix B). Participants were provided with information about the study and how the data were going to be disseminated in the initial page of the survey. This was an entirely anonymous survey with no identifiable material or information collected. No individual consent was obtained as the patients participated without providing any identifiable material. However, implied consent was taken as participants proceeded to complete the survey after reading what the survey was about and how the data were going to be used.

Statistical analysis

The statistical analysis was done in five phases. The first described the data of the participants of the COVID-19 survey, including the various factors considered in the analysis. The second phase investigated the various factors influencing the respondents' interest in approved vaccines. This analysis was done using a multinomial logistic regression model. The analysis was done on the overall data, considering various factors such as age, gender, ethnicity (BAME and non-BAME), diagnosed

health condition and qualification. Estimates were computed for the whole data by the combination of the gender, age group and ethnicity stratifications. The third phase compared the BAME and the non-BAME community responses of the COVID-19 vaccine survey using independent sample t-test. The fourth examination analysed the 'non-uptake' group, consisting of those respondents who either chose not to uptake approved vaccines or were unsure. The fifth phase of the statistical analysis examined the key reasons cited by the respondents for not being willing to take an approved COVID-19 vaccine. This analysis was done using natural language processing technique considering the reasons quoted by the respondents. The key reasons cited were further analysed based on gender and ethnicity classifications. All analysis was carried out in STATA V.16.

RESULTS

The survey had 4884 respondents. We received complete responses for each section, as participants were not able to submit the survey without completing all of the parts. The majority were women (n=3416, 69.9%) and of white ethnicity (n=4127, 84.5%). There were 461 BAME respondents (9.4%), while 49 (1%) respondents chose not to disclose their ethnicity. Among the BAME community, 258 (5.3%) respondents were Asian/Asian British–Indian, and overall, only 67 (1.4%) respondents were black/African/Caribbean/black British. The majority of the respondents were non-university degree holders (n=1574, 32.2%), while there were 1780 (36.4%) university undergraduate degree holders and 1010 (20.7%) postgraduate respondents. The age group 50–59 were the largest participant age group (1101 responses, 22.5%), with 552 (11.3%) responses from those aged 70 and above. Ninety-two percent (n=4495) of the respondents were non-smokers, and 39.9% (n=1949) of the respondents stated diagnosed health issues. See table 1 for the full breakdown.

Overall, 3873 (79.3%) respondents were interested in taking approved vaccines, while 677 (13.86%) respondents were unsure, and only 334 (6.9%) stated that they were not going to take the vaccine. Figure 1 presents the OR of the various factors that significantly influence interest in taking the approved COVID-19 vaccines. The results indicate that except for factors of 'no health issues' (OR=0.70) and 'smokers' (OR=0.45), the rest of the factors have OR >1. Among those respondents who declared their educational qualification, graduates were more likely to take the vaccine compared with the non-graduates (considered as the reference group). Similarly, of those respondents who declared their gender, men were more likely to take the approved vaccine. Respondents belonging to the age groups 50–69 (OR=5.45) and 70 and above (OR=4.63) were more likely to accept the approved COVID-19 vaccine compared with the respondents below 50 years old, which is considered as the reference group. Among the ethnicity groups, it is evident that the BAME community was more likely to accept the COVID-19 vaccine (OR=5.48). Within the BAME community, the South Asian ethnicity, that is, Indian, Pakistani and Bangladeshi, showed more interest towards uptake of the approved COVID-19 vaccine. The figure shows the reference categories against which the ORs have been estimated.

Table 2 reports the mean scores of the survey questionnaire. For the survey, a 5-point Likert Scale was used, that is, strongly disagree (1), disagree (2), neutral (3), agree (4) and strongly agree (5). The mean scores for all the questions are above three, and the SD was very low for the general questions on vaccine, such as 'vaccines are safe' and 'vaccines keep you healthy'. However, for the questions specific on COVID-19, the SD was higher. This indicates that even though the respondents tend to agree on the importance and necessity of the COVID-19 vaccine, the responses varied considerably more than the generic ones. There was a significant difference in the mean score of the responses between the BAME and the non-BAME community, with mean scores of the former significantly higher than that of the latter community, although SDs were lower. That the variation of the scores of the BAME community was higher than the non-BAME community could possibly indicate that perception of vaccines differs widely across the BAME community.

