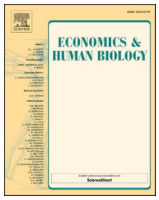
Economics and Human Biology 55 (2024) 101441

Contents lists available at ScienceDirect

Economics and Human Biology

journal homepage: www.elsevier.com/locate/ehb



Discrimination backfires? Minority ethnic disparities in vaccine hesitancy

Joan Costa-Font *, Fatima Docrat

Department of Health Policy, London School of Economics, Houghton Street, London WC2A 2AE, UK

ARTICLE INFO

JEL Classification in this article:
I18, J15, J18

Keywords:
COVID-19
Vaccination hesitancy
Ethnicity
Race
Health care access
Minority ethnic groups
Health Inequality

ABSTRACT

A number of minority ethnic groups (MEGs) exhibited persistent reluctance to receive the COVID-19 vaccine. This paper attempts to empirically identify some of the contentious behavioral determinants for vaccine hesitancy (VH) that remain unexplained including the role of risk perceptions, trust in government institutions, and prior experiences of racism and trauma. We draw on unique longitudinal data from a minority-boosted sample that was collected in the United Kingdon (UK). We document robust evidence of MEG disparities in VH, which declined between November 2020 and March 2021. While VH is associated to both historical and current distrust in government, risk beliefs, exposure to racism, and an individuals socio-economic background, these factors do not fully explain MEG disparities. Furthermore, similar patterns of inequality are observed when we examine MEG disparities in healthcare use, suggesting that disparities in VH reflect broader unobservable structural barriers to healthcare access.

1. Introduction

Already in 2019, the World Health Organization (WHO) regarded vaccine hesitancy (VH) as one of the main threats to global health (WHO, 2019). VH is an especially significant concern when society needs a certain share of the population to be rapidly immunized for infectious diseases (such as COVID-19) to be under control.[1] During the COVID-19 pandemic, a large share of vaccine hesitant individuals came from minority ethnic backgrounds, leading to what's known as the "ethnic minority vaccination paradox". This phenomenon highlights that even though the pandemic has impacted disproportionately minority ethnic groups (MEG), who are more likely to have had COVID-19, individuals that fall in the cathegory of MEG exhibit simultaneously a disproportionate hesitancy to take up the COVID-19 vaccine (Hussain et a, 2022).

The disparities in MEG representation in VH can be attributed to various factors. One significant reason is that individuals from MEG often come from more deprived socio-economic backgrounds. However, other explanations are at play, including the role of racial discrimination and the higher distrust in government and medical authorities among MEG individuals (Armstrong et al., 2007). To date, there is still limited consensus on explanations for MEG disparities in VH. Robertson et al. (2021) found that, in the UK, the highest rates of VH were observed among Black, Pakistani and Bangladeshi groups compared to British whites. In contrast, other studies such as Nguyen et al. (2022) do not find evidence of MEG differences in VH in the UK. A delphi study of the MEG disparities in vaccine uptake by Hussain et al. (2022) suggests that so far, the evidence on MEG disparities in VH calls for more research, and points to the role of collective beliefs, namely religious beliefs, safety concerns and risk perceptions which depress MEG trust in the effectiveness of the vaccine. However, it is unclear whether MEG disparities in VH are fully explained by such effects, and the extent to which other structural and unobserved determinants might be at play, including differences in access to health care.

This paper studies the existence of ethnic disparities in vaccine hesitancy during the COVID-19 pandemic in the United Kingdom (UK) controlling for the effect of distrust in the health system alongside the perception of risk, past racial discrimination, religious beliefs, as well as systematic differences in socio-economic status. We draw on longitudinal evidence spanning more than a decade, namely the UK Longitudinal Household Survey (UKLHS), also known as *Understanding Society*. We concentrate on the period from 2011 to 2021, which connects to data from earlier surveys conducted decades before. The UKLHS is a comprehensive survey that oversamples minority groups and includes a dedicated COVID-19 module. It provides valuable insights into the attitudes of minority ethnic groups (MEG), enabling us to discern whether recent and historical factors contribute to disparities in vaccination uptake among MEGs.

* Corresponding author.
E-mail address: j.costa-font@lse.ac.uk (J. Costa-Font).

[1] The level of immunization needed, known as "herd immunity", differs based on the infectiousness of the disease (Wellcome Foundation, 2019).

https://doi.org/10.1016/j.ehb.2024.101441
Received 29 June 2024; Received in revised form 13 October 2024; Accepted 14 October 2024
Available online 19 October 2024

We specifically study a number of underlying explanations offered by the literature. Given that there is nothing about ethnicity that inherently drives VH, in the mechanisms section of this paper, we then study whether there are differences in other health-related needs across MEG. More specifically, we explore whether other forms of health care inequalities prevail, namely whether MEG inequalities in health care use could stand behind the evidence of MEG differences in VH. Empirically, we estimate the relationship between VH and MEG status, controlling for several controls for alternative explanations of MEG differences including socio-economic status, differences in religious attitudes, sociodemographic compositional effects, and the experience of racial attacks and segregation alongside current and longstanding government distrust.

This paper makes several key contributions to the literature. First, we offer new evidence on the healthcare inequalities experienced by minority ethnic groups (MEGs) by identifying the unique factors influencing vaccine hesitancy at the onset and throughout the second wave of the COVID-19 pandemic. Second, we broaden the discussion on ethnic disparities in healthcare, highlighting how these disparities manifest not only in access to vaccines but also in other areas of healthcare utilization. Third, the paper deepens our understanding of VH more generally, by offering insights into the behavioural and structural factors influencing vaccine acceptance, including trust in institutions, misinformation, and past experiences of discrimination. Lastly, the paper provides evidence of the determinants of vaccination during a unique period when getting vaccinated was not just a personal health decision but also a pro-social act aimed at ending the pandemic.

Our estimates document a robust association between minority ethnic group (MEG) status and vaccine hesitancy, particularly among individuals of Black and mixed-race Caribbean backgrounds, who seem to be more hesitant than British Whites and other minority ethnic groups. We document that such specific MEG disparities persist after considering controls for socio-economic status and other measures of perceived discrimination. Similarly, we find evidence that individuals from other white backgrounds, as well as Bangladeshi and Pakistani alongside African Blacks exhibit higher VH than British Whites. Importantly, and consistently with the "trauma hypothesis", we confirm that both contemporary and past trust in government are associated with VH, and significantly reduce the effect size of MEG differences in VH, but this is true at the beginning of the COVID-19 pandemic.[2] Finally, the same MEG's that are more likely to be vaccine hesitant, are more likely to exhibit a lower health care use and satisfaction with the health system. Although increasing distrust is an important and culturally sensitive concern (Thompson et al., 2021), we find that improving trust alone would not eliminate the effect of MEG on VH insofar as systematic MEG differences persist suggesting other explanations are at play.

The rest of this paper provides the background underpinning the explanations behind COVID-19 vaccination hesitancy in the UK. Section three reports the data used and the data and empirical strategy. Section four displays the study results. A final section concludes.

2. Racial discriminantion and health care

2.1. Minority ethnic group (MEG) and access to health care

Individuals from some MEG have been documented to face systemic barriers in the access to health care, including financial constraints to accessing healthcare facilities (e.g., often located in relatively more privileged areas), which hinder individuals' ability to seek timely and appropriate medical care. Besides financial barriers, cultural differences between healthcare providers and patients have been shown to contribute to such misunderstandings (Betancourt et al., 2003). Similarly, individuals of some MEG's may fail to trust public institutions as agents acting in their best benefit, particularly where they are perceived to be "institutionally racist" (Mclean et al., 2003). Racism in the health systems has risen in prominence in policy discourses. A 2020 study revealed that Black women in England were four times more likely to die during childbirth compared to White women, while Asian women faced double the risk (Jeraj, 2021).[3]

A prominent example of MEG disadvantage in the United States was the Tuskegee Syphilis Study scandal that revealed that Black men had been intentionally denied treatment for syphilis to observe the natural history of the disease (TSIP, 2021). The Tuskegee scandal, is often mentioned in focus groups, as a salient phenomenon in the collective consciousness of people from minority ethnic groups in the United States (Strully et al., 2021). However, trauma has long-lasting effects. Costa et al. (2018) document evidence that the sons of ex-confederate prisoners of war exhibit a shorter life yet, no impact is found for their daughters. Many black individuals in the United States continue to see healthcare as oppressive rather than healing (Pain et al., 2020). Hence, traumatic experiences leading to feelings of disempowerment can to date explain distrust in the healthcare system (TSIP, 2021). We will address this issue in the mechanism section of this paper.

