COVID-19 Vaccination Hesitancy in Adults in the United Kingdom: Barriers and Facilitators to Uptake

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We have no conflicts of interest to disclose.

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Author Contributions: All authors were involved in the conceptualization and development of methodology for the research. MH undertook project administration, data collection and development of resources with support from AG, & WYC. MH & AG were responsible for Study 1 analysis. WYC, MH & AG undertook Study 2 analysis. WYC undertook Study 3 analysis. MH & AG led on the initial draft with WYC writing Studies 2 and 3 results. MH, AG & WYC reviewed and edited the paper.

Abstract

Objective: Immunization is a primary method for addressing COVID-19. Uptake in high-risk groups has been strong, however vaccination hesitancy is more prominent among younger adults. This research sought to identify the factors influencing vaccine uptake in 18–55-year-olds.

Method: Study 1, a qualitative survey (*n* = 80), identified beliefs about COVID vaccines and immunization programs. Study 2 (*n* = 473) tested whether the factors identified in study 1 predicted intention for self-vaccination and parental intention to vaccinate children. Data on vaccination behaviour was obtained in Study 3 (*n* = 309).

Results: Analysis showed individuals recognized benefits of vaccination as a path to "return to normality" and "protect others" but concerns, such as side-effects to fertility, were apparent and for some, the personal value in vaccination was questioned. Data was interpreted as largely reflective of Health Belief Model constructs. Study 2 supported this interpretation. Specifically, Benefits of, and Barriers to, vaccination predicted intention to vaccinate oneself and their children, across Black, Asian, other minority groups (BAME) and White communities. Additionally, for BAME communities, cues to action positively predicted intention. For vaccine behaviour, benefits of, and Barriers to, vaccination remained relevant in predicting vaccination behaviours, along with susceptivity and severity of COVID (no differences between ethnic communities were found). Willingness to vaccinate children decreases as the age of the child reduced.

Conclusions: Addressing vaccination hesitancy is crucial to managing COVID-19. Findings indicate emphasizing specific benefits, such as protecting others, whilst addressing barriers, including side-effect misinformation, is key to driving vaccine uptake.

Keywords: COVID-19, Vaccine Hesitancy, Mixed-Methods, Health Belief Model, Immunization

COVID-19 Vaccination Hesitancy in Adults in the United Kingdom: Barriers and Facilitators to Uptake

COVID-19, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), poses a serious threat to global health. There has been incredible speed in developing vaccines to protect people against the virus. Population-scale vaccination programs aim to achieve herd immunity, but it has been estimated that between 60-90% of the population need to be vaccinated to achieve this goal (Kadkhoda, 2021), although many feel that herd immunity is realistically not attainable (Morens et al., 2022). In the UK, the first dose of a COVID vaccine was administered in December 2020, and since then there has been a concerted effort to offer vaccination to the adult population. Currently, three vaccines are licensed and are available in the UK: Moderna, PfizerBioNTech, and the Oxford/AstraZeneca vaccine. These are available for free nationally with 12–15-year-olds included in the vaccination programme from September 2021 and 5-11-year-olds included from April 2022.

Although over 87% of people (as of 15th June 2022) aged 12 or over have received two doses of the vaccine *(https://coronavirus.data.gov.uk/*), there is still a proportion of the UK population that are hesitant, with lower rates of vaccination uptake in younger adults. In addition, vaccination amongst 12–15-year-olds varies significantly by ethnicity, ranging from 75.5% (Chinese) to 12.4% (Black Caribbean) *(https://ons. gov.uk/*). Therefore, campaigns to promote vaccination need to consider the factors that may be helpful in encouraging participation by young individuals and parents. Demographic factors that impact vaccination hesitancy, such as ethnicity have been identified (Freeman et al., 2021; Murphy et al., 2021). It would be beneficial to consider perceptual and attitudinal factors unique to younger adults, such that campaigns can target these modifiable factors to reduce vaccination hesitancy.

Various models have been suggested to explain vaccination hesitancy, including components of the Health Belief Model (HBM; Janz & Becker 1984) and the Theory of Planned Behaviour (Ajzen, 1985). Aspects of these models predict intentions to receive the seasonal flu vaccine (Kan & Zhang, 2018;