The reliability coefficient range of the questionnaire is 0.91 (value of Cronbach's alpha). The latent variables were estimated using principal component analysis. For the questionnaire, the null hypothesis of Bartlett's test of sphericity was rejected at 1% significance level (P *value <0.01*), stating that the variables are not orthogonal, that is, they are correlated. The Kaiser-Meyer-Olkin value is 0.89, indicating that the sampling is adequate. The findings show that the OR of impact of 'perception of COVID-19 vaccine on overall health' (OR=3.34) on uptake of approved COVID-19 vaccine is considerably higher than the impact of 'perception of generic vaccine on overall health' (OR=1, reference category).

In total, 1011 respondents (20.7%) were classified into the 'non-uptake' group; within this group, 334 (33%) would choose not to take the approved vaccine ('refusers'), and 677 (67%) respondents were 'unsure'. The 'unsure' group was two times larger than the 'refusers'. In the 'non-uptake' group, women accounted for 75% (n=759), with 33.6% (n=340) reported to have diagnosed health issues. Smokers were at 8.3% (n=84). Among the qualification classifications in the 'non-uptake' group, university graduates accounted for 37.2% (n=376), followed by school graduates (29.6%, n=299) and postgraduates (18.9%, n=191). Respondents without formal qualifications only constituted 1.7% (n=17). Only 5.3% (n=54) respondents in the 'non-uptake' group were of the age group 70 years old and above. Among the non-takers of vaccine, the BAME community accounted for 15.6% (n=158), while 80.9% (n=818) belonged to the non-BAME community. Of those who would choose not to have the vaccine, 52.1% (n=641) indicated that they

Table 1 Description of the survey respondents for the whole sample

	Respondents	Percentage (%)		Respondents	Percentage (%)
Interested in approved COVID-19 vaccine			Gender		
Interested	3873	79.3	Woman	3416	69.9
Not interested	334	6.8	Man	1426	29.2
Unsure	677	13.9	Prefer not to say	42	0.9
Age group			Ethnicity		
Under 18	7	0.1	Caucasian—English/Welsh/Scottish/Northern Irish/British	4127	84.5
18–29	525	10.7	Caucasian—Irish	49	1.0
30–39	708	14.5	Caucasian—Gypsy or Irish Traveller	3	0.1
40–49	1042	21.3	Caucasian—Roma	2	0.0
50–59	1101	22.5	Caucasian—others	193	4.0
60–69	914	18.7	Asian/Asian British—Indian	258	5.3
70 and above	552	11.3	Asian/Asian British—Pakistani	30	0.6
Prefer not to say	35	0.7	Asian/Asian British—Chinese	19	0.4
BAME community			Asian/Asian British—Bangladeshi	18	0.4
Non-BAME	4374	89.6	Mixed/multiple ethnic groups	69	1.4
BAME	461	9.4	Black/African/Caribbean/black British—African	67	1.4
Prefer not to say	49	1.0	Prefer not to say	49	1.0
Qualification			Smoker		
No formal qualifications	127	2.6	Smoker	386	7.9
Up to A level	1574	32.2	Non-smoker	4495	92.0
University degree (undergraduate)	1780	36.4	Prefer not to say	3	0.1
Postgraduate	1010	20.7	Diagnosed health issue		
Prefer not to say	393	8.0	No diagnosed health issues	2935	60.1
			At least one diagnosed health issue	1949	39.9

Note: The table above reports the demographic insights of the respondents of the COVID-19 survey. There were 4884 respondents, and the table is based on the full data collected.
BAME, black, Asian and minority ethnic.

have previously declined vaccinations. The details are reported in table 3.

The survey identified 16 reasons cited by the respondents for not taking approved COVID-19 vaccines. The details are reported in table 4. Panel A provides the percentages for the not sure category, whereas Panel B reports the details of the not interested category. In both categories, 'unless completely tested with no proven side effect' was the reason with the greatest response (71% for Panel A and 54.2% for Panel B).

At the end of the survey, there was an opportunity for free text comments. Some free text comments regarding reasons for not taking the vaccine revolved around the idea of the BAME community being used as 'guinea pigs' for trials to verify vaccine results and mistrust around government strategies.

DISCUSSION

This is the largest UK-based population survey, examining the views surrounding COVID-19 vaccination and providing a focus on key factors to drive vaccination uptake. This survey allows us to compare the UK with other countries that have similarly gained perceptions and potential vaccine uptake through an online survey. China had the highest rate of perceived vaccine uptake, where 91.3% would accept an approved and available COVID-19 vaccination.[16] A survey done across seven European countries found that 74% of participants would be willing to get vaccinated against COVID-19[17]—a similar finding to our results. A recent survey undertaken in the USA showed the lowest COVID-19 vaccine acceptance rate of 67% with men, older adults, Asians and college and/or graduate degree holders more accepting of the vaccine.[18]