2.2. Distrust and misperceptions of health care

Trust in the health care system is widely regarded as a driver of MEG differences in vaccine uptake (Yaqub et al., 2014). Distrust is linked to limited contact with, and advice from providers working with publicly funded health care, especially in countries where health care is provided free at the point of use like the UK. Vaccine uptake depends on public confidence in vaccines and in the system that produces them (Khan et al., 2021). Consistently, evidence from former communist countries indicates that past distrust may hinder their vaccination efforts (Costa-Font et al., 2023a). Similarly, studies on willingness to pay suggest that trust plays a crucial role in the perceived social value of a COVID-19 vaccine (Costa-Font, et al, 2023b). A US study found that White individuals implicitly trust the government but question their competency, whereas Black individuals report a deep-rooted distrust of government (Jamison et al., 2019). The erosion of trust among minority ethnic groups (MEGs) stems from a legacy of systemic discrimination, making it difficult to restore rapidly when the need arises. Trust develops gradually but can be quickly eroded by past and ongoing injustices, especially when these injustices are linked to public institutions tasked with ensuring health and safety. However, efforts to rebuild trust in these communities have not been prioritized in the UK. For instance, government policies on immigration have contributed to marginalizing MEGs, perpetuating a climate of exclusion and fear rather than inclusion and trust (Burnett, 2016). Similarly, discriminatory practices, such as racial profiling by the police, reinforce feelings of alienation and suspicion towards state institutions (Shiner et al., 2018). Such practices further complicate public health efforts, as trust in government and public institutions is essential for encouraging vaccination and healthcare engagement (SAGE, 2021).

One mechanism explaining racial disparities refers to the sources of information accessed by different MEG communities. Some MEGs rely more on informal networks and social media for health-related

[2] These results are consistent with the demand for autonomy (Adler, 1927). Consistently, Owens et al. (2014) demonstrate the existence of a control premium, or willingness to pay or forego a monetary sum to retain decision-making autonomy. Similarly, Bartling et al. (2014) document evidence of the value decision rights in addition to their instrumental benefit, and that this preference for control influences delegation decisions.

[3] The Guys and St Thomas NHS Hospital Trust commissioned a report into medical skepticism of Black people in London and found high levels of distrust "based on the innumerable injustices perpetrated against Black and other minoritized communities in the pursuit of medical advancement over the course of many centuries" (TSIP, 2021).

information, partly due to their distrust of mainstream sources (Kataria et al., 2022). Such reliance on alternative information channels makes these groups more susceptible to misinformation, contributing to vaccine hesitancy and disengagement from healthcare services (Allington et al., 2021). If individuals trust the information disseminated in their community more than information provided by the government when updating their prior beliefs, then information coming from shared identity and trusted friends and family might weigh more than any publicly provided information (Adida et al., 2017). Carrieri et al. (2023) show that trust in science is negatively associated with VH whilst trust in social media. Consistently, Grisso et al. (1999) document that Black women are more likely than White women to seek treatment information from friends/family. While medical doctors are generally considered the most trusted source of health information, MEG groups often exhibit lower levels of trust in medical professionals and are also more likely to report negative experiences with the healthcare system (Fareed et al., 2021) and rely more on social networks (Marshall, 2001). Consistently, Campbell and McLean (2002) report a "culture of solidarity" amongst Asian people in the UK. Therefore, this evidence suggests that distrust overwhelmingly contributes to vaccine hesitancy.

2.3. Misinformation during COVID-19

Misinformation was a significant challenge during the COVID-19 pandemic with the WHO claiming the pandemic has worsened the *infodemic challenge* (Khan et al., 2021). The proliferation of fake or negatively-framed communications (Bateman et al., 2020) opened the door to misinformation across social networks gaining traction where existing levels of distrust in government are high.

So far, there is limited evidence explaining the behavioral and other factors underlying variations in vaccine hesitancy (VH) across different ethnic groups (MEG), and most evidence is cross -sectional rather than longitudinal. One notable exception is the study by Quin et al. (2019), which examined differences between white and African Americans. They identified health system distrust as a major barrier to vaccine hesitancy, rooted in experiences of discrimination that lead minority groups to view the healthcare system as not acting in their best interests. Additionally, evidence suggests that some communities reject vaccines due to concerns about non-halal ingredients or a preference for natural remedies. Finally, its worth mentioning that sometimes, vaccination messages may not be accessible or aligned with the linguistic and cultural norms of minority groups (Dubé et al., 2013).

2.4. Social exclusion

An alternative explanation of MEG in VH lies in the differences in the opportunities and the poorer education of individuals. Black Caribbeans and Black Africans who emigrated in the 1950s and 1970s, as well as Pakistanis and Bangladeshis who came to the UK in the 1960s and 1970s, typically have lower educational attainment (Dustmann et al., 2011). Such educational gap is reflected in their earnings, with median pay for these groups being 13% to 16% lower compared to the white British population. In contrast, Indians and Chinese individuals have median pay that is 16% and 23% higher, respectively (ONS, 2020). Additionally, while 63% of the overall British population own their homes, only 44% of Black Africans and 40% of Black Caribbeans do (Ministry of Housing, Communities and Local Government, 2020). Such disparities may underscore an underlying issue of social exclusion.

In countries such as the UK, MEG differences in vaccine uptake also tend to exacerbate socioeconomic inequalities as minority groups tend to be socio-economically worse off (Campbell and McLean, 2002). Moreover, as ethnic groups are often geographically concentrated, limited vaccine coverage in areas below the "herd immunity" threshold can cause pockets of outbreaks. This can be an issue because areas with low vaccine uptake often lack adequate medical and healthcare resources, making it difficult for them to effectively control outbreaks. Finally, it is worth mentioning that social excision might have a protective effect among MEG as higher levels of social isolation might have protected them from the COVID-19 virus transmission. However, evidence suggests that those from ethnic minority groups face a higher risk of severe COVID-19 due to hospitalisation, intensive care unit admission and deaths (Nafilyan et al., 2021). Hence, social exclusion exerted a clear detrimental effect on COVID-19 contagion and vaccinantion.

2.5. Experience of racial discrimination

Several studies provide evidence of disparities in various aspects of life, including education, employment, and interactions with public services. For instance, the Race Disparity Audit published by the UK government in 2017 revealed significant racial disparities across multiple sectors, underscoring the challenges faced by minority ethnic communities (Cabinet Office, 2017). Discrimination can manifest in other forms, such as racial abuse, or more subtle and insidious ways, like institutional bias and microaggressions. Such experiences of discrimination can have profound effects on the mental and physical health of individuals from minority ethnic groups (Karlsen and Nazroo, 2002), and ultimately can depress their willigness to vaccinate.

2.6. Ethnic differences in vaccine hesitancy (VH) during COVID-19

Dube and MacDonald (2020) claim that 25 % of the population were unsure about taking the vaccine in the UK at the onset of the pandemic which is a similar proportion to those hesitant about routine immunizations in high-income countries. Various studies have examined the characteristics associated with VH. Eleven of fifteen studies included in Sallam's (2021) worldwide systematic review found that females are more hesitant than males. Murphy et al. (2021) found that hesitant individuals in the UK tended to be younger and in the lowest income brackets and Robertson et al. (2021) found an age correlation in the UK. In the US, Callaghan et al. (2021) found that VH is higher amongst Black individuals, women and conservatives.

A December 2020 survey of UK respondents found that COVID-19 VH was highest among Black, Bangladeshi, and Pakistani respondents which is consistent with the evidence form other vaccines against actual influenza (Razai et al., 2021). A study by Nguyen et al. (2021) found that the odds ratios for vaccine hesitancy were 2.84 for Black participants, 1.66 for South Asian and 1.84 for Middle Eastern. Similarly, in the US they found odds ratios of 3.15 for Black participants and 1.42 for Hispanics relative to White, non-Hispanics (Nguyen et al., 2021). Similarly, another US study shows that between September and December 2020, the White population group experienced the largest decrease in VH, while the Blacks experienced the highest level of vaccine hesitancy (Doherty et al., 2021).

3. Vaccination campaign in the UK

The UK's COVID-19 vaccination campaign began on December 8, 2020, and was initially structured based on age, occupation, and clinical vulnerability, following advice from the Joint Committee on Vaccination and Immunisation (JCVI). The rollout prioritized specific groups: care home residents and staff, people aged 80 and over, and frontline healthcare workers. It gradually expanded to younger populations, eventually offering vaccines to all adults and children over 12.

The vaccination program was organised on a voluntary basis, although some indirect incentives were in place. For instance, frontline healthcare and care home workers were encouraged or required to be vaccinated to maintain their employment, though these mandates varied and faced pushback. For general public access to schools and other services, there was no strict legal requirement for vaccination, but certain sectors implemented policies to limit access based on vaccination status (e.g., quarantine-free travel or attendance at large events).

Mass vaccination centres were set up alongside general practitioner

offices, pharmacies, and hospitals, making it the largest vaccination effort in the UK's history. Over time, booster campaigns and targeted efforts, such as offering vaccines at mosques and community hubs, were introduced to enhance uptake across diverse communities. This phased approach helped ensure higher-risk individuals were protected first while gradually moving to other segments of the population. Hence, our analysis as we discuss below will examine both VH before the full rollout of the vaccine, and capture the early take-up of the first phases of the vaccine rollout as we discuss in the following section.