Trent, Salmon, & MacIntyre, 2021) and the H1N1 vaccine during the swine flu pandemic (Coe et al., 2012). However, context-specific issues are important to consider when determining willingness to receive a vaccine in a novel context such as the COVID pandemic (Wakefield & Khauser, 2021). For example, concerns over whether COVID vaccines are non-halal have been identified as a specific barrier in Malaysia (Wong et al., 2020). In addition, mistrust in the COVID vaccines and mistrust in governments and authorities have been shown to be linked to hesitancy for vaccines in Austria (Schernhammer et al., 2021). There is evidence to show the influence of these factors on COVID vaccine uptake in the UK (Freeman et al., 2021; Paul, Steptoe & Fancourt, 2021; Robertson et al., 2021; Sherman et al., 2021), though the methods used to measure constructs varied considerably, and the studies collected data before vaccines were available. The timing of the data collection is a pivotal contextual issue because the various COVID vaccines have their own recommendations for usage groups, as well as various documented side effects – which has entered public awareness during the vaccine rollout (so willingness to receive a vaccine may differ depending on these time-specific and contextual factors). In addition, the variety of factors that could be influential, and the complex, nature of the COVID pandemic means that merely relying on a questionnaire or generic taxonomy to examine reasons for vaccination hesitancy (e.g., Thomson, Robinson, & Vallée-Tourangeau, 2016) may not provide a complete understanding of the factors that influence individuals' COVID vaccine intentions. Hence, a mixed method approach is beneficial to capture issues that may be unique to the context of the COVID pandemic.

As recommendations have changed in the UK to include vaccinations for those under 16 years of age, work is also needed to ascertain what factors are important in parental decisions for vaccination. Parental refusal has been linked to perceptions of severity and susceptibility of the illness, as well as concerns about vaccine safety and effectiveness (Salmon, Dudley, Glanz, & Omer, 2015). Factors contributing to the decision to personally receiving a vaccine may be different to those informing the

parental decisions for children to receive a vaccine, but very little research has examined this in the context of COVID-19.

The current research was conducted once the vaccines were made available to the public. We aimed to identify the factors influencing vaccination uptake in the younger UK population (aged 18–55). Specifically, we sought to identify beliefs about COVID vaccines qualitatively in Study 1, so that a full picture of the context-issues specific to the context of COVID-19 could be identified, that may be missed by using more standardised measures of vaccine beliefs and hesitancy. These findings were then used to develop quantitative studies (2 & 3) to explain individuals' COVID vaccine intentions and actual behaviours in a larger, more diverse sample of younger UK adults, as well as intentions to support vaccination for teenage and younger children.

Study 1.

A summary of study 1 method and results are provided here. The detailed method, results, and study data are accessible via the Open Science Framework project (https://osf.io/dc3ka/).

Participants

UK participants (*n*=80) were recruited to undertake an online qualitative survey in January 2021. Purposeful sampling was used to recruit 20 participants across age range groups (18-25;25-35;35-45;45-55) to ensure views generated were across the target age range (18-55 years). Prior research confirms that this is more than sufficient to obtain saturation of data within this sample (Hennink & Kaiser, 2021) and enable generalizations to be made to this target population. 37.5% of participants identifying as male, 61.3% female and 1.3% as non-binary. The majority (87.5%) identified as White with 3.8% Black, 7.5% Asian and 1.3% Mixed/multiple ethnicities. Only 7.5% had experienced a confirmed positive COVID test, but 25% suspected they had previously been infected with COVID, and a further 18.8% were unsure whether they had had COVID previously. Only 6.3% of participants had received at least one dose of a COVID vaccine at the time of participation. No exclusion criteria were applied to limit participation.

Prolific (www.prolific.ac) was used for recruitment and participants received a nominal fee (£1.88) on completion of the survey.

Materials

An online qualitative survey was constructed to enable data generation. Questions were designed to encourage open-text responses and to capture a range of views on COVID, COVID vaccines, and the vaccination program at the initial stages of the pandemic. This method has been shown to be an effective and robust means to generate rich data (Braun et al., 2020)

Procedure

Prior ethical approval for all studies was received from The University of Winchester Ethics Committee and followed British Psychological Association's ethical guidelines (BPS, 2018), complying with the World Medical Association Declaration of Helsinki.

Results

All responses were treated equally, though the number of words in participant responses to individual questions ranged from 1- 408 words, depending on the level of detail provided for each response e.g., "none" would be indicative of where one-word responses were given. Overall, 15,374 words were included within the analysis.

Through the analysis, researchers felt that much of the data could largely be represented and understood through the application of the Health Belief Model (HBM) (Janz & Becker, 1984). For example, the perceived benefits and barriers identified in the data map onto these same constructs in the model (See Table1).

- suggest insert table 1 here -

The data from Study 1 enabled the specific aspects under-pinning constructs for this age group to be clearly identified. Hence, the measures in studies 2 and 3 were based on these data, using the HBM as a framework. For instance, when evaluating the benefits of taking the vaccine, one of the items

was: "*The vaccination programme is our best route back to normality*". In Study 3, we also evaluated specific COVID vaccines concerns derived from the findings in Study 1 (e.g., "*The risk of fertility from vaccines*").

The HBM has previously been used as a framework within health communication research (Jones et al., 2015) and as a means for explaining intention towards vaccination in relation to other illnesses such as flu (Blue & Valley, 2002; Cheney & John, 2013), HPV (Gerend & Shepherd, 2012) or childhood immunization programs (Smith et al., 2011). However, it is unclear whether it does provide a means to explain behaviour in relation to COVID vaccine uptake although some preliminary studies are emerging (Shmueli, 2021; Zampetakis & Melas, 2021). Study 2 & 3 aimed to examine this question. Specifically, it was hypothesized that, in Studies 2 and 3, greater perceived benefits, susceptibility, severity, cues to action and self-efficacy, and fewer perceived barriers would predict greater intention to receive a vaccine both for oneself and parental intention towards vaccination for children.