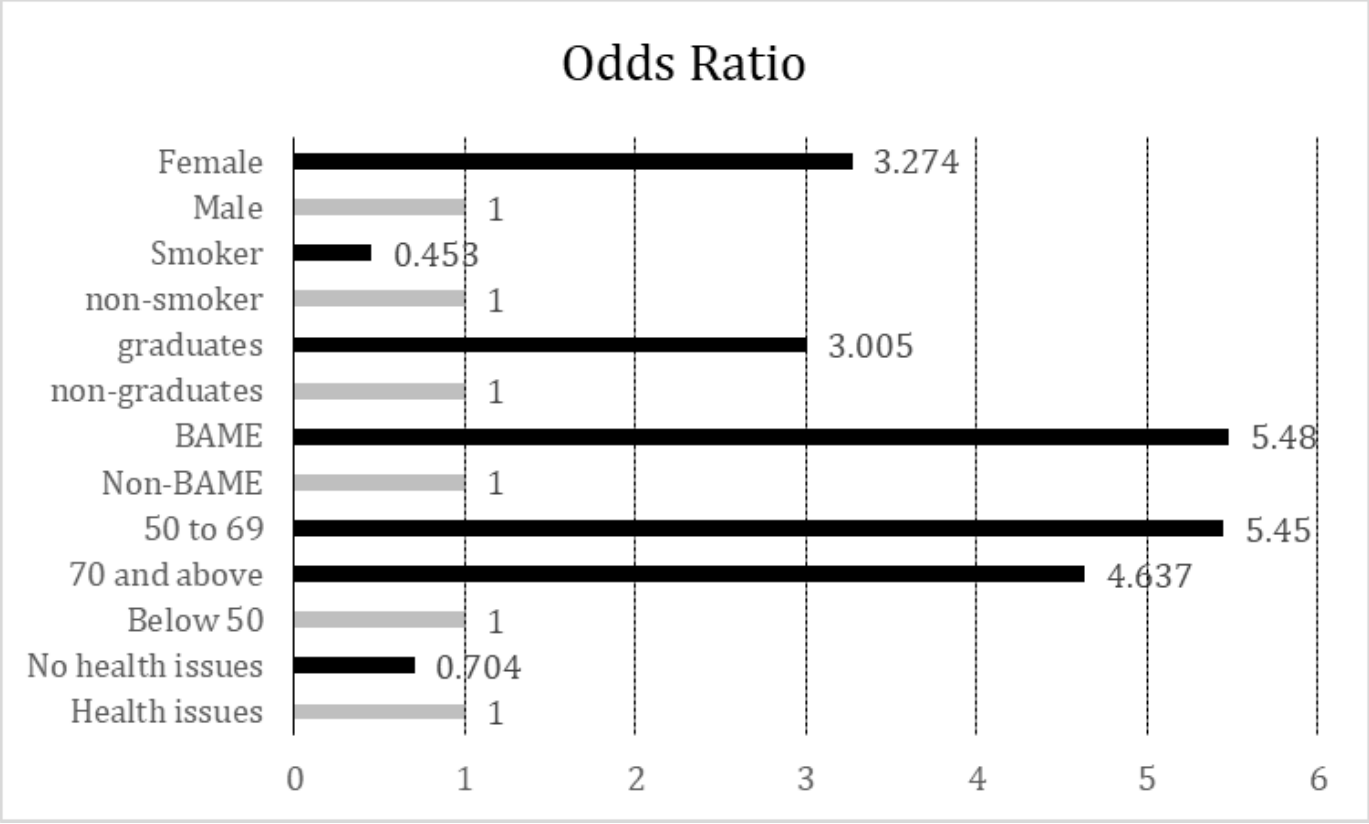

Figure 1 ORs showing factors influencing interest in taking an approved COVID-19 vaccine. BAME: black, Asian and minority ethnic.

This is also the first survey to focus specifically on the BAME population and other high-risk groups identified as the government's priority for vaccination. The 79.2% of participants willing to be vaccinated exceeds the threshold required for COVID-19 population immunity, estimated to be 74% in Europe.[17] It is important to overcome the barriers to vaccine uptake and to target the non-takers, known as the 'non-uptake' group, in order to ensure that the population immunity threshold is met across the population.

In late September, the UK government published interim advice on high-risk groups that will be prioritised with the COVID-19 vaccination programme.[19] A combination of clinical risk stratification and an age-based approach was used in determining these groups, placing clinically vulnerable and over 70 age cohort as priority groups. Both of these groups, according to our findings, are more likely to uptake the approved vaccine. Several studies have found that groups over the age of 55 are more willing to get vaccinated.[17] In a UK survey done with older adults and patients with chronic respiratory disease, 86% of respondents wanted to receive a COVID-19 vaccine.[20] This may be due to the awareness that older adults with comorbidities are at greater risk of COVID-19 complications.

