OPEN ACCESS

Original research

Coverage, completion and outcomes of COVID-19 risk assessments in a multi-ethnic nationwide cohort of UK healthcare workers: a cross-sectional analysis from the UK-REACH Study

Christopher A Martin,[1,2] Katherine Woolf,[3] Luke Bryant,[1] Charles Goss,[4] Mayuri Gogoi,[1] Susie Lagrata,[5] Padmasayee Papineni,[6] Irtiza Qureshi,[7] Fatimah Wobi,[8,9] Laura Nellums,[7] Kamlesh Khunti,[10] Manish Pareek ,[2] On behalf of the UK-REACH Study Collaborative Group

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/oemed-2022-108700).

For numbered affiliations see end of article.

Correspondence to
Professor Manish Pareek, Department of Respiratory Sciences, University of Leicester, Leicester LE1 7RH, UK; mp426@le.ac.uk

Received 13 October 2022
Accepted 31 March 2023

To cite: Martin CA, Woolf K, Bryant L, *et al*. *Occup Environ Med* Epub ahead of print: [please include Day Month Year]. doi:10.1136/oemed-2022-108700

ABSTRACT

Introduction There are limited data on the outcomes of COVID-19 risk assessment in healthcare workers (HCWs) or the association of ethnicity, other sociodemographic and occupational factors with risk assessment outcomes.

Methods We used questionnaire data from UK-REACH (UK Research study into Ethnicity And COVID-19 outcomes in Healthcare workers), an ethnically diverse, nationwide cohort of UK HCWs. We derived four binary outcomes: (1) offered a risk assessment; (2) completed a risk assessment; (3) working practices changed as a result of the risk assessment; (4) wanted changes to working practices after risk assessment but working practices did not change.

We examined the association of ethnicity, other sociodemographic/occupational factors and actual/perceived COVID-19 risk variables on our outcomes using multivariable logistic regression.

Results 8649 HCWs were included in total. HCWs from ethnic minority groups were more likely to report being offered a risk assessment than white HCWs, and those from Asian and black ethnic groups were more likely to report having completed an assessment if offered. Ethnic minority HCWs had lower odds of reporting having their work change as a result of risk assessment. Those from Asian and black ethnic groups were more likely to report no changes to their working practices despite wanting them.

Previous SARS-CoV-2 infection was associated with lower odds of being offered a risk assessment and having adjustments made to working practices.

Discussion We found differences in risk assessment outcomes by ethnicity, other sociodemographic/occupational factors and actual/perceived COVID-19 risk factors. These findings are concerning and warrant further research using actual (rather than reported) risk assessment outcomes in an unselected cohort.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Ethnic minority groups and healthcare workers have been disproportionately impacted by the COVID-19 pandemic. National Health Service (NHS) leaders were advised to take account of ethnic minority in COVID-19 risk assessments in April 2020 and were instructed to complete risk assessment of all ethnic minority staff by July 2020. However, only 61% of acute care trusts had completed the risk assessment of ethnic minority staff by this time. A survey study of UK doctors in February 2021 found that only 55% reported that they had been risk assessed and were confident that necessary adjustments were made.

WHAT THIS STUDY ADDS

⇒ In this nationwide study in a highly ethnically diverse cohort of NHS workers, we found that the majority of staff reported having been risk assessed. Ethnic minority healthcare workers were more likely than those from white ethnic groups to report having been offered a COVID-19 risk assessment and more likely to have completed a risk assessment once offered. However, ethnic minority healthcare workers were less likely to report having changes made to working practices after risk assessment and more likely to have unfulfilled wishes for changes to working practices.

INTRODUCTION

It has been established that working as a healthcare worker (HCW) represents a risk factor for infection with SARS-CoV-2 when compared with the general population.[1] Ethnic minority groups in the UK and the USA are also at higher risk of infection with SARS-CoV-2 than white groups and may also be at higher risk of adverse outcome from COVID-19.[2–4] In studies examining infection risk in HCW cohorts, those from ethnic minority groups have been demonstrated to be at higher risk of infection, implying that risk is compounded in ethnic minority HCWs.[1 5–7] There is a wealth of evidence to suggest that the increased risk of COVID-19 faced by ethnic minority groups is underpinned by social, economic and health inequalities.[2 8–10]

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This is the largest study of risk assessment outcomes in UK healthcare workers. We highlight differences in self-reported risk assessment outcomes by ethnicity and by other sociodemographic, occupational and clinical parameters. These findings are concerning and warrant urgent further investigation in an unselected cohort to inform future policy around COVID-19 risk assessment, thus protecting the healthcare workforce and preventing the ethnic disparities of the COVID-19 pandemic from widening.

In recognition of this increased risk, in March 2020, National Health Service (NHS) leaders were instructed to make adjustments for vulnerable staff.[11] Further communications in April identified ethnic minority as an emerging risk factor for COVID-19 and recommended that this was taken account of when deciding whether adjustments should be made to working practices in order to safeguard against this risk.[12] This was followed in June by communications mandating that risk assessments for staff in at-risk groups be completed within a month.[13] Despite such communications, it was reported that only 61% of acute care trusts had completed the assessment of ethnic minority staff by July 2020.[13] A survey of British Medical Association members in February 2021 found that only 55% of around 7000 respondents reported that they had been risk assessed and were confident that necessary adjustments were made.[14]

Guidance is available on how to conduct COVID-19 risk assessments including assessment of workplace, workforce and individual vulnerability factors.[15] Recommendations are that assessment of individual vulnerability should be conducted by conversation with a manager/supervisor or health and safety representative and should take account of age, sex, long-term health conditions, ethnicity, pregnancy and, more recently, SARS-CoV-2 vaccination status. Furthermore, it is advised that assessments take account of psychological and social factors, risk behaviours and mental well-being.[15 16]

Despite the importance of individual COVID-19 risk assessment for HCWs, there is little evidence on the proportion of HCWs who have undergone risk assessment or whether changes were made to working practices as a result. Furthermore, since the introduction of this national policy, there has been no systematic evidence on whether the likelihood of being risk assessed or having amendments made to working practices differs according to ethnicity and other sociodemographic and occupational factors. To address this knowledge gap, we analysed data from the UK-REACH (UK Research study into Ethnicity And COVID-19 outcomes in Healthcare workers) Study.

METHODS

This work uses data from the baseline questionnaire of the UK-REACH cohort study (administered December 2020–March 2021). The cohort includes HCWs aged 16 years or older. Recruitment and study methods are described in detail in online supplemental text 1, online supplemental figure 1 and previous work.[5 17–19]

Formation of the analysed sample is shown in figure 1. The questionnaire items specifically asked about NHS COVID-19 risk assessments; therefore, participants who did not report working for the NHS were excluded from the analyses. Participants who indicated they were not working at the time of questionnaire completion were not asked the risk assessment questions and were excluded from the analyses. To ensure our measures of occupational exposure to COVID-19 reflected levels of exposure at the time of risk assessment roll-out, we used answers to questions about occupational circumstances in the weeks following the first UK national lockdown (this period was referred to throughout the questionnaire as 'the UK national lockdown on 23 March 2020'). Those with missing ethnicity data and those not working during lockdown were excluded. Further exclusions were dependent on the outcome of the analysis (figure 1).

We derived four binary outcome measures from two questionnaire items (figure 1). Outcomes 1 and 2 are derived from the question 'Have you been offered an NHS COVID-19 risk assessment at work?'. Outcomes 3 and 4 are derived from the question 'Did your work change as a result of the NHS COVID-19 risk assessment result?', which was asked only of those who indicated they had completed a COVID-19 risk assessment.

Outcome 1: offered a risk assessment (not offered vs offered); outcome 2: completed a risk assessment when offered (completed vs not completed) but excludes those not offered; outcome 3: working practices changed as a result of the risk assessment (changed vs did not change); outcome 4: wanted changes to working practices after risk assessment but working practices did not change (did not want change vs wanted change).