4. The data and empirical strategy

4.1. The data

We use the unique Understanding Society (also known as UKLHS) dataset that contains longitudinal records of over 40,000 households in the UK. The dataset collected information regarding health, work, and social life to inform UK policymaking. Understanding Society had at the time of the study nine published annual waves as well as six COVID-19 waves collected every three months (University of Essex, 2019). COVID-19 waves collect data on experiences of UK population during the pandemic and can be linked to previous waves (University of Essex, 2021). We have used the Wave 2 (2011), Wave 9 (2019) and COVID-19 waves from November 2020, January 2021, and March 2021 in our analysis.

The longitudinal dataset employed in this paper is particularly useful for our analysis because it allows linking data from previous years and the COVID-19 period using personal identifiers (University of Essex, 2021). This unique feature of the dataset allows for pre-COVID attitudes to be controlled for. For example, we can study the relationship between distrust in the government a decade before the pandemic and vaccine hesitancy in 2020. Additionally, the dataset *oversamples minority ethnic respondents*. It collects information from the UK General Population Sample (GPS) as well as an Ethnic Minority Boost Sample (EMBS) and Immigrant and Ethnic Minority Boost Sample (IEMBS) (University of Essex, 2019). Despite the richness of the dataset, it does have limitations. Given that ethnicity is time-invariant, fixed effects analysis was not employed in our analysis; thus, potential unobservables, such as personality could still bias our estimates.[4]

The COVID-19 survey is a nationally representative data from 12,396 participants collected online from November 24th to December 1st, 2020, and then followed up over the COVID-19 period. Overall, our sample is made of 12,396 observations in November 2020, but the sample drops to 10,476 in March 2021. However, only 8361 individuals are followed between the two waves. Hence, in this study we will provide estimates using both the total and balanced sample. Vaccine hesitancy is measured either by individuals' vaccination status (and their refusal), or by their intention to (or not to) vaccinate. Evidence indicates levels of VH of 16 % in November 2020 and 4.4 % in March 2021 in the UK, but as we show below, VH is mainly driven by MEG.

UKLHS participants were asked how likely they would be to receive a vaccine if offered one, as well as the main reason for their hesitation. Overall, evidence suggests that vaccination intentions were high (82 % likely/very likely). VH was higher among women compared to men (21.0 % vs 14.7 %), younger age groups (26.5 % in 16–24-year-olds vs 4.5 % in 75+), and those with less education (18.6 % with no qualifications vs 13.2 % with a degree). VH differed across MEG and especially high among Blacks (71.8 %), individuals from Pakistani/Bangladeshi extraction (42.3 %), Mixed race (32.4 %), and non-UK/Irish Whites (26.4 %) Gender, education, and ethnicity were all independently associated with vaccine hesitancy. Vaccine hesitancy odds ratios are 13 in the Black/Black British ethnic group, 2.3 in Pakistani/Bangladeshi ethnic groups (compared to White British/Irish ethnicity), and 3.2 for people with no qualifications compared to degree educated.

4.2. Vaccine hesitancy by MEG in the data

We begin our data analysis by exploring descriptive evidence of differences in VH across ethnic groups. VH is defined by a binary variable for those who have not received the vaccine by March 2021 and would not take the vaccine when offered. We use an extensive MEG definition including a long list of ethnicities, as well as mixed ethnicities as defined in Appendix A. When we examine the entire Understanding Society sample, we find that about 74 % of the sample is made of British whites, 4 % are individuals of Indian background, 3.8 % of Pakistani background, and 2.1 % of Bangladeshi background. Caribbeans make up over 2.25 % of the population, and Black Caribbean alone make 1.75 % and African Blacks accrue about 2.2 % of the population. Other whites make 3.2 % and Irish 2.1 %. There are several other ethnicities which have a smaller share of the population.

Table 1 shows the breakdown of vaccine hesitancy by minority ethnic groups (MEG) and indicates significant disparities. In November 2020, 12% of White British individuals were vaccine-hesitant, compared to 61% of Black Caribbeans, 52% of Black Africans, and 60% of other Black individuals. Additionally, 52% of Bangladeshis and 40% of Pakistanis reported hesitancy, along with 34% of White Caribbeans, 26% of other White individuals, and 29% of other Africans. By March 2021, these figures shifted, with only 3% of British Whites remaining vaccine-hesitant, while still 28% of Black Caribbeans, 17% of Pakistanis and Bangladeshis, and 16% of Mixed Caribbean individuals continued to express hesitancy. This trend underscores that vaccine hesitancy is predominantly an issue among minority ethnic groups in the UK. Figure A1 in the Appendix plots the differences in vaccine hesitancy in the population.

The Appendix B reports an alternative break up of different MEG. Estimates in Figure B1 suggest evidence that Black populations are the most hesitant. Already in March 2021, over 20 % of Black respondents reported that they were unlikely or very unlikely to take the vaccine. Mixed race and Asian respondents were also found to be more hesitant than White respondants. Formal testing suggests statistically significant differences in vaccine hesitancy between whites and blacks. Similarly, Figure B2 provides further disaggregated evidence of variation within racial groups, with Black Caribbeans more hesitant than Black-Africans and Pakistani/Bangladeshi Asians more hesitant than Indian Asians.Individuals who report themselves as "white others" are more vaccine hesitant than white respondents, and this is especially true for white-mixed Caribbeans, in line with the explanation that it is individuals' cultural ethnicity, rather than race, that influences VH.

4.3. Control variables

We consider a number of control variables that capture the different explanations discussed before such as socio-economic status including education, namely whether individuals' education attainment exceeds GSSCs, annual household income, and individuals' religious categories. Furthermore, we also include a series of socio-demographic controls such as household size, *marital status including* Single, Married/Civil-partnership, and Separated/Divorced/Widowed, a binary variable for those who are self-employed, in paid employment, government training, unpaid family business, apprenticeship, or doing something else. We take into account an individual's gender and age groups: 16–34, 35–49, 50–64, 65–79, and over 80. Additionally, we include a variable for individuals not born in the UK, as well as a variable for those whose mother and/or father were not born in the UK.

[4] While a wave of the data does have variables for the Big 5 personality metrics, the sample of respondents was small and not representative of the dataset; thus, could not be used.

Table 1
Shares of vaccine hesitant individuals in November 2020 and March 2021 by ethnic group.

	March −2021			November-2020		
	Observations	Mean	s.e	Observations	Mean	s.e.
White British	8342	0.030	0.002	10044	0.126	0.003
Irish	145	0.021	0.012	175	0.131	0.025
Gypsy	0	0.000	0.000	1	0.000	0.000
Other white	**296**	**0.122**	**0.019**	**339**	**0.262**	**0.024**
Mixed Caribbean	**60**	**0.167**	**0.049**	**59**	**0.339**	**0.062**
Mixed African	15	0.133	0.091	17	0.294	0.114
Mixed Asian	44	0.068	0.038	48	0.229	0.061
Mixed Other	34	0.059	0.041	41	0.244	0.067
Indian	865	0.061	0.008	957	0.280	0.014
Pakistani	**174**	**0.172**	**0.029**	**172**	**0.407**	**0.037**
Bangladeshi	**81**	**0.173**	**0.042**	**70**	**0.528**	**0.060**
Chinese	43	0.070	0.039	51	0.215	0.058
Other Asian	64	0.094	0.037	75	0.187	0.045
Black Caribbean	**93**	**0.280**	**0.047**	**128**	**0.617**	**0.043**
Black African	**97**	**0.124**	**0.034**	**95**	**0.526**	**0.051**
Other Black	**14**	**0.214**	**0.114**	**10**	**0.600**	**0.163**
Arab	15	0.067	0.067	16	0.437	0.128
Other	34	0.059	0.041	38	0.210	0.067
Missing	60	0.050	0.028	60	0.133	0.044
Total	10,476	0.044	0.002	12,396	0.160	0.003

Note: The table reports the number of observations by ethnic group in November 2020 and March 2021, share of vaccine hesitant and standard error. For 2021 respondents it refers to respondents with that have taken a vaccine or more, have an appointment, or refused by disclosed ethnicity March 2021. Source: Understanding Society, several years.

4.4. Behavioural explanations

Finally, we consider a number of alternative potential behavioral explanations for VH including government mistrust**,** measured as a variable created to capture those who believe government does not care about its citizens (constructed in 2011 and 2019 pre-pandemic). Furthermore, we consider an individual's experience of racial attacks, capturing whether racial attacks are common or very common in the neighbourhood (constructed in 2011 and 2019 pre-pandemic). We consider an individual specific indicator of segregation, measured by whether all or more than half of the respondent friendship group belongs to respondents' race (constructed in 2011 and 2019 pre-pandemic). To examine the effect of risk perceptions, we measure the perceived risk of COVID-19, as a binary variable estimating whether COVID-19 risk is likely or very likely, and whether the risk of illness is likely or very likely. Lastly, two distinct samples were used to construct our estimates: the entire sample and a balanced sample of people who were tracked over the course of all the two periods.