Study 2 – Method.

Participants

UK participants (*n*=473) were recruited to undertake an online questionnaire between June and July 2021. A priori analysis indicated a sample of 193 participants would be sufficient to establish small effects (*r* = .20; power of 80%; p= .05; two-tailed). However, a larger sample size was recruited to increase validity of any subsequent generalizations made. Purposeful sampling was used to ascertain even distribution across age range groups (18-25;25-35;35-45;45-55) and ethnicity background (White, Black, and Asian). No further exclusion criteria were applied to limit participation. Two participants did not indicate their age and one participant did not reveal their ethnicity. These three participants were removed from subsequent analyses. Of the remaining 470 participants, their mean age 33.9 years (*SD* = 10.7), with 40.9% of participants identifying as male, 58.1% female, 0.6% as non-binary, and 0.4% preferred not to reveal their gender. The participants consisted of 38.3% who identified as White, 25.5%

as Black African Caribbean or Black British, 31.8% as Asian or Asian British, 2.6% as Mixed/multiple ethnicities and 1.9% as another ethnic group. We aggregated the Black, Asian, Mixed, and other ethnic groups into the BAME group (N_{WHITE} = 180, N_{BAME} = 290). Only 8.9% had experienced a confirmed positive COVID test, but 30.9% had been required to self-isolate as a close contact case. Seventy-two percent (72.3%) of participants had received at least one dose of a COVID vaccine at the time of participation. Finally, 94.7% of participants stated that they were currently in "good health" with 9.1% of participants having a chronic illness that would put them at higher risk of COVID e.g., diabetes. Prolific research database was used for recruitment and participants received a nominal fee (£1.25) on completion of the survey.

Materials

HBM *Measure*

We constructed a 25-item HBM measure (available via https://osf.io/dc3ka/) informed by prior examples (Champion, 2016; Myers & Goodwin, 2011) but drawing on the specific beliefs elicited in study 1 (data extracts are included to demonstrate how Study 1 data informed the COVID vaccine intention measure). For example, "*By having the vaccine I am protecting others*" (Benefits to Action) and "*I am afraid to have the* COVID *-19 vaccine because of side-effects*" (Barriers to Action). The response scale ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). We assessed benefits to action using seven items (e.g., "*Having the vaccine will help prevent the likelihood of me getting infected*"; *M* = 3.9, *SD* = 0.8; α = 0.90). We examined barriers to action using eight items (e.g., "*I have concerns about what the vaccine is made from*"; *M* = 2.0, *SD* = 0.7; α = 0.82). We examined susceptibility to COVID using three items (e.g., "*My chances of getting* COVID *19 in the next few months are great*"; *M* = 2.7, *SD* = 0.9; α = 0.74). We assessed severity of COVID using three items (e.g., "*I will be very sick if I get* COVID *-19*"; *M* = 3.4, *SD* = 0.9; α = 0.75). We assessed cues to action to take up the vaccine using three items (e.g., "*I have seen information encouraging people to get the* COVID *-19 vaccine*"; *M* = 4.2, *SD* = 0.7; α = 0.58). Finally, we

assessed self-efficacy concerning taking up the vaccine using a single item: "*I believe I am capable of getting vaccinated for* COVID -*19*" (*M* = 4.5, *SD* = 0.8). Self-efficacy was negatively skewed, with skewness (-1.89) to standard error of skewness ratio (.112) at -16.90. Hence, we reflected the self-efficacy and applied a log base 10 transformation. The transformed item exhibited an improved level of normality, with skewness (.962) to standard error of skewness (.112) ratio at 8.59. We used the transformed item in our subsequent analyses.

Intention to take up COVID vaccine

We examined participants' intention to take up COVID vaccine by administering one item: "*Do you intend to get vaccinated against COVID-19?*" Participants indicated either "*Yes (intend or already undertaken)*" (85.3%), "*No*" (7.9%), or "*Unsure*" (6.8%). To evaluate the odds of participants taking up the vaccine against negative responses, we aggregated the "*No*" and "*Unsure*" into one category in the subsequent analyses. (See statistical note 1 in supplementary file.).

At the time of data collection, vaccines were not yet made available for children aged under 18. Hence, we examined parents' intention to vaccine their children using one item: "*If made available to 12–18-year-olds, would you intend to get your children vaccinated against COVID-19*?" Participants indicated either "*Yes (intend or already undertaken)*" (24.5%), "*No*" (7.9%), "*Unsure*" (10.2%), or "*Not Application as do not have children*" (57.4%). In subsequent analyses, we excluded participants with no children, and aggregated "*No*" and "*Unsure*" into one category.