For analyses using outcomes 3 and 4, we only included those who indicated the assessment result could, or should, have led to workplace adjustments (ie, we excluded those who responded 'No [my work did not change] because it did not need to').

Our primary exposure of interest was self-reported ethnicity. To maximise statistical power, we categorised ethnicity into the five broad ethnic groups (white, Asian, black, mixed and other) suggested by the UK Office for National Statistics.[20]

Potential confounders of the relationship between ethnicity and our outcome measures were hypothesised to be: demographic characteristics (age, sex); occupational group (categorised into medical, nursing, allied health professional (AHP), dental and administrative/estates/other); migration status (categorised as born in the UK and born overseas).

We also explored the effects of other variables related to the risk, or perceived risk, of severe COVID-19 and perceived risk of transmitting COVID-19 to others on the outcome measures. These variables are as follows (for details, see online supplemental table 1): level of exposure to patients with COVID-19 during lockdown; number of long-term physical health conditions; body mass index; previous SARS-CoV-2 infection status; perceived risk of hospitalisation with COVID-19; perceived risk of unknowingly spreading COVID-19; cohabiting with someone over the age of 65 years.

It should be noted that occupation might be considered to be a mediator rather than a confounder of the relationship between ethnicity and risk assessment outcome. However, occupation may have influenced inclusion of HCWs from ethnic minority groups in the cohort;[21] therefore, we elected to adjust for occupation when examining ethnic differences in multivariable models.

In an analysis of two subgroups, we investigated the effect of specific occupational parameters on outcomes 1 and 2, namely pay band for those on the NHS agenda for change pay scales and grade for doctors. The agenda for change pay scales determines the salary of NHS staff other than doctors, dentists and those in very senior management positions. There are nine bands (band 1–band 9) and salary increases as band increases. In this analysis, we use this scale as a proxy measure for occupational seniority. We did not conduct the same analysis on outcomes 3 and 4 as it

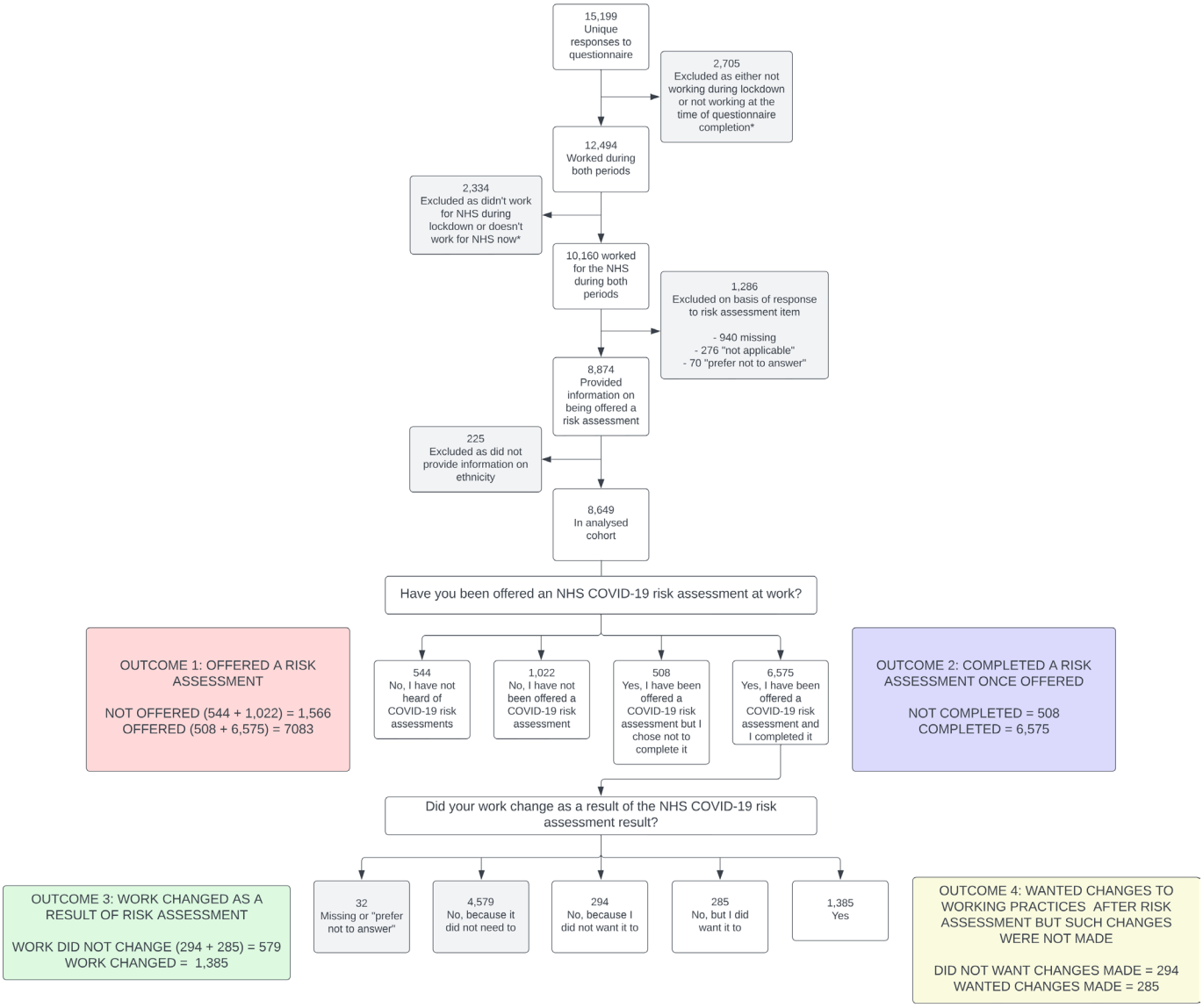


Figure 1 Formation of the analysed sample and derivation of outcome measures. *at time of questionnaire completion. NHS, National Health Service.

was felt that the number of participants included in such analyses would be too small to provide meaningful results. We excluded those who did not provide information on grade or NHS pay band from the relevant subgroup analysis.

We summarised categorical variables as frequency and percentage, and continuous variables as median and IQR.

We used multivariable logistic regression to determine associations of the variables described above with the outcomes and present adjusted ORs (aORs), 95% CIs and p values. Ethnicity and hypothesised confounders (age, sex, occupation and migration status) were included in a base model. We then added the variables relating to risk/perceived risk of COVID-19 to this base model separately such that the aORs included in the figure are adjusted for the variables in the base model (but not the other risk/perceived risk variables). We did not include the 'perceived risk' variables in the analysis of outcome 1 as we felt these would not have influenced whether an HCW was offered a risk assessment.

Multiple imputation was used to impute missing data in logistic regression models. The imputation models contained all variables used in the analysis except the one being imputed. Rubin's Rules were used to combine the parameter estimates and SEs from 10 imputations into a single set of results.[22]

We conducted multiple sensitivity analyses: (1) analysis of the main outcome measures in complete cases to test the effect multiple imputation had on results; (2) examination of univariable ORs for the association of ethnicity with our outcome measure to test the impact of adjustment for other variables in the base model; (3) an analysis which excludes those with no direct contact with patients with COVID-19 to test the hypothesis that differences in exposure to patients with COVID-19 by ethnicity may have influenced ethnic differences in risk assessment coverage and outcome.

We set statistical significance at $p<0.05$ and did not correct for multiple comparisons because of lower statistical power due to smaller sample sizes in analyses using outcomes 3 and 4, and because we felt it would be overly restrictive for this exploratory analysis.

All analyses were conducted using Stata V.17. Figures were created using GraphPad Prism.

For details on public/professional involvement and engagement, see online supplemental text 2.

The funders had no role in study design, data collection, data analysis, interpretation or writing of the report.