4.5. Empirical strategy

We examine whether MEG status of individuals (E_{it}) is associated with the probability of an individual to report to be vaccine-hesitant (VH_{it}). The VH variable is measured in two different time periods, namely November 2020 and March 2021 corresponding to a period where the vaccine rollout was only starting. Hence, individuals report whether they have received the vaccine, or they intend to take it, and we include a number of controls (X_{it}). Controls include socio-demographic and socio-economic covariates as well as alternative explanations for VH that we expect will influence the effect of MEG status in a way that if MEG were to reflect differences in terms of risk perceptions or socio-economic backgrounds or institutional trust, the effect of MEG should eventually become insignificant. The specification is as follows:

$$VH_{it} = \gamma_0 + \gamma_1 E_{it} + \gamma_2 X_{it} + \varepsilon_{it} \quad (1)$$

Our coefficient of interest is γ_1. Other parameters refer to the intercept and the effect of different controls which capture either adjustments or alternative explanations for VH. Finally, our model includes an error term. As a robustness check, we also ran the same specifications using probit models and found the resulting coefficients to be qualitatively similar. More importantly, we have considered different specifications, both with and without controls. Next, we include reasons for hesitancy such as distrust. Distrust is proxied through pre-pandemic distrust in government, distrust in NHS, and experience of racial attacks. Finally, we extend the model by adding ten-year lagged measures of institutional distrust with the government, alongside past experiences of racial attacks. Including these lagged effects allows for analysis of the impact of deep-rooted explanations on present-day vaccine hesitancy. It is worth mentioning that as a sensitivity analysis we used a stepwise regression strategy where we consider specifications with and without different types of controls.

5. Results

5.1. Baseline estimates

We first report the results of a "naive model" including only ethnicity as covariates without controls and then we consider a series of different controls as reported in Table 2. When vaccine hesitancy is regressed solely on ethnicity, we find that the Mixed Caribbean, Pakistani, Bangladeshi, Caribbean, and African groups are significant at the 1% level. Caribbean respondents are approximately 25 percentage points (pp) more likely to be vaccine hesitant than White respondents. Pakistanis and Bangladeshis are 14 pp more likely, while Africans are 9 pp more likely to exhibit vaccine hesitancy. However, these estimates might be driven by the influence of socio-demographic and socio-economic status. To account for the effect of population composition and socio-economic status, Table 2 adds several socio-demographic controls and socio-economic controls.

Estimates reported in Table 2 suggest as expected large MEG differences in VH. Indeed, whilst Irish, Mixed African, and Chinese did not exhibit a different VH than White British (both in November 2020 and Match 2021), Black Caribbeans are 50 percentage points (pp) more likely to be vaccine hesitant in November 2020 and controls do not change such hesitancy, though estimates in March 2021 still show 24pp larger vaccine hesitancy. A comparable effect is found among Mixed-race Caribbeans, exhibiting a 21pp higher likelihood of VH. Although the effect is more sensitive to controls than that of Black Caribbeans, it remains significant at 14pp and drops to 10pp in March 2021. In contrast, we find large 40pp coefficients for Bangladeshi respondents,

Table 2
Baseline regression estimates COVID-19 Vaccine Hesitancy (Total Sample) in November 2020 and March 2021.

	November 2020			March 2021		
	(1)	(2)	(3)	(4)	(5)	(6)
Irish	0.00508	0.00330	0.00612	−0.00976	−0.00551	−0.00308
	(0.0258)	(0.0252)	(0.0252)	(0.0120)	(0.0120)	(0.0120)
Other white	**0.136*** **	**0.115*** **	**0.122*** **	**0.0912*** **	**0.0806*** **	**0.0846*** **
	(0.0241)	**(0.0235)**	**(0.0235)**	**(0.0191)**	**(0.0185)**	**(0.0185)**
Mixed Caribbean	**0.213*** **	**0.150** **	**0.148** **	**0.136*** **	**0.110** **	**0.109** **
	(0.0618)	**(0.0601)**	**(0.0589)**	**(0.0482)**	**(0.0467)**	**(0.0468)**
Mixed African	0.168	0.119	0.126	0.103	0.0772	0.0830
	(0.111)	(0.115)	(0.114)	(0.0879)	(0.0891)	(0.0886)
Mixed Asian	0.103*	0.0624	0.0769	0.0377	0.0168	0.0196
	(0.0608)	(0.0595)	(0.0586)	(0.0381)	(0.0391)	(0.0394)
Mixed Other	0.118*	0.0641	0.0772	0.0284	0.00364	0.00451
	(0.0672)	(0.0681)	(0.0679)	(0.0404)	(0.0397)	(0.0399)
Indian	**0.154*** **	**0.125*** **	**0.128*** **	0.0308***	−0.00784	−0.00504
	(0.0149)	**(0.0278)**	**(0.0280)**	(0.00838)	(0.0155)	(0.0155)
Pakistani	**0.281*** **	**0.106** **	**0.102** **	**0.142*** **	**0.0853** **	**0.0846** **
	(0.0376)	**(0.0499)**	**(0.0496)**	**(0.0287)**	**(0.0379)**	**(0.0378)**
Bangladesh	**0.402*** **	**0.212*** **	**0.209*** **	**0.142*** **	**0.0797***	**0.0791***
	(0.0598)	(0.0674)	(0.0666)	(0.0421)	(0.0449)	(0.0450)
Chinese	0.0893	0.0702	0.0955*	0.0393	0.0360	0.0445
	(0.0577)	(0.0567)	(0.0566)	(0.0389)	(0.0386)	(0.0386)
Other Asian	0.0603	0.0128	0.0208	0.0633*	0.0535	0.0565
	(0.0451)	(0.0451)	(0.0441)	(0.0365)	(0.0367)	(0.0364)
Black Caribbean	**0.491*** **	**0.449*** **	**0.449*** **	**0.249*** **	**0.242*** **	**0.241*** **
	(0.0431)	**(0.0436)**	**(0.0436)**	**(0.0466)**	**(0.0470)**	**(0.0467)**
Black African	**0.400*** **	**0.349*** **	**0.361*** **	**0.0933*** **	**0.0799** **	**0.0848** **
	(0.0514)	**(0.0514)**	**(0.0521)**	**(0.0335)**	**(0.0328)**	**(0.0329)**
Other Black	**0.474*** **	**0.459*** **	**0.460*** **	0.184*	0.180*	0.177
	(0.155)	(0.158)	(0.157)	(0.110)	(0.108)	(0.109)
Arab	0.311**	0.152	0.169	0.0362	−0.0163	−0.00642
	(0.124)	(0.120)	(0.117)	(0.0645)	(0.0709)	(0.0714)
Other	0.0842	0.0773	0.0946	0.0284	0.0248	0.0287
	(0.0663)	(0.0613)	(0.0610)	(0.0404)	(0.0403)	(0.0403)
Missing	0.00699	−0.0641	−0.0633	0.0196	−0.0263	−0.0244
	(0.0440)	(0.0427)	(0.0426)	(0.0282)	(0.0286)	(0.0286)
Constant	0.126***	0.233***	0.171***	0.0304***	0.0866***	0.0753***
	(0.00332)	(0.0137)	(0.0175)	(0.00188)	(0.00772)	(0.0104)
Socio-demographic Controls	No	Yes	Yes	No	Yes	Yes
Socio-economic controls	No	No	Yes	No	No	Yes
Observations	10,476	10,476	10,476	12,396	12,396	12,396
R-squared	0.035	0.057	0.061	0.057	0.095	0.106

Note: this table reports regression estimates of the linear probability model predicting vaccine hesitancy for November 2020 and March 2021. Coefficient values from linear probability outputs are presented with standard errors in parentheses. Base category is White population group. Socio-demographic controls include gender, religion, marital status, and age. Socio-economic covariates include highest education level, income, and employment status. Estimate for White Traveller are not reported due to small number of observations. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

but they drop to 20pp when we include a long list of controls. Such coefficients are not any different in March 2021 when we consider different controls. When we focus on Pakistani respondents, we estimate a 28pp larger likelihood of vaccine hesitancy but such an effect more than halves when controls are included, yet it continues to be significant in March 2021 exhibiting an 8pp larger effect. A similar effect is found among Black Africans, which exhibit a 40pp higher likelihood of vaccine hesitancy in November 2020, but the effect size is sensitive to the inclusion of controls and drops to 8pp in March 2021.

Fig. 1 reports the effect sizes and confidence intervals of the previous coefficients. There were notable differences between November 2020 and March 2021, with significant declines in the large MEG disparities during that time. However, for groups like other whites, the differences in vaccine hesitancy between the two periods barely changed. Furthermore, figure C1 and Table C1in the appendix show evidence of no differences across genders.