Procedure

As in Study 1, participant information sheets were shown on the recruiting website with consent to participate gained online prior to transference to the survey site. The participants proceeded through the questionnaire in the same order: Demographics, background information concerning experiences with COVID, general health, and intentions to vaccinate oneself and teenage children (if applicable), HBM measure, debrief and exit/return to host site.

Statistical Analysis

We examined which factors predicted the likelihood of vaccine uptake, and we conducted the analyses on two target recipients: 1) vaccination for oneself and 2) vaccination for teenage children. Preliminary analyses revealed that when considering vaccination for oneself in relation to each demographic variable individually, individuals with BAME background (compared with those with White background), women (compared with men), and younger participants were less likely to have an intention to take up the vaccine. Therefore, for both target recipients, we conducted logistic regression to examine if the likelihood of vaccine uptake ("Yes" coded as one, and "No" or "Unsure" coded as zero) differed among individuals from different ethnic background (White coded as zero, BAME coded as one), gender (male coded as zero, female coded as one; 5 participants who identified as non-binary or preferred not to say were not included in the analyses), and age.

Second, we conducted further logistic regression models to test which health belief constructs predicted intention to take up vaccine. We also considered if there were differences between White and BAME participants when we examined the intention of vaccinating oneself.

Results

Intention to Vaccinate Oneself

Most participants indicated an intention to get vaccinated for COVID (85.38%). Results from a logistic regression model with three predictors (ethnicity, gender, and age) revealed that participants with BAME background were significantly less likely to intend to take up the vaccine themselves (OR = 0.49; 95% CI = 0.26 to 0.88, p = .022). Females were also significantly less likely to intend to get the vaccine (OR = 0.54; 95% CI = 0.30 to 0.94, p = .033). Age was not associated with likelihood of having the intention to vaccinate oneself (OR = 1.02; 95% CI = 0.99 to 1.05, p = .092). We compared the logistic regression model with three predictors (ethnicity, gender, and age) without their interactions to another model with the interaction term. A chi-squared test revealed that the latter model did not improve on

the former 1, deviance = 7.78, p = 0.100. Hence, we retained the model without the interaction between ethnicity, gender, and age.

Next, we evaluated the extent to which the six health beliefs were associated with the intention to get vaccinated for COVID, for individuals with BAME and white background. We estimated the model using the lme4 package in R and estimated the coefficients for White and BAME participants separately by partitioning the data based on ethnicity. Multicollinearity check revealed that self-efficacy had a high variance inflation factor (VIF = 10.55) amongst the White participants. We therefore proceeded with the logistic regression model without this variable.

Table 2 displays the estimates of the odds ratios for each ethnic group. For participants with White and BAME background, those who perceived having more benefits of taking up the COVID vaccine and less barriers, were more likely to have stronger intentions towards vaccination for themselves. Uniquely for participants with BAME background, those who perceived having more cues to action to take up the vaccine were more likely to have stronger intentions towards being vaccinated for COVID. However, the variable "cue" had a low Cronbach's alpha value, which indicated sub-optimal internal consistency. We therefore repeated the analyses but split the aggregated "cue" variable into its three original items. Results indicated that the effect of cue was only manifested in one item ("Lots of people that I know have been vaccinated for Covid-19"). For both groups of participants, perceived susceptibility to catching COVID and perceived severity of COVID health complications were not associated with intention to vaccinate oneself.

- suggest insert Table 2 here -

Intention to Vaccinate Teenage children

Among the 200 participants with children, 57.5% indicated they intended to vaccinate their children, and 42.5% indicated they would not vaccinate their children, or they were unsure about it.

We conducted logistic regression models for intention to vaccinate one's teenage children (Yes versus No or unsure). Preliminary analyses revealed that ethnicity, gender, and age were not associated with this intention. Participants who intended to vaccinate themselves were more likely to also intend to vaccinate their children, χ^2 (1) = 34.36, $p < .001$. (See statistical note 2 in supplementary file).

- suggest Table 3 here -

Next, we evaluated the extent to which the six health beliefs are associated with intention to vaccinate one's children. Table 3 displays the estimates of the odds ratios. Those who perceived having more benefits of taking up the COVID vaccine and less barriers, were more likely to have stronger intentions to vaccinate their children.

Hence, parents were more inclined to vaccinate their children if they perceived the vaccine as likely to be more beneficial for health and to reduce the impacts of the pandemic, and if they perceived having fewer barriers to taking up the vaccine, e.g., side effects and logistical issues. Susceptibility to catching COVID, severity, self-efficacy, and cues to action were not associated with likelihood to intend to vaccinate one's children. However, in the further analysis that split the aggregated "cue" variables into its original three items, those who endorsed item "*I have confidence in what scientists and medical professionals say about the vaccine*" were more like to have the intention to vaccinate their children.

Study 3– Method.