RESULTS

Participants included and excluded in each analysis are detailed in figure 1. A description of the analysed cohort and the amount of missing data for each variable is shown in table 1. Of the 8649 HCWs included, 1820 (21.0%) were from Asian, 371 (4.3%) from black, 360 (4.2%) from mixed and 198 (2.3%) from other ethnic groups. One thousand eight hundred eighty-two (21.8%) had missing data in at least one of the variables of interest.

Overall, 81.9% (n=8649) reported being offered a risk assessment (outcome 1) and 92.8% (n=7083) reported completing a COVID-19 risk assessment once offered (outcome 2). Among those who completed a risk assessment and did not indicate that workplace adjustments were unnecessary, 70.5% (n=1964) reported having such amendments made (outcome 3). In those who reported their work did not change as a result of risk assessment and who did not indicate it did not need to change, half (49.2%, n=579) reported unfulfilled wishes for workplace adjustments (outcome 4).

A description of the cohort stratified by responses to the two questionnaire items can be found in online supplemental text 3 and online supplemental tables 2 and 3.

Figure 2 and online supplemental tables 4 and 5 show the results of the logistic regression analyses for outcomes 1–4.

Compared with white HCWs, and after adjustment for age, sex occupation and migration status, HCWs from Asian, black and mixed ethnic groups were more likely to report having been offered a risk assessment, and those from Asian and black ethnic groups were more likely to report having completed an assessment if offered. Among those who completed an assessment, HCWs from all ethnic minority groups had lower odds of reporting having their work change as a result of risk assessment, and those from Asian and black ethnic groups were more likely to report no change to their working practices despite wanting it.

Those in dental roles had lower odds than those in medical roles of reporting being offered a risk assessment but higher odds of reporting completing the assessment once offered. Those in AHP roles and those in 'administrative/estates/other' roles were more likely than those in medical roles to report having adjustments made to working practices. Those in nursing, AHP and dental roles were more likely to report not having changes to their working practices despite wanting them.

An increasing number of long-term conditions was positively associated with being offered, completing and having work changed as a result of risk assessment.

HCWs who reported physical contact with patients with COVID-19 during lockdown were less likely than those who did not report being offered, having completed and not having work changed as a result of risk assessment. They were also less likely to want changes but not get them.

A history of SARS-CoV-2 infection was associated with lower odds of being offered a risk assessment and having changes made to working practices.

Among those on the NHS agenda for change pay scales, those in band 1 or 2 were less likely to report being offered a risk assessment than those in band 5. With each band above 5, the OR for reporting being offered a risk assessment increased (table 2).

Among doctors, general practitioners had around one-third of the odds of reporting being offered a risk assessment than consultants but were more likely to report completing a risk assessment once offered (table 3).

In an analysis of complete cases, significant findings were largely unchanged (online supplemental tables 6 and 7).

Table 1 Description of the analysed cohort

Variable	Description N=8649
Ethnicity	
White	5900 (68.2)
Asian	1820 (21.0)
Black	371 (4.3)
Mixed	360 (4.2)
Other	198 (2.3)
Age in years, median (IQR)	44 (34–53)
Missing	43 (0.5)
Sex	
Male	2202 (25.5)
Female	6429 (74.3)
Missing	18 (0.2)
Occupation	
Medical/medical support	2366 (27.4)
Nursing (inc. midwives, nursing associates)	1903 (22.0)
Allied health professionals*	3360 (38.9)
Dental	289 (3.3)
Administrative/estates/other	446 (5.2)
Missing	285 (3.3)
Migration status	
Born in the UK	6249 (72.3)
Born overseas	2379 (27.5)
Missing	21 (0.2)
Exposure to patients with COVID-19 during lockdown	
None (or remote contact only)	4122 (47.7)
Face-to-face with social distancing only	520 (6.0)
Physical contact	3938 (45.5)
Missing	69 (0.8)
Number of long-term physical health conditions†	
0	5819 (67.3)
1	1721 (19.9)
≥2	419 (4.8)
Missing	690 (8.0)
Body mass index (kg/m^2)	
<25	3675 (42.5)
≥25 and <30	2360 (27.3)
≥30	1513 (17.5)
Missing	1101 (12.7)
Perceived risk of being hospitalised with COVID-19 in the next 6 months (scale 0–100), median (IQR)	20 (5–50)
Missing	534 (6.2)
Level of concern about unknowingly spreading COVID-19	
Not at all concerned	1071 (12.4)
A little concerned	3023 (35.0)
Quite concerned	2197 (25.4)
Very concerned	1891 (21.9)
Missing	467 (5.4)
SARS-CoV-2 infection status (on 1 May 2020)	
Uninfected	7075 (81.8)
Infected	1068 (12.4)
Missing	506 (5.9)
Cohabitation with those over 65 years old	
Does not live with someone over the age of 65	7842 (90.7)
Lives with someone over the age of 65	591 (6.8)
Missing	216 (2.5)

Table 1 provides a description of the 8649 HCWs who worked for the NHS during lockdown and at the time of questionnaire response, provided information on their ethnicity and answered the question about being offered risk assessments. All data in the right-hand column are n (%) unless stated otherwise.
*Include pharmacists, health scientists, ambulance workers and those in optical roles.
†Include diabetes, heart disease, hypertension, previous stroke, kidney or liver disease, asthma, lung condition other than asthma, cancer, neurological disease, organ transplant and immunosuppression.
HCWs, healthcare workers; NHS, National Health Service.