While the overall proportion of BAME participants was relatively low in our study, the BAME recruitment was greater than any other UK COVID-19 vaccination-based study thus far. Our results found that the BAME community in general is more likely to accept approved vaccines when compared with the non-BAME community. This contrasts with previous literature suggesting generally poor vaccination uptake rates in the BAME community, such as for child and influenza vaccinations.[14] There has also historically been racial disparities surrounding trust in vaccines, where the BAME community is less likely to trust pharmaceutical companies and government strategies.[21] A primary reason for a potential increase in uptake with the COVID-19 vaccine may be due to the disproportionate amount of COVID-19 deaths in the BAME population with a third of these patients being admitted to the intensive care unit.[11]

However, examining the individual ethnic groups, there are clear disparities with potential uptake. Our results showed that the South Asian groups showed more interest towards uptake of the approved COVID-19 vaccine. The South Asian population made up most of the BAME participation, and historically, these groups have a higher uptake in vaccination programmes in the UK and also in their home countries, where trust in the medical profession is high.[18 22] Only 1.4% of our study participants were black British, making it difficult to fully deduct the views of this community with such a limited sample size. However, our findings support previous literature surrounding the black community and their lower vaccine uptake rates.[23] There is a deep-rooted mistrust

Table 2 Comparing the responses of the survey questionnaire on COVID-19

	Overall		BAME		Non-BAME		BAME vis-à-vis non-BAME			
Related questions	**Mean core**	**SD**	**Mean Score**	**SD**	**Mean Score**	**SD**	**(P value)**	**Latent variable**	**OR**	***(P value)***
Vaccines are safe	3.97	0.938	3.67	1.036	4.01	0.904	(0.000)	Perception of generic vaccine on overall health	1 (reference category)	
Vaccines keep you healthy	4.07	0.951	3.79	1.067	4.11	0.916	(0.000)			
Vaccines are imp. for overall health	4.14	0.963	3.86	1.070	4.19	0.925	(0.000)			
Approved COVID-19 vaccines are safe	4.04	1.019	3.77	1.120	4.09	0.986	(0.000)	Perception of COVID-19 vaccine on overall health	3.34	(0.000)
Vaccine is a necessity for COVID-19	4.08	1.069	3.77	1.147	4.13	1.035	(0.000)			
Vaccine is best to prevent COVID-19	4.17	1.058	3.82	1.183	4.22	1.016	(0.000)			
Only vaccine can control COVID-19	4.11	1.098	3.80	1.201	4.16	1.061	(0.000)			
COVID-19 vaccine won't harm me	3.94	1.022	3.67	1.159	3.98	0.986	(0.000)			

Note: The table reports the mean scores of the responses of the COVID-19 survey. In total, there were 4884 respondents. A 5-point Likert Scale was used for this survey, that is, strongly disagree (1), disagree (2), neutral (3), agree (4) and strongly agree (5). The reliability coefficient range of the questionnaire is 0.91 (value of Cronbach's alpha). The latent variables were estimated using principal component analysis. For the questionnaire, the null hypothesis of Bartlett's test of sphericity was rejected at 1% significant level, stating that the variables are not orthogonal, that is, they are correlated. The Kaiser-Meyer-Olkin value is 0.89 indicating that the sampling is adequate. The OR of the latent variables was computed employing binary logistic regression model.
BAME, black, Asian and minority ethnic.

Table 3 Non-uptakers of approved COVID-19 vaccine

Non-uptakers category	Not sure (677 respondents)	Refusers (334 respondents)	Total (1011 respondents)
Gender (%)			
Man	20.38	26.05	22.26
Woman	78.29	68.56	75.07
Prefer not to say	1.33	5.39	2.67
Smoker (%)	5.61	13.77	8.31
Diagnosed health condition (%)	35.45	29.94	33.63
Qualification (%)			
No qualification	2.22	0.60	1.68
School graduates	31.17	26.35	29.57
Graduates	37.81	35.93	37.19
Postgraduates	19.20	18.26	18.89
Prefer not to say	9.60	18.86	12.66
Age group (%)			
Under 18	0.00	0.30	0.10
18–29	13.00	15.87	13.95
30–39	18.46	20.66	19.19
40–49	23.63	26.95	24.73
50–59	25.26	20.06	23.54
60–69	11.67	8.98	10.78
70+	6.50	2.99	5.34
Prefer not to say	1.48	4.19	2.37
Ethnicity (%)			
BAME	9.45	16.77	15.63
Non-BAME	83.31	76.05	80.91
Prefer not to say	7.24	7.19	3.46
Record of declined vaccination (%)	20.53	52.09	30.95