Balanced sample estimates are reported in Table 3. Although based on a smaller sample, such estimates suggest a very similar picture as Table 2 vary with.

5.2. Controlling for Risk and Racist Experiences

Next, we examine another set of explanations for VH namely, the role of risk perceptions and past experiences. This is undertaken by adding additional covariates into our analysis in the form of controls. Table 4 reports estimates that account for risk perceptions related to COVID-19 and actual COVID-19 illness, as well as both contemporary and historical instances of racism and racial segregation. The estimates indicate barely no effect of such controls on the effect sizes of MEG. However, they do show that risk perception decreases vaccine hesitancy, as individuals who believed they were likely or very likely to have COVID-19 or another illness were 2 percentage points less likely to be vaccine-hesitant in November 2020. Consistently, the contemporary experience of racial attacks increases VH by 7pp and the experience of such attacks increases VH by an additional 2.3pp. These estimates indicate that enhancing information and preventing experiences of racism can reduce vaccine hesitancy, but they are unlikely to eliminate the differences in vaccine hesitancy associated with MEG.

5.3. Controlling for contemporary and past government distrust

Table 5 reports the estimates of VH controlling for other reasons for VH such as pre-pandemic distrust in government. As expected, when considering government trust as a control, *we find evidence of a significant effect* in explaining VH for the November 2020 sample but not in the March 2021 sample. Next, we consider both contemporaneous and past

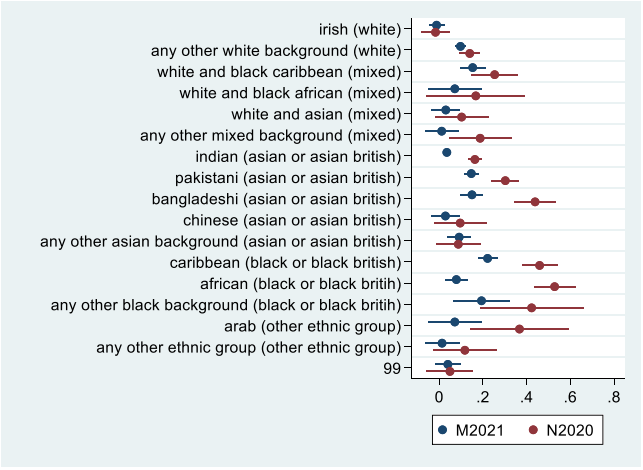


Fig. 1. Coefficient plot of MEG status limpact on vaccine hesitancy in November 2020 (M2020) and March 2021 (M2021). *Notes*: This table plots the coefficients of a linear probability estimate for vaccine hesitancy in the UK by ethnic group in the first wave (March 2020) and the second wave (March 2021) or the pandemic. The base category is White population group, and 99 refers to missing observations.

distrust in government in 2011 as Understanding Society allows for COVID-19 waves to be merged with previous waves. Importantly, our results suggest that even when we solely control for long-lasting distrust, the relationship between ethnicity and VH remains very much stable, with an effect size of 21pp larger among Black Caribbeans, 12pp for Mixed Caribbeans and 9pp for Other White and Pakistani.

6. Mechanisms

Given that our results suggest that MEG effects remain after controlling for a number of explanations, we consider whether MEG predicts the use of health care. Tables 6 and 7 report evidence of an association between MEG and a number of health outcomes alongside different types of healthcare use using the same controls in our main specification in Eq. (1). Table 6 examines the relationship between MEG and health outcomes to determine if differences in MEG are influenced by varying health needs. The evidence shows minimal differences in health outcomes that cannot be explained by other controls. These results suggest only a smaller perceived risk of illness and self-reported health among mixed-race Caribbeans. Table 7 indicates that both Black and Mixed-race Caribbeans consistently experience lower access to nearly all types of healthcare, including primary, outpatient, and inpatient services. In contrast, estimates for other ethnic groups suggest that both White individuals and Black Caribbeans are more likely to

Table 3
Baseline regression estimates COVID-19 Vaccine Hesitancy (Balanced Sample) in November 2020 and March 2021.

	November 2020			March 2021		
	(1)	(2)	(3)	(4)	(5)	(6)
Irish	−0.0170	−0.0137	−0.00603	−0.0122	−0.00665	−0.00469
	(0.0294)	(0.0298)	(0.0300)	(0.0118)	(0.0116)	(0.0117)
Other White	**0.140*****	**0.112*****	**0.123*****	**0.0973*****	**0.0868*****	**0.0901*****
	(0.0287)	**(0.0279)**	**(0.0279)**	**(0.0213)**	**(0.0206)**	**(0.0206)**
Mixed Caribbean	**0.254*****	**0.186*****	**0.185*****	**0.153*****	**0.125****	**0.124****
	(0.0736)	(0.0716)	(0.0693)	(0.0582)	(0.0566)	(0.0567)
Mixed African	0.167	0.111	0.123	0.0713	0.0461	0.0495
	(0.145)	(0.146)	(0.142)	(0.0950)	(0.100)	(0.0986)
Mixed Asian	0.103	0.0629	0.0796	0.0301	0.0170	0.0199
	(0.0729)	(0.0707)	(0.0688)	(0.0404)	(0.0411)	(0.0413)
Mixed Other	0.187**	0.135	0.147	0.0113	−0.00892	−0.00823
	(0.0935)	(0.0944)	(0.0943)	(0.0393)	(0.0372)	(0.0375)
Indian	0.163***	0.143***	0.158***	0.0347***	−0.0110	−0.00744
	(0.0189)	(0.0358)	(0.0359)	(0.0100)	(0.0182)	(0.0180)
Pakistani	**0.302*****	**0.0893**	**0.0859**	**0.147*****	**0.0960****	**0.0946****
	(0.0435)	**(0.0574)**	**(0.0570)**	**(0.0333)**	**(0.0434)**	**(0.0433)**
Bangladesh	**0.439*****	**0.213*****	**0.209*****	**0.150*****	**0.0895***	**0.0889***
	(0.0663)	(0.0754)	(0.0742)	(0.0513)	(0.0539)	(0.0539)
Chinese	0.0959	0.0752	0.103	0.0284	0.0245	0.0320
	(0.0712)	(0.0698)	(0.0695)	(0.0393)	(0.0399)	(0.0400)
Other Asian	0.0873	0.0278	0.0370	0.0913**	0.0779*	0.0800*
	(0.0588)	(0.0597)	(0.0585)	(0.0460)	(0.0462)	(0.0459)
Black Caribbean	**0.459*****	**0.424*****	**0.422*****	**0.221*****	**0.214*****	**0.214*****
	(0.0566)	**(0.0581)**	**(0.0583)**	**(0.0498)**	**(0.0501)**	**(0.0499)**
Black African	0.528***	0.473***	0.491***	0.0784*	0.0639	0.0663
	(0.0635)	(0.0631)	(0.0640)	(0.0414)	(0.0413)	(0.0414)
Other Black	0.423**	0.418**	0.412**	0.193	0.191	0.189
	(0.166)	(0.174)	(0.171)	(0.139)	(0.138)	(0.139)
Arab	0.367**	0.147	0.154	0.0713	0.0239	0.0268
	(0.158)	(0.162)	(0.161)	(0.0950)	(0.103)	(0.103)
Other	0.117	0.0965	0.116	0.0129	0.0124	0.0160
	(0.0886)	(0.0821)	(0.0821)	(0.0409)	(0.0404)	(0.0404)
Missing	0.0491	−0.0470	−0.0431	0.0395	−0.00710	−0.00594
	(0.0583)	(0.0567)	(0.0564)	(0.0381)	(0.0383)	(0.0383)
Constant	0.133***	0.238***	0.195***	0.0287***	0.0851***	0.0809***
	(0.00402)	(0.0150)	(0.0202)	(0.00198)	(0.00903)	(0.0121)
Observations	8723	8723	8723	8723	8723	8723
R-squared	0.061	0.099	0.112	0.034	0.058	0.061

Note: this table reports regression estimates of the linear probability model predicting vaccine hesitancy on a balanced sample for November 2020 and March 2021. Coefficient values from linear probability outputs are reported with standard errors in parentheses. Base category is White population group. Socio-demographic controls include gender, religion, marital status, and age. Socio-economic covariates include highest education level, income, and employment status. Estimates for White Traveller are not reported due to small number of observations Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 4
Baseline regression estimates COVID-19 Vaccine Hesitancy (Total Sample) in November 2020 and March 2021 controlling for risk perception and racist episodes.