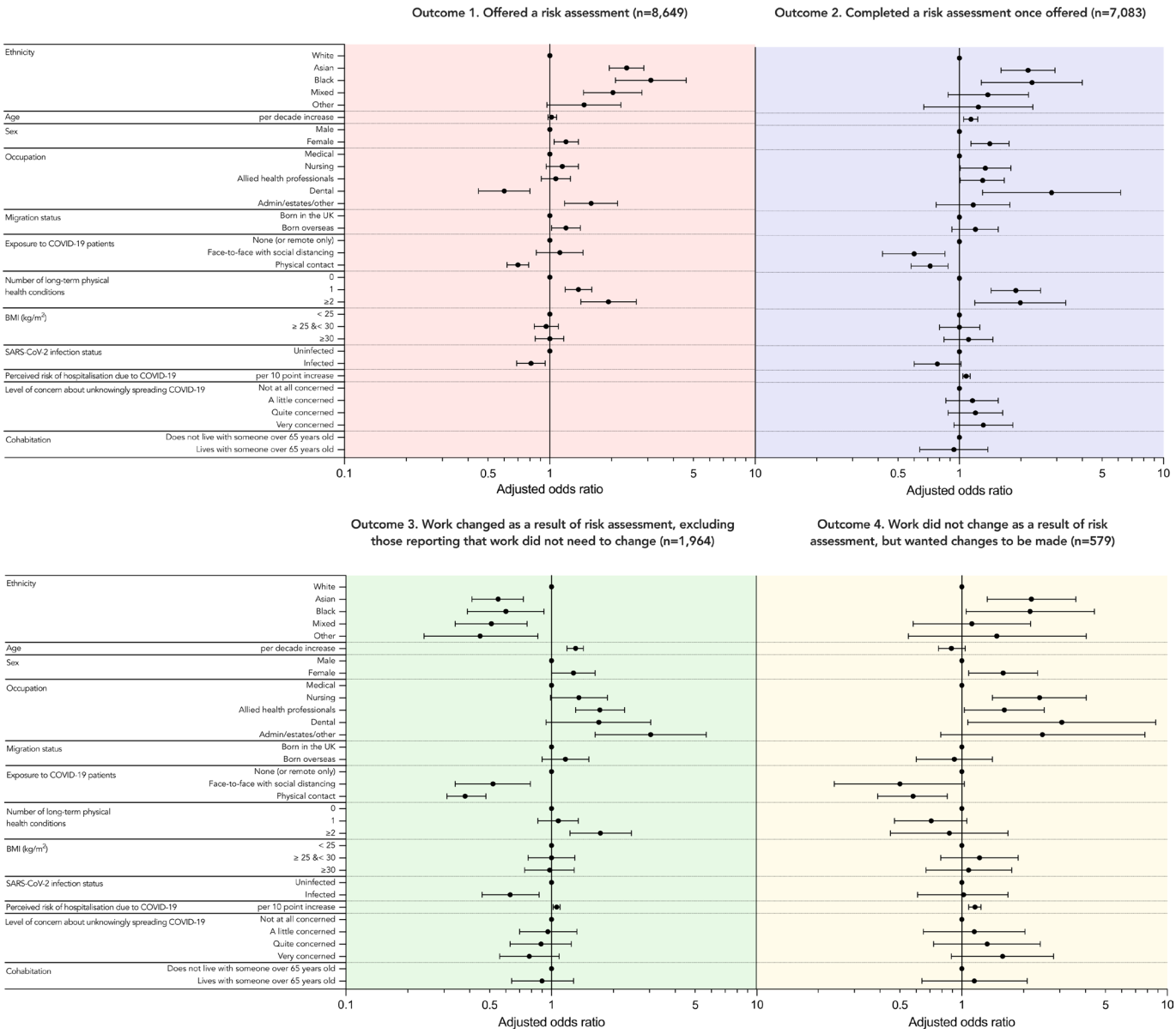


Figure 2 Adjusted ORs and 95% CIs are shown for the association of sociodemographic, occupational and perceived risk variables with four outcomes relating to NHS COVID-19 risk assessments derived from multivariable logistic regression. ORs are adjusted for age, sex, ethnicity, occupation and migration status. All outcome variables are binary and all analyses include only HCWs who were working for the NHS during UK national lockdown and at the time of questionnaire completion. Outcome 1 is whether or not an HCW was offered a COVID-19 risk assessment; the analysed sample includes all HCWs who provided information on their ethnicity and the outcome of interest. Certain risk perception variables were not included in this analysis (as shown by the lack of ORs) as it was felt that these were unlikely to influence being offered a risk assessment. Outcome 2 is whether or not an HCW chose to complete a risk assessment; the analysed sample includes all those in the previous analysis who were offered a risk assessment. Outcome 3 is whether or not changes were made to the working practices of HCWs after the risk assessment; the analysed sample includes HCWs who completed a risk assessment and provided information on the outcome with those indicating that work did not need to change excluded. Outcome 4 is whether or not an HCW wanted changes to be made at work; the analysed sample includes all HCWs who indicated their work did not change, excluding those who indicated that their work did not need to change. Derivation of all outcomes is described in detail in figure 1. In the occupation variable, nursing includes midwives, nursing associates and healthcare assistants; allied health professionals include pharmacists, healthcare scientists, ambulance workers and those in optical roles. BMI, body mass index; HCWs, healthcare workers; NHS, National Health Service.

Significant findings change very little between the unadjusted and adjusted models with the exception of outcome 4 where ethnic differences were attenuated in the unadjusted model (online supplemental table 8). This may be due to differences in the occupational and sex distributions across ethnic groups (shown previously[5]). In an analysis that excludes those without direct contact with a patient with COVID-19, significant findings relating to ethnicity are largely unchanged aside from an attenuation of the estimates for black HCWs (vs white) in outcome 3 (online supplemental table 9).

DISCUSSION

This analysis of a large, ethnically diverse cohort of NHS HCWs has several novel findings. Overall, four in five NHS HCWs reported being offered a COVID-19 risk assessment, and among

Table 2 Association of agenda for change pay band with being offered and completing a risk assessment in a cohort of non-medical staff

	Outcome 1: offered a risk assessment (N=5798) aOR (95% CI)	Outcome 2: completed a risk assessment (N=4736) aOR (95% CI)
Band 1 or 2	0.58 (0.37 to 0.89)	0.60 (0.27 to 1.32)
Band 3 or 4	1.05 (0.79 to 1.41)	1.19 (0.67 to 2.10)
Band 5	Ref	Ref
Band 6	1.27 (1.06 to 1.52)	1.01 (0.73 to 1.40)
Band 7	2.11 (1.71 to 2.61)	1.04 (0.73 to 1.49)
Band 8 and above	3.00 (2.29 to 3.93)	0.76 (0.52 to 1.10)

aOR, adjusted OR.

those offered an assessment, 9 in 10 reported completing one. Ethnic minority groups were more likely to be offered a risk assessment and to complete one once offered compared with white groups. Among those who completed a risk assessment (and did not indicate workplace adjustments were unnecessary), 7 in 10 reported having work adjustments made, but this was less likely for ethnic minority HCWs. Finally, in those whose work did not change (and who and did not indicate workplace adjustments were unnecessary), half (49.2%) reported unfulfilled wishes for workplace adjustments, and this was more likely among HCWs from black and Asian ethnic groups than white groups.

Our findings indicate that ethnicity was being recognised as a risk factor for adverse outcomes from COVID-19 by both NHS employers (evidenced by the higher odds of being offered a risk assessment in ethnic minority groups compared with white groups) and by individual HCWs (evidenced by the higher odds of completing an assessment once offered in ethnic minority groups compared with white groups). While ethnicity was proven a major factor in mediating the risk of SARS-CoV-2 infection in HCWs[1 7 23] and, therefore, represents an important criterion to include in COVID-19 risk assessments, it is important to note that targeting risk assessments at those from ethnic minority groups has the potential to create stigma;[24 25] thus, adopting the recommended approach of a universal risk assessment that takes account of ethnicity may be preferable.[16]

Table 3 Association of grade with being offered and completing a risk assessment in a cohort of medical staff

	Outcome 1: offered a risk assessment (N=2332) aOR (95% CI)	Outcome 2: completed a risk assessment (N=1969) aOR (95% CI)
Foundation trainee	0.69 (0.38 to 1.25)	0.86 (0.38 to 1.94)
Core trainee	0.57 (0.33 to 0.97)	0.85 (0.39 to 1.83)
Specialty trainee	0.71 (0.48 to 1.05)	1.14 (0.65 to 2.00)
Consultant	Ref	Ref
General practitioner	0.36 (0.27 to 0.49)	2.06 (1.17 to 3.64)
Other	0.73 (0.27 to 1.95)	0.55 (0.18 to 1.67)

ORs in tables 2 and 3 are adjusted for age, sex, ethnicity and migration status. As agenda for change pay band increases so does salary. Band 5 is the level of a newly qualified nurse. In the analysis of medical staff, a foundation trainee is a newly qualified doctor in the first 2 years of training after medical school; a core trainee has completed foundation training and selected a broad area of specialisation (such as acute care, medicine, surgery or psychiatry) but not yet started specialty training; a specialty trainee (otherwise known as a registrar) has completed core training and is undertaking training in a particular specialty area; a consultant has completed training in a particular specialty; a general practitioner is a doctor who has completed training in general practice and typically works in the community rather than in hospital.
aOR, adjusted OR.

Given that the NHS did recognise that risk assessments should consider ethnicity,[15 26] it is surprising that ethnic minority HCWs were less likely to have adjustments made (after exclusion of those who reported work adjustments were unnecessary). This is driven both by the increased proportion of ethnic minority HCWs (compared with white HCWs) reporting not wanting changes made and those reporting wanting changes made and not getting them. Previous work has suggested that clinicians from ethnic minority groups experience a dilemma of choosing between their clinical and leadership responsibilities and risks to their own health and that of their loved ones from COVID-19.[24 27] Such dilemmas may also partly explain our finding that those who had physical contact with patients with COVID-19 were less likely to have work changed after a risk assessment than those who had no (or remote) contact only. Additionally, HCWs may fear barriers to career progression that could follow redeployment or other workplace amendments and such concerns may not affect different ethnic groups equally.[13] They may also fear being judged negatively by colleagues.[24] Race discordance between managers and staff may make conversations around risk assessment more difficult.[24] It should also be noted that there has been criticism of the lack of consistency across the NHS in the risk assessment process[13] with experiences ranging from informal conversations with managers to meetings with formal documentation.[24] Therefore, it is possible that not all risk assessments took ethnicity into account.