Note: The table reports the demographic details of respondents who chose not to take the COVID-19 vaccine. Overall, 1011 respondents chose not to take the vaccine.
BAME, black, Asian and minority ethnic.

within this community in medical and vaccine research, due to historical oppression and health inequalities.[20 24] Several US studies have supported this, with the black community having higher levels of COVID-19 vaccine hesitancy.[15 18] The perception surrounding vaccines differs widely across the BAME community and remains a challenge for this high-risk group.

Aside from ethnic differences, our study identified that smokers, those aged 40–49 and those with no known illness were less likely to accept approved vaccines. This is the first study to identify smokers being less likely to accept approved vaccines and could be an area of concern. Smokers are 1.4 times more likely to have severe symptoms of COVID-19 and approximately 2.4 times more likely to be admitted to an intensive care unit.[25] A younger and healthy cohort being less willing to vaccinate has also been supported by study findings in Europe and the USA[15 17] and may reflect the perception from these groups that they have less complications of COVID-19 or may die from it.[26] However, with the infectious nature of COVID-19, having these groups not vaccinated poses a greater risk of spreading to those susceptible to greater complications from COVID-19.[27]

Contrary to previous studies,[15] educational qualifications did not have an influence on vaccine uptake in our study. This may suggest that vaccination attitude is more likely to be influenced by motivational and psychological factors, including a feeling of individual responsibility for population-wide health, rather than education.[27] The 52.1% of the non-takers had a recorded history of declined vaccination in the past, making it more likely that this is a long-term view held about vaccinations, with a similar trend found in other studies.[15]

Table 4 Key reasons cited by the non-uptakers category of 1011 respondents

		Panel A: not sure (677 respondents)					Panel B: refuser (334 respondents)				
No.	Reasons	Responses (%)	Woman (%)	Man (%)	BAME (%)	Non-BAME (%)	Responses (%)	Woman (%)	Man (%)	BAME (%)	Non-BAME (%)
1	Unless completely tested and no proven side effects	71.00	67.50	32.50	5.45	94.55	54.21	75.48	24.52	4.55	95.45
2	Impaired immune system	4.00	68.00	32.00	3.68	96.32	20.32	67.82	32.18	7.82	92.18
3	Undisclosed reasons	2.28	45.60	54.40	12.07	87.93	3.41	66.45	33.55	27.89	72.11
4	COVID-19 doesn't need vaccine	2.00	55.45	44.55	17.81	82.19	4.89	38.28	61.72	14.35	85.65
5	Don't believe in vaccines	2.00	62.67	37.33	13.69	86.31	3.67	61.78	38.22	11.62	88.38
6	Religious reasons	2.00	66.82	33.18	81.92	18.08	4.21	69.05	30.95	89.15	10.85
7	Vaccine development is being rushed	10.00	55.22	44.78	0.00	100.00	2.65	85.49	14.51	0.46	99.54
8	Below 50 years old, so not important for my age	1.00	65.20	34.80	0.00	100.00	1.24	75.28	24.72	1.67	98.33
9	Already infected, so not sure of vaccine side effects	1.00	55.64	44.36	0.00	100.00	0.45	60.75	39.25	4.89	95.11
10	Cautious of age (65+)	2.00	55.88	44.12	0.00	100.00	0.67	88.34	11.66	1.57	98.43
11	Don't trust the government and pharmaceuticals	0.20	59.72	40.28	18.69	81.31	1.00	63.48	36.52	10.68	89.32
12	Concerned about the impact to health of family members	2.00	61.08	38.92	0.00	100.00	0.78	67.43	32.57	25.78	74.22
13	BAME will be used as trials to verify vaccine results	0.00	0.00	0.00	0.00	0.00	0.12	100.00	0.00	13.78	86.22
14	Pregnancy-related and motherhood-related worries	0.40	100.00	0.00	18.04	81.96	0.58	100.00	0.00	47.28	52.72
15	Bad experience of influenza vaccine	0.10	71.05	28.95	0.00	100.00	1.78	59.82	40.18	4.77	95.23
16	Unethical measures used	0.02	100.00	0.00	10.67	89.33	0.02	100.00	0.00	5.89	94.11

Note: This table reports the key reasons cited for not willing to take the COVID-19 vaccine. Panel A reports the reasons cited by the not sure category, and Panel B reports the findings for the refuser category.
BAME, black, Asian and minority ethnic.