Participants

We invited participants who took part in Study 2 to take part in Study 3. The gap between the two studies was approximately ten months. Out of the 473 participants who took part in Study 2, 311 (65.75%) responded. Two participants did not complete any items concerning health beliefs and COVID concerns and were therefore excluded from the subsequent analyses. For the remaining 309 participants, their mean age was 36.3 years (*SD* = 10.5), with 41.75% of participants identifying as male, 57.28% female, 0.32% as non-binary, and 0.65% prefer not to reveal their gender. The participants

consisted of 30.74% who identified as White, 26.21% as Black African Caribbean or Black British, 39.16% as Asian or Asian British, 2.27% as Mixed/multiple ethnicities and 1.62% as another ethnic group. We aggregated the Black, Asian, Mixed, and other ethnic groups into the BAME group (N_{WHITE} = 95, N_{BAME} = 214).

There were 115 participants (37.22%) who indicated that they had children under the age of 18 years, of which 56, 64, and 46 of them have children in the age of 12-18, 5-11, and under 5, respectively (some parents have more than 1 child).

Finally, 46.93% had experienced a confirmed positive COVID test and 94.82% of participants stated that they were currently in "good health". Participants received a nominal fee (£1.25) on completion of the survey.

Materials

We used the same 25-item HBM measure as in Study 2, comprising the six HBM constructs (Susceptibility; Severity; Benefits to action; Barriers to action, Cues to Action; Self-Efficacy). The self-efficacy measure was transformed the same way as in Study 2. We added five items to evaluate COVID specific concerns (1 = *No concern whatsoever*, 5 = *A major concern)*. These concerns were derived from the qualitative findings in Study 1 (e.g., "Vaccines are not effective against future variants", "The risk to fertility from vaccines").

We also examined the extent to which participants' attitudes toward the COVID vaccine had changed since they took part in Study 2, (-3 = *A lot more negative now*, 0 = *No change*, 3 = *A lot more positive now*).

COVID vaccination

We examined whether participants were vaccinated, using one item: "Have you been vaccinated for COVID-19?" Participants indicated either "*Yes*" or "*No*". We also examined whether participants' children were vaccinated. When we asked about children aged 12-18, participants indicated either:

"*Yes,*" "*No,*" or "*Do not have children in that age group.*" When we asked about children aged 5-11, or under 5, participants indicated either: "*Yes (or intend to when the vaccine is available),*" "*No,*" or "*Do not have children in that age group."* In subsequent analyses concerning children's record of vaccination, we only focus on participants who had children in the relevant age group.

Procedure

As in Studies 1 and 2, we presented participant information sheet on the recruiting website. We sought participants' consent prior to transference to the online survey site. After completing the measures, participants were debriefed and returned to the host site.

Statistical Analysis

We first used a one-sample *t*-test to examine if attitudes toward the COVID vaccine have changed from the first wave of data collection (July 2021) to the second wave (May, June 2022). If the average value of "attitude change" deviated from the mid-point of the scale (0) in the positive direction, it would indicate a more positive attitudes toward the COVID vaccine from Time 1 to Time 2. A change in the negative direction would indicate more negative attitudes.

We then examined which factors may predict whether individuals were vaccinated ("Yes" responses were coded as one, and "No" responses were coded as zero). For parents, we examined factors that may predict whether any of their children: 1) aged 12-18 years, 2) aged 5-11, or 3) under five years old were vaccinated ("Yes" coded as one, and "No" coded as zero). For the latter two groups, if the parents intended for their children to be vaccinated when the vaccine was made available to them, it was also coded as one.

For all four groups of target recipients (participants themselves, their children aged 12-18, aged 5-11, and under five), we first considered if their decisions differed by ethnicity (White vs. BAME), gender, and age. Preliminary analyses revealed that none of the demographic variables differentiated whether individuals were vaccinated. Hence, for each of the target recipients, we conducted logistic

regression to examine health belief constructs and COVID concerns predicted the likelihood of vaccination. Specifically, we examined if benefits, barriers, susceptibility, severity, self-efficacy, cues, and COVID concerns predicted likelihood of vaccination. Note that in the transformation of correcting skewness, self-efficacy was reflected, and a log base 10 transformation was applied. Hence, a bigger value of self-efficacy refers to lower level of self-efficacy.

Changes in attitudes

A one-sample *t*-test revealed that participants' attitudes toward COVID vaccine (M = 0.3, SD = 1.0) deviated significantly from the mid-point of the scale (0), in a positive direction, thus indicating their attitudes became more positive from the first to the second wave of data collection, $t(308) = 4.28$, $p < .001$.

Vaccination for Oneself

Most participants had been vaccinated (88.03%). Note that, in Study 2, 85.38% of the participants indicated an intention to take up the vaccine. The highly comparable findings provide some reassurance that the intention to take up the vaccine did translate into action.

The logistic regression model revealed that participants who perceived more benefits of receiving the COVID vaccine, and stronger susceptibility to COVID, were significantly more likely to have been vaccinated (see Table 4). Participants who perceived having more barriers to taking up the vaccine were significantly less likely to have been vaccinated. Surprisingly, participants who perceived stronger severity of COVID were also less likely to have been vaccinated. Self-efficacy, cues, and COVID concerns were not associated with whether participants were vaccinated.