	November 2020	March 2021	November 2020	March 2021
Irish	0.00468	−0.00547	0.00197	−0.00523
	(0.0253)	(0.0120)	(0.0253)	(0.0120)
Other White	**0.115*** **	**0.0807*** **	**0.103*** **	**0.0779*** **
	(0.0235)	**(0.0185)**	**(0.0236)**	**(0.0184)**
Mixed Caribbean	**0.154** **	**0.110** **	**0.132** **	**0.108** **
	(0.0602)	**(0.0468)**	**(0.0606)**	**(0.0472)**
Mixed African	0.118	0.0770	0.107	0.0777
	(0.114)	(0.0891)	(0.116)	(0.0896)
Mixed Asian	0.0628	0.0167	0.0461	0.0145
	(0.0600)	(0.0391)	(0.0605)	(0.0393)
Mixed Other	0.0638	0.00321	0.0432	−0.000312
	(0.0683)	(0.0397)	(0.0683)	(0.0404)
Indian	**0.127*** **	**−0.00785**	**0.108*** **	**−0.0124**
	(0.0277)	**(0.0155)**	**(0.0281)**	**(0.0158)**
Pakistani	**0.108** **	**0.0851** **	**0.0882***	**0.0813** **
	(0.0499)	**(0.0380)**	**(0.0499)**	**(0.0381)**
Bangladesh	**0.216*** **	**0.0800***	**0.191*** **	**0.0768***
	(0.0672)	**(0.0449)**	**(0.0673)**	**(0.0450)**
Chinese	0.0685	0.0358	0.0500	0.0326
	(0.0570)	(0.0386)	(0.0574)	(0.0389)
Other Asian	0.0142	0.0536	−0.00452	0.0502
	(0.0449)	(0.0368)	(0.0441)	(0.0369)
Black Caribbean	**0.451*** **	**0.242*** **	**0.431*** **	**0.238*** **
	(0.0436)	**(0.0470)**	**(0.0443)**	**(0.0475)**
Black African	**0.350*** **	**0.0801** **	**0.328*** **	**0.0756** **
	(0.0514)	**(0.0328)**	**(0.0512)**	**(0.0330)**
Other Black	0.460***	0.180*	0.436***	0.180*
	(0.159)	(0.108)	(0.158)	(0.108)
Arab	0.147	−0.0165	0.134	−0.0177
	(0.120)	(0.0709)	(0.123)	(0.0716)
Other	0.0767	0.0247	0.0666	0.0226
	(0.0613)	(0.0403)	(0.0603)	(0.0403)
Missing	−0.0634	−0.0264	−0.0623	−0.0242
	(0.0431)	(0.0286)	(0.0431)	(0.0287)
Risk covid	−0.0215*	−0.00585		
	(0.0121)	(0.00866)		
Risk illness	−0.0224***	0.000779		
	(0.00715)	(0.00424)		
Racial attack			0.0778***	0.00984
			(0.0285)	(0.0165)
Racial Segregation			−0.0124	0.00138
			(0.0112)	(0.00748)
Racial attack in 2011			0.0233***	0.00831*
			(0.00782)	(0.00492)
Racial Segregation in 2011			−0.00973	−0.00300
			(0.0101)	(0.00619)
Constant	0.240***	0.0866***	0.230***	0.0803***
	(0.0139)	(0.00802)	(0.0201)	(0.0125)
Observations	12,396	10,476	12,396	10,476
R-squared	0.096	0.058	0.098	0.058

Note: this table reports regression estimates of the linear probability model predicting vaccine hesitancy on a balanced sample for November 2020 and March 2021. Coefficient values from linear probability outputs are presented with standard errors in parentheses. Base category is White population group. Socio-demographic controls include gender, religion, marital status, and age. Socio-economic covariates include highest education level, income, and employment status. Estimates for White Traveller are not reported due to small number of observations. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

report negative experiences with the NHS. These results suggest that previous results could be driven by underlying barriers to health care and support the idea that vaccine hesitancy may be perceived as a form of retaliatory or other behavior resulting from the limited access to healthcare experienced by these groups.

Table 5
Baseline regression estimates COVID-19 Vaccine Hesitancy (Balanced Sample) in November 2020 and March 2021 controlling for Contemporary Distrust and Past Distrust.

	November 2020		March 2021	
	(1)	(2)	(3)	(4)
Irish	−0.00456	−0.00468	−0.00524	−0.00522
	(0.0298)	(0.0298)	(0.0117)	(0.0117)
Other white	**0.125*** **	**0.125*** **	**0.0891*** **	**0.0891*** **
	(0.0279)	**(0.0279)**	**(0.0206)**	**(0.0206)**
Mixed Caribbean	**0.172** **	**0.172** **	**0.123** **	**0.123** **
	(0.0706)	**(0.0706)**	**(0.0564)**	**(0.0564)**
Mixed African	0.128	0.128	0.0480	0.0477
	(0.153)	(0.153)	(0.101)	(0.101)
Mixed Asian	0.0724	0.0726	0.0183	0.0182
	(0.0696)	(0.0696)	(0.0413)	(0.0414)
Mixed Other	0.159*	0.160*	−0.00431	−0.00445
	(0.0937)	(0.0937)	(0.0373)	(0.0373)
Indian	0.143***	0.144***	−0.0112	−0.0112
	(0.0357)	(0.0357)	(0.0182)	(0.0182)
Pakistani	0.0800	0.0798	0.0941**	0.0941**
	(0.0572)	(0.0572)	(0.0433)	(0.0433)
Bangladesh	0.207***	0.207***	0.0877	0.0876
	(0.0752)	(0.0752)	(0.0541)	(0.0541)
Chinese	0.0892	0.0893	0.0277	0.0277
	(0.0699)	(0.0699)	(0.0398)	(0.0398)
Other Asian	0.0413	0.0418	0.0796*	0.0795*
	(0.0601)	(0.0601)	(0.0461)	(0.0462)
Black Caribbean	**0.431*** **	**0.431*** **	**0.216*** **	**0.216*** **
	(0.0587)	**(0.0587)**	**(0.0500)**	**(0.0501)**
Black African	**0.486*** **	**0.486*** **	**0.0660**	**0.0657**
	(0.0630)	**(0.0630)**	**(0.0413)**	**(0.0413)**
Other Black	0.419**	0.419**	0.192	0.192
	(0.178)	(0.178)	(0.139)	(0.139)
Arab	0.120	0.120	0.0187	0.0190
	(0.165)	(0.165)	(0.103)	(0.103)
Other	0.104	0.105	0.0150	0.0151
	(0.0807)	(0.0807)	(0.0403)	(0.0403)
Missing	−0.0437	−0.0442	−0.00614	−0.00612
	(0.0554)	(0.0554)	(0.0382)	(0.0382)
Government Distrust	0.0341***		0.00426	
	(0.00798)		(0.00430)	
Government Distrust 2011		0.0344***		0.00311
		(0.00796)		(0.00427)
Constant	0.228***	0.228***	0.0857***	0.0862***
	(0.0149)	(0.0149)	(0.00920)	(0.00920)
Controls	No	Yes	No	Yes
Observations	8723	8723	8723	8723
R-squared	0.105	0.105	0.059	0.059

Note: this table reports regression estimates of a linear probability model predicting vaccine hesitancy on a balanced sample for November 2020 and March 2021. Coefficient values from linear probability outputs are reported with standard errors in parentheses. Base category is White population group. Socio-demographic controls include gender, religion, marital status, and age. Socio-economic covariates include highest education level, income, and employment status. Estimates for White Traveller are not reported due to small number of observations Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

7. Conclusion

COVID-19 vaccine hesitancy (VH) in the United Kingdom (UK) is driven by some minority ethnic group attitudes and behaviors. This paper draws on an analysis of a large and boosted ethnic minority sample to study disparities in COVID-19 vaccine hesitancy (VH) in the United Kingdom (UK). We document significant disparities in vaccine hesitancy (VH) among minority ethnic groups (MEGs) in November 2020, which continued to be significant in March 2021. Our analysis demonstrates that, even after controlling for individual differences in socio-economic status and demographic factors, these disparities in VH persist. Black Caribbeans exhibit a vaccine hesitancy (VH) that is 21 to 24 percentage points higher than white British respondents, while Mixed

Table 6
Baseline regression estimates for a number of health-related mechanisms.