Explanations for the increased likelihood for ethnic minority staff to indicate that they wanted changes to be made but did not happen may relate to structural discrimination. It has been suggested that ethnic minority HCWs feel less empowered to ask for risk assessments,[13] which in itself may be related to factors such as a lack of trust in their employing organisation[21] or due to their experiences of harassment or bullying at work.[28] These same factors may also influence not feeling empowered to ask for changes to working practices from employers/managers. Specific occupational characteristics such as seniority within a healthcare team (a factor we show to be important in influencing decisions around risk assessment) or healthcare specialty may also impact upon risk assessment outcome. Ethnic minority HCWs are more likely to work in junior positions,[28] which may involve greater patient contact. It may, therefore, be more difficult for employers/managers to usefully redeploy these HCWs into different roles or make amendments to their level of contact with patients when compared with a more senior HCW who could take on greater administrative responsibilities at the expense of patient contact. This may also explain why staff in administrative roles are more likely to have workplace adjustments made than medical staff. Establishing the groups of HCWs who had unfulfilled wishes for workplace adjustment is of critical importance. HCWs continuing to work in an environment where they feel at risk is likely to have a detrimental effect on well-being and undermine trust in employing organisation (a factor shown to relate to other ethnic inequalities in HCWs such as vaccine hesitancy).[29]

General practitioners and those in dental roles had lower odds of being offered risk assessments than consultants or medical staff, respectively. This may be due to evidence suggesting that community HCWs are at lower risk of COVID-19[5] than hospital staff, which might lead to the perception that risk assessment was less important in these groups. Community HCWs may also have less access to occupational health services than their counterparts in acute trusts, which could account for these differences.[30]

Previous COVID-19 was associated with lower odds of being offered and having adjustments made as a result of risk assessment. SARS-CoV-2 infection provides immune protection against reinfection and thus might represent an important factor to be taken account of during risk assessment. However, this protection wanes and may be evaded by new SARS-CoV-2 variants.[31 32] It would be important to reassess such people in the light of current knowledge, particularly considering the risk of morbidity from long COVID.

Our work has several limitations: we are unable to determine the exact outcome of individual risk assessments. We have assumed that staff assessed as being at low risk by whichever risk assessment tool was employed would respond to the question about whether workplace changes were made with 'No, because it did not need to'. It is possible, however, that such HCWs could respond with 'No, but I wanted it to' if the risk assessment outcome was discordant with the HCWs' perceived level of risk. We are also unable to determine whether changes made to working practices were appropriate and acceptable to the HCWs.

Selection bias may have affected our results. HCWs who responded to our survey may also be more likely to respond to an offer of a COVID-19 risk assessment; therefore, we may have overestimated the proportion of HCWs who completed an assessment once offered. As we administered the questionnaire in December 2020 and ask about occupational circumstances at the time of the first UK lockdown in March 2020, we may have introduced recall bias. The cross-sectional nature of the study means we cannot be definitive about the direction of any association; however, in planning our analysis, we were careful to omit variables that may have been particularly affected by reverse causality from the models. We did not ask participants for the date of their risk assessment. We have, therefore, used variables concerning SARS-CoV-2 infection and exposure that we can be sure predate the roll-out of NHS COVID-19 risk assessments; however, these may not accurately reflect the occupational circumstances of the HCWs at the time of risk assessment. Through exclusion of those not working during lockdown and at the time of questionnaire response, we will have excluded some HCWs who were 'shielding' (ie, avoiding contact with others as a means of protecting themselves against infection). These HCWs are likely to have had changes made to their working practices as they will be among the most vulnerable to severe COVID-19; therefore, this could lead to underestimating the proportion of HCWs who had adjustments made to working practices. Furthermore, it is possible that risk assessment (whether formal or informal) occurred at some point prior to the first UK national lockdown; therefore, in some cases, our occupational COVID-19 exposure variable may result in occupational circumstances after risk assessment. We do not account for clustering by NHS Trust; authors do not have access to the specific NHS Trusts at which participants work to protect confidentiality. Previous work in this cohort which stratified respondents by region of workplace[5 18 33] did not indicate that any particular region was dominant; thus, we do not anticipate that this had a major impact on results.

Universal risk assessments, which are repeated to take account of changing risk factors, such as vaccination, new variants of SARS-CoV-2, changing job roles and personal protective equipment access, are critical to protect HCWs against SARS-CoV-2 infection and its sequelae. We have determined that a large proportion of NHS staff have completed a COVID-19 risk assessment and that there are ethnic differences in NHS COVID-19 risk assessment outcomes. While it is encouraging that employers seem to have taken account of the increased risk of infection and severe outcomes from COVID-19 faced by ethnic minority HCWs when offering risk assessments, we caution that the likelihood of workplace adjustments being made after risk assessment may be lower in those from ethnic minority groups than white groups. These findings are concerning and warrant further research in a larger, unselected cohort.

Author affiliations
[1]Department of Respiratory Sciences, University of Leicester, Leicester, UK
[2]Department of Infection and HIV Medicine, University Hospitals of Leicester NHS Trust, Leicester, UK
[3]Research Department of Medical Education, University College London Medical School, London, UK
[4]Department of Occupational Health, University Hospitals of Leicester NHS Trust, Leicester, UK
[5]Queen Square Insitute of Neurology and National Hospital for Neurology and Neurosurgery, University College London Hospitals NHS Foundation Trust, London, UK
[6]Department of Infectious Diseases, London North West University Healthcare NHS Trust, Harrow, UK
[7]Population and Lifespan Sciences, University of Nottingham, Nottingham, UK
[8]Public Health Institute, Liverpool John Moores University, Liverpool, UK
[9]School of Law, University of Leicester, Leicester, UK
[10]Diabetes Research Centre, University of Leicester, Leicester, UK

Twitter Manish Pareek @drmanpareek

Acknowledgements We would like to thank all the healthcare workers who took part in this study when the NHS was under immense pressure. We wish to acknowledge the members of the UK-REACH Professional Expert Panel (Amir Burney, Association of Pakistani Physicians of Northern Europe; Tiffanie Harrison, London North West University Healthcare NHS Trust; Ahmed Hashim, Sudanese Doctors Association; Sandra Kazembe, University Hospitals Leicester NHS Trust; Susie M Lagrata (Co-chair), Filipino Nurses Association-UK and University College London Hospitals NHS Foundation Trust; Satheesh Mathew, British Association of Physicians of Indian Origin; Juliette Mutuyimana, Kingston Hospitals NHS Trust; Padmasayee Papineni (Co-chair), London North West University Healthcare NHS Trust), and the Steering and Advisory Group, and SERCO, as well as the following people for their support in setting up the study from the regulatory bodies: Kerrin Clapton and Andrew Ledgard (General Medical Council), Caroline Kenny (Nursing and Midwifery Council), David Teeman and Lisa Bainbridge (General Dental Council), My Phan and John Tse (General Pharmaceutical Council), Angharad Jones and Marcus Dye (General Optical Council), Charlotte Rogers (The Health and Care Professions Council) and Mark Neale (Pharmaceutical Society of Northern Ireland). We would also like to acknowledge the following trusts and sites that recruited participants to the study: Nottinghamshire Healthcare NHS Foundation Trust, University Hospitals Leicester, Lancashire Teaching Hospitals NHS Foundation Trust, Northumbria Healthcare, Berkshire Healthcare, Derbyshire Healthcare NHS Foundation Trust, South Tees NHS Foundation Trust, Birmingham and Solihull NHS Foundation Trust, Affinity Care, Royal Brompton and Harefield, Sheffield Teaching Hospitals, St George's Hospital, Yeovil District Hospital, Lewisham and Greenwich NHS Trust, Black Country Community Healthcare NHS Foundation Trust, Sussex Community NHS Foundation Trust, South Central Ambulance Service, University Hospitals Coventry and Warwickshire, University Hospitals Southampton NHS Foundation Trust, London Ambulance Trust, Royal Free, Birmingham Community Healthcare NHS Foundation Trust, Central London Community Healthcare, Chesterfield Royal Hospital, Bridgewater Community Healthcare, Northern Borders, County Durham and Darlington Foundation Trust, Walsall Healthcare NHS Trust.