Vaccination for Children Aged 12-18

Most of the parents (94.64%) with children in this age group were vaccinated themselves, and 60.71% of children in this age group had been vaccinated. For parents who were vaccinated, 64.15%

vaccinated their children in this age group. No unvaccinated parents had permitted vaccination for their children in this age group.

The logistic regression model revealed that parents who had lower levels of self-efficacy concerning taking up the vaccine themselves were also significantly less likely to have vaccinated their children in this age group. All other health beliefs and concerns were not associated to whether their children were vaccinated.

Vaccination for Children Aged 5-11

Most of the parents (90.62%) were vaccinated themselves, and 23.81% of children in this age group were also vaccinated, or parents were intending to have them vaccinated when it was available. Therefore, for parents who were vaccinated, 27.59% had vaccinated (or intended to vaccinate) their children in this age group and no unvaccinated parents expressed an intention to vaccinate their children in this age group.

Multicollinearity checks revealed that cues had a high variance inflation factor (VIF = 6.79). We therefore proceeded with the logistic regression model without this variable. Results revealed that parents who had stronger concerns for COVID specific issues were marginally more likely to have, or intend to have, their children vaccinated. No other significant associations with health beliefs were identified.

Vaccination for Children under Five

Most parents (84.78%) were vaccinated themselves but only 8.7% of children in this age group were vaccinated or were intended to be vaccinated. For parents who were vaccinated, only 10.26% of them had vaccinated or intended to vaccinate their children in this age group. As with the previous age-groups, no unvaccinated parents expressed an intention to permit vaccination of their children.

Multicollinearity checks revealed that benefits, severity, self-efficacy, and cues high variance inflation factor (VIFs > 5). We therefore conducted the logistic regression model without these variables.

However, none of the health beliefs or COVID concerns were associated to whether children in this age-group were vaccinated.

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Discussion

This research aimed to identify the factors influencing vaccine uptake in the younger UK population (aged 18–55). Specifically, we sought to identify beliefs about COVID vaccines qualitatively, so that a full picture of the context-issues specific to COVID-19 could be identified. Further we tested the results of the qualitative findings to see if they were able to predict individuals' intention for and actual behaviours in self-vaccination for COVID, and where appropriate, intentions to support vaccination for children.

The findings did highlight that the nature of the pandemic had created some quite clear beliefs about the vaccine and wider immunization programme that was not simply reflective of "typical" vaccines. Specifically, more altruistic motives were apparent in the expression of a wish to act "to ensure others are safe" and the desire to return to pre-pandemic life, with individuals seeing the vaccine as "the first step towards "getting back to normal". Similarly, concerns over the speed of vaccine delivery and lack of long-term trials are grounded in the COVID context. Further, specific misinformation and misrepresentation around COVID vaccine side-effects was seen in the qualitative findings with concerns over fertility, blood clots, longer-term efficacy, and mutations of the virus. The dominant sources of information for individuals were largely as expected; mainstream news, scientists, health services/organisations and to a lesser extent, government officials. But participants recognized challenges over "fake-news," misleading information and distribution, with many expressing concerns over inequality of vaccine access. Overall, the qualitative findings study did fit within the framework of the Health Belief Model constructs, but the detail was indicative of content that was not mirroring past research and showed how the nature of COVID was influencing beliefs and intentions.

By testing the application of the qualitative findings in the second and third studies, the research does provide a stronger indicator of how to understand vaccine intention and behaviours, and importantly vaccine hesitancy. Increased perceptions on the positive benefits of the COVID vaccine and fewer beliefs over barriers, were predictive of intentions in both personal, and to some degree, in parental intentions for vaccination. The findings suggest that interventions aiming to reduce vaccine hesitancy and increase vaccine uptake should focus on addressing information and misinformation, as well as highlighting the benefits, both for individuals and for the community. A more pro-active approach to addressing concerns about side effects and risk, through education may reduce the impact of barriers to vaccination, and lead to greater willingness to be vaccinated.

Although benefits and barriers were predictive across all ethnicities, cues to action were a predictor of intentions to vaccinate oneself for Black, Asian, and other minority groups in Study 2. Interestingly, when focusing on individual items that evaluated cues, only the one concerning "people that I know" was linked to the intention to vaccinate. Items concerning scientists and medical professionals did not seem to be as relevant. Our findings resonated with that by Woodhead et al., (2021), who found that BAME communities expressed their consideration between risks of harm and potential benefits for themselves and other people, and their mistrust toward the government and the vaccine development process. In addition, Acharya et al., (2021) discussed the relevance of social norms or community influence among BAME communities in influenza vaccinations, which they deemed applicable to the COVID context. Hence, it may be beneficial for campaigns which target BAME communities to feature community leaders or celebrities. One such attempt took place in January 2021 (BBC), when a few British Asian celebrities jointly release a video, with an aim to dispel fake information concerning the vaccine. The benefits of the vaccine over the risk should also be highlighted, such as the role of vaccinations in protecting loved ones who may be more vulnerable to the virus. Although the aggregated variable "cues to action" did not predict intention to vaccinate teenage children in Study 2,

the single item concerning confidence on scientists and professionals did. Hence, campaigns targeting children from BAME communities may be more effective by including information from the scientific and medical health communities.