VARIABLES	(1) Risk covid	(2) Risk illness	(3) Mental distress	(4) Self-reported Health	(5) Cancelled Treatment
Irish	0.00622	0.0587*	0.0871**	−0.210	0.388
	(0.0207)	(0.0353)	(0.0391)	(0.181)	(0.344)
Other white	0.0499***	−0.00701	0.0231	0.109	0.326
	(0.0189)	(0.0250)	(0.0274)	(0.105)	(0.246)
Mixed Caribbean	**−0.0247**	**0.204*** **	**0.0334**	**−0.742*** **	**0.864**
	(0.0366)	**(0.0644)**	**(0.0660)**	**(0.261)**	**(0.612)**
Mixed African	−0.0446	0.00751	−0.0527	−0.815*	1.114
	(0.0564)	(0.115)	(0.114)	(0.471)	(1.102)
Mixed Asian	−0.0171	0.0385	−0.0386	−0.201	0.0697
	(0.0402)	(0.0712)	(0.0672)	(0.362)	(0.574)
Mixed Other	−0.0305	0.0276	0.117	−0.169	0.982
	(0.0411)	(0.0749)	(0.0866)	(0.388)	(0.744)
Indian	0.0355	0.0121	−0.0475	−0.251	−0.307
	(0.0219)	(0.0294)	(0.0312)	(0.211)	(0.227)
Pakistani	0.0217	0.0442	0.0648	−0.673*	−0.0298
	(0.0363)	(0.0504)	(0.0513)	(0.361)	(0.366)
Bangladesh	0.0968*	0.0806	0.0275	−0.879*	−0.642
	(0.0538)	(0.0640)	(0.0684)	(0.517)	(0.464)
Chinese	−0.0574**	−0.00706	−0.0289	−0.429	−0.967***
	(0.0277)	(0.0659)	(0.0655)	(0.394)	(0.372)
Other Asian	0.0659	−0.00372	−0.0442	−0.366	−0.481
	(0.0437)	(0.0533)	(0.0553)	(0.314)	(0.383)
Black Caribbean	0.0451	0.0260	−0.0395	−0.505*	−0.0778
	(0.0311)	(0.0429)	(0.0469)	(0.296)	(0.371)
Black African	0.0843**	−0.0207	−0.0979**	−0.813**	−0.135
	(0.0404)	(0.0463)	(0.0469)	(0.407)	(0.429)
Other Black	0.0984	−0.0266	−0.171	1.898**	−0.687
	(0.128)	(0.152)	(0.111)	(0.925)	(1.125)
Arab	−0.0953	−0.179*	−0.0593	0.294	0.492
	(0.0605)	(0.0962)	(0.113)	(0.477)	(1.131)
Other	6.28e−05	−0.0203	−0.0575	−0.514	1.000
	(0.0444)	(0.0719)	(0.0760)	(0.399)	(0.788)
Missing	−0.0117	0.0452	−0.0565	−0.445	0.189
	(0.0393)	(0.0578)	(0.0578)	(0.300)	(0.533)
Constant	0.128***	0.202***	0.336***	5.006***	−6.911***
	(0.0107)	(0.0135)	(0.0149)	(0.0661)	(0.113)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	12,426	12,426	10,640	11,775	12,426
R-squared	0.031	0.196	0.016	0.069	0.019

Note: this table reports regression estimates of the linear probability model predicting health outcomes on a balanced sample for March 2021. Coefficient values from linear probability outputs are presented with standard errors in parentheses.

Caribbeans show a 12 percentage point increase in VH. Additionally, we document evidence of a 9 percentage point higher VH among Other Europeans and Pakistanis. The effects are robust to using balanced samples and to the inclusion of alternative explanations for VH that have been put forward by the literature, such as experienced racist attacks, risk perceptions, and especially government distrust. Indeed, we find that while these factors influence vaccine hesitancy (VH), they do not account for the observed disparities among minority ethnic groups (MEGs). Thus, the association between ethnicity and vaccine hesitancy remains robust, even when considering alternative explanations.

We investigate two alternative explanations in our mechanisms section, namely the presence of higher health needs by some MEG and the existence of barriers in accessing health care that affect VH. Our findings indicate no evidence of higher healthcare needs among specific minority ethnic groups (MEGs). However, we document a systematically lower access to both primary, inpatient, and outpatient care by Black and Mixed Caribbean individuals, and a higher likelihood of experiencing unpleasant encounters with the national health system (NHS) by Mixed-race Caribbean and Eastern Europeans, which is suggestive of the presence of wider health system access barriers as a potential explanation for VH.

The evidence presented in this study comes from the United Kingdom, where healthcare is provided free at the point of use. As a result, access to vaccines is unlikely to be constrained by financial barriers, unlike in other countries. However, our findings imply that addressing institutional and structural barriers faced by MEG is crucial for reducing disparities in healthcare engagement and, more specifically, vaccine hesitancy (VH).

Our analysis shows that MEGs were pivotal in influencing overall vaccine hesitancy (VH) during the pandemic, highlighting the need to address these persistent barriers to vaccination. Health authorities need to actively involve minority communities in the development and implementation of healthcare initiatives to build trust and foster a sense of shared ownership. Research by Strully et al. (2021) emphasizes the value of such participatory approaches. Similarly, Crawshaw et al. (2021) show that engaging MEGs in vaccine trials and collaboratively addressing their concerns reduces the perception that vaccines are imposed, thereby promoting local buy-in.

Further research is needed to refine intervention strategies that address the sense of alienation often felt by ethnic minorities in healthcare settings. Despite efforts during the COVID-19 vaccination campaign, vaccine uptake remained disproportionately low among minority communities. These disparities reflect the nuanced nature of healthcare behavior among MEG populations, underscoring the need for tailored, trust-building interventions to improve both access and engagement.

CRediT authorship contribution statement

Joan Costa Font: Writing – review & editing, Writing – original draft, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation,

Table 7
Baseline regression estimates for a number of health-care use (Total Sample).

VARIABLES	(1) GP Access	(2) Prescription Drugs	(3) Outpatient	(4) Inpatient	(5) NHS Bad Experience
Irish	−0.0299	−0.195**	−0.193	−0.220*	−0.0142
	(0.138)	(0.0848)	(0.169)	(0.121)	(0.0553)
Other white	**0.00148**	**0.136****	**−0.0317**	**−0.00990**	**0.380*****
	(0.0978)	**(0.0618)**	**(0.113)**	**(0.0689)**	**(0.0493)**
Mixed Caribbean	**−0.630****	**−0.332**	**−0.829****	**−0.473***	**0.0896**
	(0.298)	**(0.208)**	**(0.357)**	**(0.274)**	**(0.110)**
Mixed African	0.236	0.150	−0.662	−0.460	0.175
	(0.383)	(0.223)	(0.502)	(0.364)	(0.195)
Mixed Asian	0.462**	0.0805	−0.102	−0.383	0.324**
	(0.223)	(0.154)	(0.300)	(0.244)	(0.133)
Mixed Other	−0.315	−0.141	−0.257	0.00241	0.443***
	(0.271)	(0.146)	(0.303)	(0.163)	(0.146)
Indian	**−0.158**	**0.110**	**−0.382*****	**−0.237****	**0.497*****
	(0.117)	**(0.0783)**	**(0.139)**	**(0.0987)**	**(0.0642)**
Pakistani	0.0974	0.228*	−0.291	−0.400**	0.481***
	(0.181)	(0.122)	(0.227)	(0.179)	(0.0980)
Bangladesh	0.222	0.214	0.00249	0.0138	0.280**
	(0.230)	(0.144)	(0.264)	(0.176)	(0.129)
Chinese	−0.0306	0.202	−0.0221	−0.501	0.420***
	(0.331)	(0.241)	(0.355)	(0.307)	(0.142)
Other Asian	0.0817	0.0613	−0.486*	−0.0140	0.385***
	(0.239)	(0.176)	(0.292)	(0.211)	(0.109)
Black Caribbean	**-0.519*****	−0.0516	**−0.663*****	**−0.444****	**0.242*****
	(0.195)	(0.135)	(0.236)	(0.188)	(0.0811)
Black African	−0.254	0.0346	−0.544*	−0.546**	0.448***
	(0.237)	(0.171)	(0.280)	(0.235)	(0.0986)
Other Black	−0.403	−0.242	−0.0832	−0.155	0.361
	(0.601)	(0.322)	(0.655)	(0.381)	(0.291)
Arab	−0.557	−0.234	−1.210	−0.941	0.320
	(0.822)	(0.665)	(0.939)	(0.820)	(0.258)
Other	−0.0464	0.0356	−0.414	0.198	0.0796
	(0.277)	(0.133)	(0.338)	(0.139)	(0.117)
Missing	−0.206	−0.0128	−0.213	−0.326*	−0.171
	(0.237)	(0.148)	(0.262)	(0.195)	(0.154)
Constant	3.828***	2.208***	5.249***	4.731***	1.231***
	(0.0604)	(0.0415)	(0.0650)	(0.0466)	(0.0290)
Observations	12,426	12,426	12,426	12,426	12,426
R-squared	0.018	0.066	0.020	0.016	0.210

Note: this table reports regression estimates of the linear probability model predicting health care use on a balanced sample for March 2021. Coefficient values from linear probability outputs are presented with standard errors in parentheses.

Conceptualization. **Fatima Docrat:** Conceptualization, Data curation, Writing – original draft.

Declaration of Competing Interest

The authors have no conflict of interest or funding to disclose

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ehb.2024.101441.

Data availability

The data is publicly available (upon registration) and the code will be made available on request.

References

Adida, C., et al., 2017. Reducing or reinforcing in-group preferences? An experiment on information and ethnic voting. Q. J. Political Sci. 12 (4), 437–477. https://doi.org/10.1561/100.00017018.

Adler, A., 1927. Individual psychology. J. Abnorm. Soc. Psychol. 22 (2), 116–122.