Collaborators Manish Pareek (chief investigator), Laura Gray (University of Leicester), Laura Nellums (University of Nottingham), Anna L Guyatt (University of Leicester), Catherine John (University of Leicester), I Chris McManus (University College London), Katherine Woolf (University College London), Ibrahim Abubakar (University College London), Amit Gupta (Oxford University Hospitals), Keith R Abrams (University of York), Martin D Tobin (University of Leicester), Louise Wain (University of Leicester), Sue Carr (University Hospital Leicester), Edward Dove (University of Edinburgh), Kamlesh Khunti (University of Leicester), David Ford (University of Swansea), Robert Free (University of Leicester).

Contributors MP conceived of the idea for UK-REACH and led the application for funding with input from KW, LN, KK and the study collaborative group. The questionnaire was designed by CAM, KW, LB, LN, KK, MP and the study collaborative group. Online consent and questionnaire tools were developed by LB. CAM, KW and MP formulated the idea for the analysis and contributed to the analysis plan. CAM analysed the data with input from KW and MP. CAM drafted the manuscript with

input from KW and MP. SL and PP are members of the professional expert panel. All authors reviewed, edited and approved the final version of the manuscript for publication. MP acts as guarantor for this work.

Funding UK-REACH is supported by a grant from the MRC-UK Research and Innovation (MR/V027549/1) and the Department of Health and Social Care through the National Institute for Health Research (NIHR) rapid response panel to tackle COVID-19. Core funding was also provided by NIHR Biomedical Research Centres. KW is funded through an NIHR Career Development Fellowship (CDF-2017-10- 008). LN is supported by an Academy of Medical Sciences Springboard Award (SBF005\1047). KK and LG are supported by the National Institute for Health Research (NIHR) Applied Research Collaboration East Midlands (ARC EM, NIHR200171). KK and MP are supported by the NIHR Leicester Biomedical Research Centre (BRC). MP is funded by an NIHR Development and Skills Enhancement Award (NIHR301192). This work is carried out with the support of BREATHE-The Health Data Research Hub for Respiratory Health (MC_PC_19004) in partnership with SAIL Databank. BREATHE is funded through the UK Research and Innovation Industrial Strategy Challenge Fund and delivered through Health Data Research UK.

Competing interests KK is Director of the University of Leicester Centre for Black Minority Ethnic Health, Trustee of the South Asian Health Foundation and Chair of the Ethnicity Subgroup of the UK Government Scientific Advisory Group for Emergencies (SAGE). MP reports grants from Sanofi, grants and personal fees from Gilead Sciences and personal fees from QIAGEN, outside the submitted work.

Patient consent for publication Not required.

Ethics approval This study involves human participants and was approved by Brighton and Sussex Research Ethics Committee (ethics reference: 20/HRA/4718). All participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. To access data or samples produced by the UK-REACH Study, the working group representative must first submit a request to the Core Management Group by contacting the UK-REACH Project Manager in the first instance. For ancillary studies outside of the core deliverables, the Steering Committee will make final decisions once they have been approved by the Core Management Group. Decisions on granting the access to data/materials will be made within 8 weeks. Third-party requests from outside the project will require explicit approval of the Steering Committee once approved by the Core Management Group. Note that should there be significant numbers of requests to access data and/or samples, then a separate Data Access Committee will be convened to appraise requests in the first instance.

ORCID iD

Manish Pareek http://orcid.org/0000-0003-1521-9964

REFERENCES

1 Nguyen LH, Drew DA, Graham MS, *et al*. Risk of COVID-19 among front-line health-care workers and the general community: a prospective cohort study. *The Lancet Public Health* 2020;5:e475–83.
2 Martin CA, Jenkins DR, Minhas JS, *et al*. Socio-demographic heterogeneity in the prevalence of COVID-19 during Lockdown is associated with Ethnicity and household size: results from an observational cohort study. *EClinicalMedicine* 2020;25:100466.
3 Sze S, Pan D, Nevill CR, *et al*. Ethnicity and clinical outcomes in COVID-19: A systematic review and meta-analysis. *EClinicalMedicine* 2020;29–30:100630.
4 Martin CA, Pan D, Hills G, *et al*. Predictors of adverse outcome in the first and second waves of the COVID-19 pandemic: results from a UK centre. *Ther Adv Infect Dis* 2022;9:20499361221074569.
5 Martin CA, Pan D, Melbourne C, *et al*. Risk factors associated with SARS-Cov-2 infection in a Multiethnic cohort of United Kingdom Healthcare workers (UK-REACH): A cross-sectional analysis. *PLoS Med* 2022;19:e1004015.
6 Martin CA, Patel P, Goss C, *et al*. Demographic and occupational determinants of anti-SARS-Cov-2 IgG Seropositivity in hospital staff. *J Public Health* 2022;44:234–45.
7 Shields A, Faustini SE, Perez-Toledo M, *et al*. SARS-Cov-2 Seroprevalence and asymptomatic viral carriage in Healthcare workers: a cross-sectional study. *Thorax* 2020;75:1089–94.
8 Mathur R, Rentsch CT, Morton CE, *et al*. Ethnic differences in SARS-Cov-2 infection and COVID-19-related Hospitalisation, intensive care unit admission, and death in 17 million adults in England: an observational cohort study using the Opensafely platform. *Lancet* 2021;397:1711–24.
9 MacKenna B, Curtis HJ, Morton CE, *et al*. n.d. Trends, regional variation, and clinical characteristics of COVID-19 vaccine recipients: a retrospective cohort study in 23.4 million patients using Opensafely. *MedRxiv*;2021:2021.
10 Katikireddi SV, Lal S, Carrol ED, *et al*. Unequal impact of the COVID-19 crisis on minority ethnic groups: a framework for understanding and addressing inequalities. *J Epidemiol Community Health* 2021;75:970–4.
11 NHS England. Important and urgent – next steps on NHS response to COVID-19. 2020. Available: https://www.england.nhs.uk/coronavirus/documents/important-and-urgent-next-steps-on-nhs-response-to-covid-19/ [Accessed 7 Oct 2022].
12 NHS England. *Second phase of NHS response to COVID-19*. 2020.
13 Iacobucci G. Covid-19: many trusts have not done risk assessments for ethnic minority staff, BMJ investigation finds. *BMJ* 2020;370:m2792.
14 British Medical Association. *BMA COVID-19 tracker survey*. 2021.
15 Khunti K, Bono A, Browne I, *et al*. Risk reduction framework for NHS staff at risk of COVID-19 infection. 2020. Available: https://madeinheene.hee.nhs.uk/Portals/0/Risk%20Assessment%20Framework%20for%20NHS%20Staff_1.pdf [Accessed 22 Aug 2022].
16 Khunti K, Griffiths A, Majeed A, *et al*. Assessing risk for Healthcare workers during the COVID-19 pandemic. *BMJ* 2021;372:602.
17 Martin CA, Woolf K, Bryant L, *et al*. Persistent hesitancy for SARS-Cov-2 vaccines among Healthcare workers in the United Kingdom: analysis of longitudinal data from the UK-REACH cohort study. *Lancet Reg Health Eur* 2022;13:100299.
18 Bryant L, Free RC, Woolf K, *et al*. Cohort profile: the United Kingdom research study into Ethnicity and COVID-19 outcomes in Healthcare workers (UK-REACH). *Int J Epidemiol* 2023;52:e38–45.
19 Woolf K, Melbourne C, Bryant L, *et al*. The United Kingdom research study into Ethnicity and COVID-19 outcomes in Healthcare workers (UK-REACH): protocol for a prospective longitudinal cohort study of Healthcare and ancillary workers in UK Healthcare settings. *BMJ Open* 2021;11:e050647.
20 Office for National Statistics. Ethnic group, national identity and religion [Available from]. n.d. Available: https://www.ons.gov.uk/methodology/classificationsandstandards/measuringequality/ethnicgroupnationalidentityandreligion
21 Woolf K, McManus IC, Martin CA, *et al*. Ethnic differences in SARS-Cov-2 vaccine hesitancy in United Kingdom Healthcare workers: results from the UK-REACH prospective nationwide cohort study. *Lancet Reg Health Eur* 2021;9:100180.
22 Rubin DB. Inference and missing data. *Biometrika* 1976;63:581–92.
23 Martin CA, Marshall C, Patel P, *et al*. SARS-Cov-2 vaccine uptake in a multi-ethnic UK Healthcare workforce: A cross-sectional study. *PLoS Med* 2021;18:e1003823.
24 Qureshi I, Gogoi M, Wobi F, *et al*. Healthcare workers from diverse Ethnicities and their perceptions of risk and experiences of risk management during the COVID-19 pandemic: qualitative insights from the United Kingdom-REACH study. *Front Med (Lausanne)* 2022;9:930904.
25 Jesuthasan J, Powell RA, Burmester V, *et al*. We weren't checked in on, nobody spoke to us': an exploratory qualitative analysis of two focus groups on the concerns of ethnic minority NHS staff during COVID-19. *BMJ Open* 2021;11:e053396.
26 Clift AK, Coupland CAC, Keogh RH, *et al*. Living risk prediction algorithm (QCOVID) for risk of hospital admission and mortality from Coronavirus 19 in adults: national derivation and validation cohort study. *BMJ* 2020;371:m3731.
27 Shah N, Ahmed IM, Nazir T. Torn between caution and compassion: a dilemma for Clinicians from black and minority ethnic groups during the COVID-19 pandemic. *J Racial Ethn Health Disparities* 2021;8:21–3.
28 NHS England. NHS workforce race equality standard 2022. Available: https://www.england.nhs.uk/wp-content/uploads/2022/04/Workforce-Race-Equality-Standard-report-2021-.pdf [Accessed 18 Aug 2022].
29 Veli N, Martin CA, Woolf K, *et al*. Hesitancy for receiving regular SARS-Cov-2 vaccination in UK Healthcare workers: a cross-sectional analysis from the UK-REACH study. *BMC Med* 2022;20:386.
30 Tonkin T. Occupational health access – because they're worth it: British Medical Association. 2021. Available: https://www.bma.org.uk/news-and-opinion/occupational-health-access-because-they-re-worth-it [Accessed 7 Oct 2022].
31 Townsend JP, Hassler HB, Wang Z, *et al*. The durability of immunity against Reinfection by SARS-Cov-2: a comparative evolutionary study. *Lancet Microbe* 2021;2:e666–75.
32 Chemaitelly H, Ayoub HH, AlMukdad S, *et al*. Duration of mRNA vaccine protection against SARS-Cov-2 Omicron BA.1 and BA.2 Subvariants in Qatar. *Nat Commun* 2022;13.
33 Martin CA, Pan D, Nazareth J, *et al*. Access to personal protective equipment in Healthcare workers during the COVID-19 pandemic in the United Kingdom: results from a nationwide cohort study (UK-REACH). *BMC Health Serv Res* 2022;22:867.