Study 3 examined vaccine behaviour, and the data was collected approximately 10 months after Study 2. During this time of the pandemic, benefits and barriers remained significant predictors, but cues to action no longer seemed relevant, and differences between ethnic groups were not apparent. As the pandemic progress, the need for cues for action may have saturated and other factors became more prominent. Indeed, whereas susceptibility was not a predictor of intentions at the earlier stage of the vaccine rollout (in Study 2), those who considered themselves more susceptible were more likely to have been vaccinated when we examined them 10 months later (in Study 3). It may be due to the awareness that each new variant of the virus seems to be more transmissible, even for younger adults. Hence, susceptibility became a more relevant consideration. Surprisingly, we found in Study 3 that those who considered the consequences of catching COVID was severe were *less* likely to have been vaccinated. More studies in the future are needed to examine whether those who consider catching COVID to be severe may be more prone to healthcare avoidance. Overall, to increase uptake as the pandemic progress, public health messaging should be purposefully framed to emphasize benefits – reducing risk to vulnerable family members and risk from high exposure with schools, address barriers – emphasizing the increased risk from the disease compared to the vaccines well as culturally specific concerns.

In the earlier stage of vaccine rollout, 42.5% of parents intended to vaccinate their teenage children (Study 2). Ten months later, a higher proportion (60.71%) teenage children (aged from 12-18) had been vaccinated. However, the willingness to vaccinate younger children was not as strong, with only 23.81% (5-11yrs) and 8.7% (under 5s) having either been vaccinated or awaiting the opportunity for vaccination (Study 3). Our findings did not reveal clear health beliefs or concerns that predicted their

behaviours, and it would be informative to examine further the specific reasons driving parental decisions. It may be that because the number of clinical studies conducted with younger childern compared to were relatively scant, and media reporting of information was less clear, parents may consider the benefits, over risks, of vaccinating their younger children was not as clearcut. Note that when we evaluated health beliefs, the measure does not specify the recipients of the vaccine. If we had specified children as the recipients of the vaccine, we may have found more clear predictors of parents' intentions, and behaviour, towards vaccinating their younger children.

There are some key limitations to be acknowledged in relation to the research. In the first qualitative study, there was a lack of ethnic diversity in the participants recruited and although Study 2 adopted purposeful sampling to address this gap, it is still recognized that more depth of insight into black, Asian, and other minority group beliefs is needed as there is likely to be other social and culturally specific differences in views and experiences. The use of a qualitative survey (as opposed to interviews) can sometimes be viewed as resulting in less rich data, due to participants being required to enter the data themselves, or the lack of opportunity to probe participants responses, for example. However, this perception can be challenged (Braun et al., 2020) as the method has been successfully used in applied health previously (Grogan et al., 2018; Grogan & Mechan, 2017). Further, the breadth and depth of responses that could be obtained during the early stage of the pandemic using this method, and the amount of data generated, indicates this is not a major concern. It is also recognized that the basis of this research is to examine beliefs and motivators around intention to vaccinate against COVID, and without a measure of action, we cannot be certain that intention would necessarily translate into behaviour. Further the fast-paced nature of the pandemic and vaccine programme does mean that beliefs and intentions reflect the time that data was collected. However, although much progress has been made, there is still sizeable numbers of the UK population who remain unvaccinated by choice.

Concluding summary

This mixed-method research provides evidence to aid in the targeting of content for interventions to address COVID vaccination hesitancy in younger, low-risk adults and parents. Specifically, the findings suggest focusing on context-specific benefits of the COVID vaccine, including enabling a return to normality and protecting others, and addressing context-specific barriers, such as misinformation around fertility risk, and education around the efficacy of vaccines, may increase intention towards vaccination for those currently unsure, or even unwilling, to take up the vaccine.

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Table 1

Examples of Study 1 data relevant to the Health Belief Model constructs

Health Belief Model Construct	Example extract
Perceived Benefit	I miss being able to see my girlfriend without careful planning around bubbles and isolation, I miss taking trains to go on days out in places as fascinating as Bolton and Hull, I miss going to the pub and talking shit with the people on the social table. I miss going for drinks after work. I've even started to miss the commute. I'll be taking the vaccine as soon as it is offered to me
Perceived Barriers	I prefer to stay fit and try and keep a strong immune system rather than be artificially vaccinated as I don't know whether I will have side effects or problems that manifest in the longer term.
Perceived Susceptibility	I am relatively low risk and therefore would feel safer not having it
Perceived Severity	I don't think they are very useful unless you are old or vulnerable and likely to succumb if you contract the virus.
Cues to Action	although I don't trust the … government, I do trust the scientists that have worked on the vaccine. if they say it's safe, then I shall accept that
Self-efficacy	If I'm offered it, I'll take it. No hesitation.