Our study reports 16 key reasons for not accepting approved vaccines, with the main one being fear of side effects. Other studies have also identified safety as a key reason for vaccine hesitancy.[15 20] At the time of the survey circulation, news channels were publicising the Oxford–AstraZeneca trial being paused due to participants having side effects, and this was widely circulated in the media at the time.[28] Specifically, there were concerns of side effects of transverse myelitis that, although may not be directly linked to the vaccine, could also not be ruled out.[29] This could have influenced participants' view on the safety of vaccines.

This survey was done at the time when an approved vaccine had not yet been made available. However, now that vaccines have been licensed and shown to be safe and effective, recent surveys have shown the intention to vaccinate is higher. Nguyen *et al*'s study showed that from September to December 2020, intent to receive COVID-19 vaccination increased by around 10% and non-intent decreased by 6%.[30]

Similar numbers from our 'non-uptake' group were found in another UK-based study.[31] However, in our study, the 'unsure' group is twice the size of the 'non-uptake' group. An Australian study by Attwell *et al*[32] demonstrated that respondents were more likely to be in the 'maybe' group versus the 'no' group for vaccination if they perceived COVID-19 to be a severe disease and not a 'hoax', were more likely to have the influenza vaccination and had greater trust in science. In the case of our study, the 'unsure' group, which makes a significant portion of the 'non-uptake' group, may change their mind about the vaccine once further details on an approved vaccine become available, particularly information on safety and efficacy. Furthermore, they may be more willing to take the vaccine if it is positively promoted on social media. This is reinforced by a repeat of Attwell *et al*'s survey in November 2020, compared with May 2020, that found more respondents being in the 'maybe' category for vaccination, conveying how dynamic and changing the decision making process can be.

The next most common reason (16.1%) was having an 'impaired immune system'. This would include patients who are on immunosuppressant medication or have a cancer diagnosis. However, similar to the influenza vaccine, those with an impaired immune system are still encouraged to have the annual influenza vaccination.[33] The hesitancy in vaccine uptake in this immunocompromised cohort may also be linked back to safety and the belief that vaccines may be suboptimal[34] and ultimately whether the risks of taking the vaccine may outweigh the benefits. However, this may well sway the 'unsure' group into the 'uptake' group as they see more people with various comorbidities taking the vaccine without any adverse effects.

Participants added their own reasons for not accepting approved vaccines. This revolved around the idea of the BAME community being used as 'guinea pigs' for trials to verify vaccine results and mistrust around government strategies, which has been supported in other studies.[21] These views may have also been influenced by social media views at the time, particularly those highlighting vaccines as being rushed and rolled out quickly to the public without adequate testing. Furthermore, in terms of the views surrounding vaccines in general compared with a COVID-19-specific one, there was more variety in the responses related to the COVID-19-specific statements compared with the generic vaccine ones, and this was particularly found in the BAME responses. The topical nature surrounding COVID-19 vaccinations specifically is likely to draw more polarised opinions, particularly given the constant focus on COVID-19 in social media and news channels. Twitter reported a COVID-19-related tweet every 45 milliseconds, and the hashtag #coronavirus is the second most used in 2020.[35] There are also greater anti-vaccination sentiments shared on social media compared with those promoting uptake, which can lead to considerable public health concerns and the consequent potential to downstream vaccine hesitancy.[35]

Interventional educational and public health campaigns need to be targeted towards populations at risk of vaccine hesitancy and challenge the key reasons for not accepting approved vaccines. Furthermore, policymakers and shareholders need to be aware that these key reasons cited by the non-uptake cohort are potential barriers to vaccine uptake. This is to combat misinformation, particularly those circulated on social media platforms in an uncensored manner.[35] Our study also reveals that the perception of vaccine on one's overall health plays a significant driver in the decision for uptake of an approved vaccine. There is an understanding in our population cohort that vaccines are important in the fight against COVID-19 and that vaccines are needed to prevent COVID-19. This needs to be highlighted further in promotion and education of vaccines.[36]

A limitation of this study is that, while this is one of the most BAME-inclusive COVID-19 vaccination-related studies, our BAME participant percentage (9.44%) is still below the overall BAME representation in the UK, which is approximately 14%.[37] In particular, we received a very small amount of black and East Asian (eg, Chinese) participants, so it is difficult to fully deduct the views of the entirety of the BAME community. From the data that we have, however, it appears that the UK black community follows a similar trend to the USA in higher levels of vaccine hesitancy, but this can be difficult to generalise with such a small data set. Regardless, further work is needed to engage the black community in research participation and, from the limited data we do have, also in vaccine promotion.