Supplementary information

Coverage, completion and outcomes of COVID-19 risk assessments in a multi-ethnic nationwide cohort of UK healthcare workers: a cross sectional analysis from the UK-REACH study

Christopher A. Martin[1,2], Katherine Woolf[3], Luke Bryant[1], Charles Goss[4], Mayuri Gogoi[1], Susie Lagrata[5], Padmasayee Papineni[6], Irtiza Qureshi[7], Fatimah Wobi[8,9], Laura B. Nellums[7], Kamlesh Khunti[10], Manish Pareek[1,2]

On behalf of the UK-REACH Study Collaborative Group+

Corresponding author mp426@le.ac.uk

+Manish Pareek (Chief investigator), Laura Gray (University of Leicester), Laura Nellums (University of Nottingham), Anna L Guyatt (University of Leicester), Catherine John (University of Leicester), I Chris McManus (University College London), Katherine Woolf (University College London), Ibrahim Abubakar (University College London), Amit Gupta (Oxford University Hospitals), Keith R Abrams (University of York), Martin D Tobin (University of Leicester), Louise Wain (University of Leicester), Sue Carr (University Hospital Leicester), Edward Dove (University of Edinburgh), Kamlesh Khunti (University of Leicester), David Ford (University of Swansea), Robert Free (University of Leicester).

1. Department of Respiratory Sciences, University of Leicester, Leicester, UK

2. Department of Infection and HIV Medicine, University Hospitals of Leicester NHS Trust, Leicester, UK

3. University College London Medical School, London, UK

4. Department of Occupational Health, University Hospitals of Leicester NHS Trust

5. University College London Hospitals NHS Foundation Trust, Leicester, UK

6. Department of Infectious Diseases, Ealing Hospital, London North West University Healthcare NHS Trust, London

7. Population and Lifespan Sciences, School of Medicine, University of Nottingham, Nottingham, UK

8. Public Health Institute, Liverpool John Moores University, Liverpool, UK

9. School of Law, University of Leicester, Leicester, UK

10. Diabetes Research Centre, University of Leicester, Leicester, UK

Supplementary information

Supplementary Text 1. UK-REACH – overview and recruitment

Overview

UK-REACH is a research programme consisting of multiple sub-studies. The overarching aim of the programme is to determine whether, and to what degree, there has been a disproportionate impact of the COVID-19 pandemic on ethnic minority HCWs.

This work uses data from the baseline questionnaire of the nationwide cohort study, which was administered between December 2020 and March 2021. Details of the design, sampling and measures included in the questionnaire can be found in the study protocol[15], the cohort profile[16], the data dictionary (https://www.uk-reach.org/data-dictionary), and in other published work[6 17-19].

Recruitment

We recruited individuals aged 16 years or over, living in the UK and employed as HCWs or ancillary workers in a healthcare setting and/or registered with one of seven major UK professional regulatory bodies:

- The General Medical Council (GMC)
- The Nursing and Midwifery Council (NMC)
- The General Dental Council (GDC)
- The Health and Care Professions Council (HCPC)
- The General Optical Council (GOC)
- The General Pharmaceutical Council (GPC)
- The Pharmaceutical Society of Northern Ireland (PSNI)

Professional regulators distributed emails to their registrants embedded with a hyperlink to the study website. Those interested could create a user profile, read the participant information sheet and, provided they were willing, sign an online consent form. Participants were then asked to complete the online questionnaire. The sample was supplemented by recruitment of eligible HCWs through

participating healthcare Trusts, and advertising on social media and in newsletters. These participants were also provided with a link to the study website and followed the same procedure as above.

Participation rates at each stage are reported as recommended by the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).

We recruited individuals aged 16 years or over, living in the UK and employed as HCWs or ancillary workers in a healthcare setting and/or registered with one of seven major UK professional regulatory bodies.

Professional regulators distributed emails to their registrants embedded with a hyperlink to the study website. Those interested could create a user profile, read the participant information sheet and, provided they were willing, sign an online consent form. Participants were then asked to complete the online questionnaire. The sample was supplemented by recruitment of eligible HCWs through participating healthcare Trusts, and advertising on social media and in newsletters. These participants were also provided with a link to the study website and followed the same procedure as above.

Participation rates at each stage are reported as recommended by the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).

Supplementary Text 2. Involvement and engagement

We worked closely with a Professional Expert Panel of HCWs from a range of ethnic backgrounds, healthcare occupations, and sexes, as well as with national and local organisations (see study protocol).[20] The panel were involved in the design of the survey instruments and assisted in developing the research question and analysis plan. Some members have critically reviewed the manuscript and are co-authors on the study.