Explanatory Note: "it" as referred to in the extracts above relates to the vaccine.

Table 2

Odds Ratios of Intentions to Vaccinate Oneself predicted by Health Beliefs in Study 2

	Odds Ratio	95% CI
White		
Benefits Þ Vaccinate	35.47**	5.67 to 507.51
Barriers Þ Vaccinate	0.11*	0.01 to 0.61
Susceptibility Þ Vaccinate	0.61	0.16 to 2.22
Severity Þ Vaccinate	2.38	0.65 to 11.14
Cues Þ Vaccinate	1.20	0.27 to 5.99
BAME		
Benefits Þ Vaccinate	10.10**	4.32 to 27.41
Barriers Þ Vaccinate	0.26**	0.10 to 0.62
Susceptibility Þ Vaccinate	0.79	0.44 to 1.42
Severity Þ Vaccinate	0.80	0.46 to 1.36
Cues Þ Vaccinate	2.38*	1.10 to 5.39

Note. Vaccinate = Intention to vaccine oneself, Benefits = benefits of taking up COVID vaccine, Barriers = barriers to taking up the vaccine, Susceptibility = susceptibility to catching COVID, Severity = severity of COVID, Self-, Cues to action = cues to action to take up the vaccine. *N*=200.

* $p<.05$. ** $p<.01$.

Table 3

Odds Ratios of Intentions to Vaccinate Teenage Children predicted by Health Beliefs in Study 2

	Odds Ratios	95% CI
Benefits Þ Vaccinate children	2.35**	1.30 to 4.40
Barriers Þ Vaccinate children	0.33**	0.16 to 0.61
Susceptibility Þ Vaccinate children	1.36	0.89 to 2.10
Severity Þ Vaccinate children	1.39	0.93 to 2.10
Self-efficacy Þ Vaccinate children	0.73	0.07 to 8.01
Cues Þ Vaccinate children	0.76	0.38 to 1.48

Note. Vaccinate children = Intention to vaccine one's children, Benefits = benefits of taking up COVID vaccine, Barriers = barriers to taking up the vaccine, Susceptibility = susceptibility to catching COVID, Severity = severity of COVID, Self-efficacy = self-efficacy concerning taking up the vaccine, Cues to action = cues to action to take up the vaccine. *N*=200.

** $p<.01$.

Table 4

Estimates of Odds Ratios of Vaccination for oneself and children of different age group in Study 3

	Odds Ratio.	95% CI
Oneself (N = 309)		
Benefits Þ Vaccinate	15.28**	5.44 to 56.84
Barriers Þ Vaccinate	0.27*	0.08 to 0.85
Susceptibility Þ Vaccinate	3.37**	1.63 to 7.67
Severity Þ Vaccinate	0.32*	0.11 to 0.80
Self-efficacy Þ Vaccinate	0.11	0.001 to 4.03
Cues Þ Vaccinate	1.45	0.50 to 4.16
COVID concerns Þ Vaccinate	1.41	0.72 to 2.82
Children Aged 12-18 (N = 56)		
Benefits Þ Vaccinate	1.90	0.61 to 6.53
Barriers Þ Vaccinate	1.48	0.31 to 7.33
Susceptibility Þ Vaccinate	1.34	0.52 to 3.64
Severity Þ Vaccinate	1.76	0.73 to 4.80
Self-efficacy Þ Vaccinate	0.001*	0.001 to 0.16
Cues Þ Vaccinate	1.05	0.21 to 5.44
COVID concerns Þ Vaccinate	0.87	0.48 to 1.56
Children Aged 5-11 (N = 63)		
Benefits Þ Vaccinate	1.44	0.49 to 4.86
Barriers Þ Vaccinate	0.25	0.03 to 1.61
Susceptibility Þ Vaccinate	1.16	0.58 to 2.44
Severity Þ Vaccinate	1.47	0.71 to 3.24
Self-efficacy Þ Vaccinate	0.48	0.01 to 30.76
COVID concerns Þ Vaccinate	1.74^{+}	1.01 to 3.27
Children Aged Under 5 (N = 45)		
Barriers Þ Vaccinate	0.05	0.001 to 1.20
Susceptibility Þ Vaccinate	3.11	0.49 to 37.07

Concern Þ Vaccinate	0.74	0.21 to 2.28

Note. Vaccinate = Intention to vaccine oneself, Benefits = benefits of taking up COVID vaccine, Barriers = barriers to taking up the vaccine, Susceptibility = susceptibility to catching COVID, Severity = severity of COVID, Self-efficacy = self-efficacy concerning taking up the vaccine, Cues to action = cues to action to take up the vaccine.

***p* < 001, *p < .05, †*p* = .061.