Similar to other published surveys, there was also selection bias, as a computer or smart phone was needed to complete the survey. This may have excluded the older population, who is less likely to be digitally literate, and also economically marginalised groups. There are data suggesting these groups engage the least with the UK NHS digital resources, and it remains a challenge to provide

reliable and updated information to them.[23] This survey is also more likely to attract responses from those who are motivated to complete this survey and who are more likely to have stronger opinions related to the COVID-19 vaccination, attracting selection bias. Furthermore, there is a clear skew towards women and those more educated, so it may be difficult to generalise our results to the entire UK population. This survey also remains a snapshot of what the view was as of September 2020, but it may have likely changed since the vaccination programme has started or even in the early phases of the trials as other studies have suggested.[30 32]

Strengths of our study include the ability to stratify on demographic factors to predict COVID-19 vaccine uptake. Exploring key reasons towards vaccine hesitancy provides policymakers and key shareholders an insight into how to effectively target public health campaigns.

CONCLUSION

The uptake of approved vaccines is crucial in the fight against the COVID-19 pandemic. These novel findings regarding public insight on vaccines, including key barriers and facilitators towards vaccination, have the potential to shape future policy, practice and intervention development. This study provides necessary policy recommendations essential for the UK government and the UK medical advisory team on designing strategies. This study emphasises policies targeting the needs of increased participation from the BAME community, young people and those with no diagnosed health conditions to uptake approved COVID-19 vaccines. This will allow the UK to effectively reach population immunity thresholds nationwide and in controlling further outbreaks of this rapidly spreading disease. Widespread vaccine uptake will be a crucial turning point in rebuilding the nation's social, health and financial losses from this unprecedented pandemic.

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REFERENCES

1 Li Q, Guan X, Wu P, *et al*. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med* 2020;382:1199–207.
2 WHO. Rolling updates on coronavirus disease (COVID-19), 2020. Available: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen
3 Lewnard JA, Lo NC. Scientific and ethical basis for social-distancing interventions against COVID-19. *Lancet Infect Dis* 2020;20:631–3.
4 Weill JA, Stigler M, Deschenes O, *et al*. Social distancing responses to COVID-19 emergency declarations strongly differentiated by income. *Proc Natl Acad Sci U S A* 2020;117:19658–60.
5 Serafini G, Parmigiani B, Amerio A, *et al*. The psychological impact of COVID-19 on the mental health in the general population. *QJM: An International Journal of Medicine* 2020;113:531–7.
6 Fontanet A, Cauchemez S. COVID-19 herd immunity: where are we? *Nat Rev Immunol* 2020;20:583–4.
7 Salje H, Tran Kiem C, Lefrancq N, *et al*. Estimating the burden of SARS-CoV-2 in France. *Science* 2020;369:208–11.
8 Raisi-Estabragh Z, McCracken C, Bethell MS, *et al*. Greater risk of severe COVID-19 in Black, Asian and Minority Ethnic populations is not explained by cardiometabolic, socioeconomic or behavioural factors, or by 25(OH)-vitamin D status: study of 1326 cases from the UK Biobank. *J Public Health* 2020;42:451–60.
9 Razaq A, Harrison D, Karunanithi S. BAME COVID-19 deaths-what do we know? Rapid data & evidence review. The Centre for Evidence-Based Medicine. University of Oxford, 2020. Available: https://www.cebm.net/covid-19/bame-covid-19-deaths-what-do-we-know-rapid-data-evidence-review/
10 BBC News. Covid-19 vaccine: first person receives pfizer Jab in UK, 8 December 2020, 2020. Available: https://www.bbc.co.uk/news/uk-55227325
11 Gallagher J, Triggle N. Covid-19: Oxford-AstraZeneca vaccine approved for use in UK. BBC news. Available: https://www.bbc.co.uk/news/health-55280671
12 Deml MJ, Jafflin K, Merten S, *et al*. Determinants of vaccine hesitancy in Switzerland: study protocol of a mixed-methods national research programme. *BMJ Open* 2019;9:e032218.
13 Siciliani L, Wild C, McKee M, *et al*. Strengthening vaccination programmes and health systems in the European Union: a framework for action. *Health Policy* 2020;124:511–8.
14 Forster AS, Rockliffe L, Chorley AJ, *et al*. Ethnicity-specific factors influencing childhood immunisation decisions among black and Asian minority ethnic groups in the UK: a systematic review of qualitative research. *J Epidemiol Community Health* 2017;71:544–9.
15 Fisher KA, Bloomstone SJ, Walder J, *et al*. Attitudes toward a potential SARS-CoV-2 vaccine: a survey of U.S. adults. *Ann Intern Med* 2020;173:964–73.
16 Wang J, Jing R, Lai X, *et al*. Acceptance of COVID-19 vaccination during the COVID-19 pandemic in China. *Vaccines* 2020;8:482.
17 Neumann-Böhme S, Varghese NE, Sabat I, *et al*. Once we have it, will we use it? a European survey on willingness to be vaccinated against COVID-19. *Eur J Health Econ* 2020;21:977–82.
18 Malik AA, McFadden SM, Elharake J, *et al*. Determinants of COVID-19 vaccine acceptance in the US. *EClinicalMedicine* 2020;26:100495.
19 Department of Health and Social Care. Priority groups for coronavirus (COVID-19) vaccination: advice from the JCVI, 25 September 2020, 2020. Available: https://www.gov.uk/government/publications/priority-groups-for-coronavirus-covid-19-vaccination-advice-from-the-jcvi-25-september-2020/jcvi-updated-interim-advice-on-priority-groups-for-covid-19-vaccination