Allington, D., McAndrew, S., Moxham-Hall, V.L., Duffy, B., 2021. Media usage predicts intention to be vaccinated against SARS-CoV-2 in the US and the UK. Vaccine 39 (18), 2595–2603.

Armstrong, K.K.L., Ravenell, S., McMurphy, M.Putt, 2007. Racial/Ethnic Differences in Physician Distrust in the United States. Am. J. Public Health 97 (7), 1283–1289.

Betancourt, J.R., Green, A.R., Carrillo, J.E., & Owusu Ananeh-Firempong, I.I. (2003). Defining cultural competence: a practical framework for addressing racial/ethnic disparities in health and health care. Public health reports.

Bateman, W. *et al.* (2020) 'COVID-19 Vaccination: Reducing vaccine hesitancy Review & Recommendations ', (December).

Burnett, J., 2016. The Hostile Environment: immigration enforcement and racism in the UK. Race Cl. 58 (2), 86–95.

Cabinet Office. (2017). Race Disparity Audit. Retrieved from ⟨https://www.gov.uk/government/publications/race-disparity-audit/race-disparity-audit⟩.

Callaghan, T., et al., 2021. Correlates and disparities of intention to vaccinate against COVID-19. In: *Social science & medicine (1982)*. 2021/01/04, 272. Elsevier Ltd, 113638. https://doi.org/10.1016/j.socscimed.2020.113638.

Campbell, C., McLean, C., 2002. Ethnic identities, social capital and health inequalities: factors shaping African-Caribbean participation in local community networks in the UK. Soc. Sci. Med. 55, 643–657.

Carrieri, V., Guthmuller, S., Wübker, A., 2023. Trust and COVID-19 vaccine hesitancy. Sci. Rep. 13, 9245.

Costa, D.L., Yetter, N., DeSomer, H., 2018. Intergenerational transmission of paternal trauma among US Civil War ex-POWs. Proc. Natl. Acad. Sci. 115 (44), 11215–11220.

Costa-Font, J., Garcia-Hombrados, J., Nicińska, A., 2023b. The institutional origins of vaccines distrust: Evidence from former-Soviet countries. Plos one 18 (3), e0282420.

Costa-Font, J., Rudisill, C., Harrison, S., Salmasi, L., 2023a. The social value of a SARS-CoV-2 vaccine: Willingness to pay estimates from four western countries. Health Economics 32 (8), 1818–1835.

Crawshaw, A.F., et al., 2021. What must be done to tackle vaccine hesitancy and barriers to COVID-19 vaccination in migrants? J. Travel Med. 28 (4), 1–4. https://doi.org/10.1093/jtm/taab048.

Doherty, I.A., et al., 2021. COVID-19 vaccine hesitancy in underserved communities of North Carolina. medRxiv 1–30. https://doi.org/10.1101/2021.02.21.21252163.

Dubé, E., Laberge, C., Guay, M., Bramadat, P., Roy, R., Bettinger, J.A., 2013. Vaccine hesitancy: An overview. Hum. Vaccin. Immunother. 9 (8), 1763–1773.

Dubé, E., MacDonald, N.E., 2020. How can a global pandemic affect vaccine hesitancy? Expert Rev. Vaccin. 899–901.

Fareed, N., et al., 2021. Socioeconomic factors influence health information seeking and trust over time: evidence from a cross-sectional, pooled analyses of HINTS data. Am. J. Health Promot. https://doi.org/10.1177/08901171211018135.
Grisso, J.A., et al., 1999. Racial differences in menopause information and the experience of hot flashes. In: Journal of general internal medicine, 14. United States, pp. 98–103. https://doi.org/10.1046/j.1525-1497.1999.00294.x.
Hussain, B., Latif, A., Timmons, S., Nkhoma, K., Nellums, L.B., 2022. Overcoming COVID-19 vaccine hesitancy among ethnic minorities: A systematic review of UK studies. Vaccine 40 (25), 3413–3432.
Jamison, A.M., Quinn, S.C., Freimuth, V.S., 2019. You don't trust a government vaccine": Narratives of institutional trust and influenza vaccination among African American and white adults. In: Social Science and Medicine, 221. Elsevier, pp. 87–94. https://doi.org/10.1016/j.socscimed.2018.12.020.
Jeraj, S., 2021. Doing the work to end health inequalities caused by systemic racism. Br. Med. J. 373 (April), 1–2. https://doi.org/10.1136/bmj.n821.
Karlsen, S., Nazroo, J.Y., 2002. Relation between racial discrimination, social class, and health among ethnic minority groups. Am. J. Public Health 92 (4), 624–631.
Kataria, I., et al., 2022. Racial disparities in vaccine hesitancy and trust in COVID-19 information sources. Public Health Pract. 3, 100232.
Khan, M.S., et al., 2021. Rethinking vaccine hesitancy among minority groups. Lancet 1863–1865. https://doi.org/10.1016/S0140-6736(21)00938-7.
Marshall, H.H., 2001. 'Cultural influences on the development of self-concept: Updating our thinking'. Young-.-. Child. 56 (6), 19–25.
Mclean, C., Campbell, C., Cornish, F., 2003. African-Caribbean interactions with mental health services in the UK: experiences and expectations of exclusion as (re) productive of health inequalities. Soc. Sci. Med. 56, 657–669.
Murphy, J., et al., 2021. Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. Nat. Commun. 12 (1), 29. https://doi.org/10.1038/s41467-020-20226-9.
Nafilyan, V., Islam, N., Ayoubkhani, D., Gilles, C., Katikireddi, S.V., Mathur, R., Khunti, K., 2021. Ethnicity, household composition and COVID-19 mortality: a national linked data study. J. R. Soc. Med. 114 (4), 182–211.
Nguyen, L.H., et al., 2021. 'Racial and ethnic differences in COVID-19 vaccine hesitancy and uptake'. medRxiv 1–49.
Nguyen, Q.C., Yardi, I., Gutierrez, F.X.M., Mane, H., Yue, X., 2022. Leveraging 13 million responses to the US COVID-19 Trends and Impact Survey to examine vaccine hesitancy, vaccination, and mask wearing, January 2021-February 2022. BMC Public Health 22 (1), 1911.
Owens, D., Grossman, Z., Fackler, R., 2014. The control premium: a preference for payoff autonomy. Am. Econ. J.: Microecon. 6 (4), 138–161.
Pain, R., Rezwana, N., Sahdan, Z., 2020. Trauma, gender and space: Insights from Bangladesh, Malaysia and the UK'. Routledge Handbook of Gender and Feminist Geographies. Herman 1997, pp. 287–296.
Quinn, K., Bowleg, L., Dickson-Gomez, J., 2019. "The fear of being Black plus the fear of being gay": The effects of intersectional stigma on PrEP use among young Black gay, bisexual, and other men who have sex with men. Soc. Sci. Med. 232, 86–93.
Razai, M.S., Osama, T., et al., 2021. Covid-19 vaccine hesitancy among ethnic minority groups. Br. Med. J. 372, 1–2. https://doi.org/10.1136/bmj.n513.
Robertson, E., et al., 2021. Predictors of COVID-19 vaccine hesitancy in the UK household longitudinal study. In: Brain, Behavior, and Immunity, 94. Elsevier Inc, pp. 41–50. https://doi.org/10.1016/j.bbi.2021.03.008.
SAGE, 2021. Factors influencing COVID-19 vaccine uptake among minority ethnic groups. Sci. Advis. Group Emergencies 1–15.
Sallam, M., 2021. COVID-19 vaccine hesitancy worldwide: a concise systematic review of vaccine acceptance rates. Vaccines 9 (2). https://doi.org/10.3390/vaccines9020160.
Shiner, M., Carre, Z., Delsol, R., & Eastwood, N. (2018). The Colour of Injustice: 'Race', Drugs and Law Enforcement in England and Wales. StopWatch.
Strully, K.W., et al., 2021. Strategies to address COVID-19 vaccine hesitancy and mitigate health disparities in minority populations. Front. Public Health 9 (April), 1–7. https://doi.org/10.3389/fpubh.2021.645268.
Thompson, H.S., Manning, M., Mitchell, J., et al., 2021. Factors associated with racial/ethnic group-based medical mistrust and perspectives on covid-19 vaccine trial participation and vaccine uptake in the US. JAMA Netw. Open 4 (5), e2111629.
TSIP (2021) Medical Scepticism / Distrust Community Research.
University of Essex (2019) 'Understanding Society Waves 1-9 User Guide', pp. 1–119. Available at: ⟨https://www.understandingsociety.ac.uk/⟩.
WHO (2019) Ten threats to global health in 2019. Available at: ⟨https://www.who.int/emergencies/ten-threats-to-global-health-in-2019⟩.
Yaqub, O., Castle-Clarke, S., Sevdalis, N., Chataway, J., 2014. Attitudes to vaccination: A critical review. Soc. Sci. Med. 112, 1–11.