20 Williams L, Gallant AJ, Rasmussen S, *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.
21 Jamison AM, Quinn SC, Freimuth VS. "You don't trust a government vaccine": narratives of institutional trust and influenza vaccination among African American and white adults. *Soc Sci Med* 2019;221:87–94.
22 Larson HJ, de Figueiredo A, Xiahong Z, *et al*. The state of vaccine confidence 2016: global insights through a 67-Country survey. *EBioMedicine* 2016;12:295–301.
23 Ensuring your trial is designed for all who could benefit. include ethnicity framework worksheet., 2020Trial Forge. Available: https://www.trialforge.org/trial-forge-centre/include/
24 Yancy CW. COVID-19 and African Americans. *JAMA* 2020;323:1891–2.
25 Vardavas CI, Nikitara K. COVID-19 and smoking: a systematic review of the evidence. *Tob Induc Dis* 2020;18:20.
26 Wilson RF, Sharma AJ, Schluechtermann S. Factors influencing risk for COVID-19 exposure among young adults aged 18–23 years — Winnebago County, Wisconsin, March–July 2020. *MMWR Centers for Disease Control and Prevention* 2020;69:1497–502.
27 Barello S, Nania T, Dellafiore F, *et al*. 'Vaccine hesitancy' among university students in Italy during the COVID-19 pandemic. *Eur J Epidemiol* 2020;35:781–3.
28 The Financial Times. AstraZeneca puts vaccine trial on hold after participant falls ill, 2020. Available: https://www.ft.com/content/98fca6d4-fcd2-488c-bcfc-d47758740a1a
29 Voysey M, Clemens SAC, Madhi SA, *et al*. Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK. *Lancet* 2021;397:99–111.
30 Nguyen KH, Srivastav A, Razzaghi H, *et al*. COVID-19 vaccination intent, perceptions, and reasons for not vaccinating among groups prioritized for early vaccination - United States, September and December 2020. *MMWR Morb Mortal Wkly Rep* 2021;70:217–22.
31 Paul E, Steptoe A, Fancourt D. Attitudes towards vaccines and intention to vaccinate against COVID-19: implications for public health communications. *The Lancet Regional Health - Europe* 2021;1:100012.
32 Attwell K, Lake J, Sneddon J, *et al*. Converting the maybes: crucial for a successful COVID-19 vaccination strategy. *PLoS One* 2021;16:e0245907.
33 Centers for disease control and prevention. Weakened immune system and adult vaccination, 2016. Available: https://www.cdc.gov/vaccines/adults/rec-vac/health-conditions/weakenedimmune.html#:~:text=Weakened%20Immune%20System%20and%20Adult%20Vaccination&text=Tdap%20vaccine%20to%20protect%20against,up%20to%20age%2026%20years
34 Bosaeed M, Kumar D. Seasonal influenza vaccine in immunocompromised persons. *Hum Vaccin Immunother* 2018;14:1311–22.
35 Puri N, Coomes EA, Haghbayan H, *et al*. Social media and vaccine hesitancy: new updates for the era of COVID-19 and globalized infectious diseases. *Hum Vaccin Immunother* 2020;16:2586–93.
36 Reiter PL, Pennell ML, Katz ML. Acceptability of a COVID-19 vaccine among adults in the United States: how many people would get vaccinated? *Vaccine* 2020;38:6500–7.
37 Office for National Statistics. Population of England and Wales, 2020. Available: https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/national-and-regional-populations/population-of-england-and-wales/latest