Supplementary information

Supplementary Text 3. Description of the cohort by responses to questionnaire items

Responses to questionnaire item 1 - "Have you been offered an NHS COVID-19 risk assessment at work?"

6,575 (76.0%) of HCWs reported that they had been offered a risk assessment and chose to complete it; 508 (5.9%) reported being offered a risk assessment but choosing not to complete it; 1,022 (11.8%) reported not being offered a risk assessment and 544 (6.3%) reported having not heard of COVID-19 risk assessments (Supplementary Table 2).

The proportion of those who reported not having heard of COVID-19 risk assessments was lower in Asian and Black ethnic groups when compared to the proportion of the total cohort from these ethnic groups (Asian 11.6% vs 21.0%, Black 1.5% vs 4.3%). A similar pattern was seen for reporting not being offered a risk assessment (Asian 12.6% vs 21.0%, Black 2.1% vs 4.3%) and for being offered a risk assessment but not completing it (Asian 14.6% vs 21.0%, Black 2.8% vs 4.3%).

Compared to the cohort as a whole, the proportion of those reporting not having heard of COVID-19 risk assessments who were working in medical roles were lower (21.8% vs 28.3%) and allied health professional roles were higher (48.5% vs 40.2%). The proportion of those who were offered a risk assessment and chose not to complete it who worked in dental roles was lower than the proportion of dentists in the cohort (1.4% vs 3.3%).

A higher proportion of HCWs who reported being offered but not completing a risk assessment and not having heard of risk assessments had no long-term physical health conditions (83.1% and 83.4 %) when compared to the whole cohort (73.1%).

Median score on the perceived risk of COVID-19 hospitalisation scale in the group who reported being offered but not completing a risk assessment was half that of the cohort overall (10 IQR 5 – 30 vs 20 IQR 5 – 50).

Responses to questionnaire item 2 - "Did your work change as a result of the NHS COVID-19 risk assessment result?"

Supplementary information

6,543 HCWs who reported having completed a risk assessment provided information on whether their work changed as a result. 4,579 (70.0%) reported their work did not change because it did not need to; 294 (4.5%) reported that their work did not change because they didn't want it to; 285 (4.4%) reported that their work didn't change but they wanted it to; 1,385 (21.2%) reported that their work had changed in some way (Supplementary Table 3).

When compared to the total proportions of those who completed a risk assessment, a higher proportion of the HCWs who reported that their work did not change as a result of the risk assessment because they did not want it to were from ethnic minority groups (Asian 35.0% vs 23.6%; Black 6.1% vs 5.0%; Mixed 9.2% vs 4.5%; Other 4.1% vs 2.3%). A similar pattern was seen amongst those who reported that their work didn't change but they wanted it to (Asian 40.4% vs 23.6%; Black 9.1% vs 5.0%; Mixed 7.4% vs 4.5%; Other 3.2% vs 2.3%).

There were a smaller proportion of female HCWs in the group reporting that their work did not change because they didn't want it to when compared to the total cohort who reported completing a risk assessment (62.5% vs 74.9%).

A higher proportion of those reporting that their work did not change because they did not want it to were working in medical roles than the proportion of those in medical roles within the whole cohort who completed a risk assessment (43.1% vs 29.0%). Nurses made up a larger proportion of the group reporting that their work did not change despite wanting it to (27.0% vs 22.7%).

When comparing the group of HCWs who reported that their work did not change because they didn't want it to with the cohort who completed a risk assessment, a much high proportion were made up of those who reported physical contact with COVID-19 patients during lockdown (61.2% vs 44.2%) the same group made up a smaller proportion of the group who reported having changes made to working practices after risk assessment (29.7% vs 44.2%).

Supplementary information

Supplementary Table 1. Derivation of variables used in the analysis

Variable	Description
Ethnicity	Categorical variable. Participants were asked to select their ethnicity from a list of the 18 Office for National Statistics categories: Asian/Asian British – Indian Asian/Asian British – Pakistani Asian/Asian British – Bangladeshi Asian/Asian British – Chinese Asian/Asian British - Any other Asian background Black/African/Caribbean/Black British - African Black/African/Caribbean/Black British – Caribbean Black/African/Caribbean/Black British - Any other Black/African/Caribbean background Mixed/Multiple ethnic groups - White and Black Caribbean Mixed/Multiple ethnic groups - White and Black African Mixed/Multiple ethnic groups - White and Asian Mixed/Multiple ethnic groups - Any other Mixed/multiple ethnic background White - English/Welsh/Scottish/Northern Irish/British White – Irish White - Gypsy or Irish Traveller White - Any other white background Other ethnic group – Arab Other ethnic group - Any other ethnic background These were categorised into the 5 broader Office for National Statistics ethnicity categories (Asian, Black, Mixed, White, Other).
Age	Continuous variable. Age in years. Derived from date of birth entered by participants at registration.
Sex	Binary variable. Participants were asked their sex assigned at birth.
Migration status	Binary variable - Born in the UK vs Born overseas. Participants were asked whether they were born in the UK.
Occupation	Categorical variable. Participants were asked to select their main job/role. Categorised as below: **Doctor or medical support** - Doctor, Advanced Critical Care Practitioner, Anaesthesia associate, Surgical Care Practitioner, Other medical associate **Nurse, NA or Midwife -** Advanced Nurse Practitioner, Healthcare assistant, Maternity support worker, Midwife, Nurse, Nursing Associate, Other nursing and midwifery role, **Allied Health Professional (including pharmacists, ambulance workers and those in optical roles)** - Arts therapist, Biomedical scientist, Chiropodist/Podiatrist, Clinical scientist, Dietician, Hearing aid dispenser, Occupational therapist, Operating department practitioner, Orthoptist, Physiotherapist, Practitioner psychologist, Prosthetist / Orthotist, Radiographer, Speech and language therapist, Other Allied Health Professional role, Emergency medical , Paramedic , Other ambulance role, OT Support , Phlebotomist, Physiotherapy Assistant, Radiography Other clinical support role , Pharmacist , Pharmacy technician, Other pharmacy role, Optical - Dispensing optician, Optometrist, Other Optical role **Dental -** Clinical dental technician, Dental Hygienist, Dental nurse, Dental technician, Dentist, Other dental role **Admin, estates or other –** Administration, Catering services, Domestic services, Estates services, Porter, Other
Level of exposure to COVID-19 patients during lockdown.	Categorical variable (ordered). Participants were asked how many COVID-19 patients they attended to on a weekly basis during lockdown. There were three separate questions relating to how many patients they saw i) remotely; ii) face-to-face with social distancing; iii) with physical contact. These questions were used to derive a variable which indicates the 'closest contact' the participant indicated they had with COVID-19 patients i.e. no contact (or remote contact only), face-to-face with social distancing but no physical contact or physical contact.
Number of long-term physical health conditions.	Categorical variable (ordered). Number of long-term physical health conditions from a selection of diabetes, hypertension, heart disease, asthma, lung disease (other than asthma), kidney or liver disease, neurological disease, cancer, immunosuppression or organ transplant (categorised as 0, 1 or ≥2).

Supplementary information

Body mass index	Categorical variable (ordered). Participants were asked to enter their height and weight. This was used to derive body mass index in kg/m^2. This was categorised using recognised cut-off values into <25, 25 – 30 and ≥30.
Previous SARS-CoV-2 infection status.	Binary variable. Uninfected vs infected. Self-reported confirmed or suspected SARS-CoV-2 infection status on 1st May 2020 (categorised as uninfected and infected). As we do not have information on date of risk assessment, we selected this threshold date to balance the likelihood that the infection event occurred before a risk assessment took place and to capture enough infection events to determine the association between infection status and our outcome measures.
Perceived risk of hospitalisation with COVID-19 after infection with SARS-CoV-2	Continuous variable. Participants were asked " If you do catch coronavirus, what do you think are¬†your¬†chances of needing hospital treatment? Please enter a value on a scale from 0 to 100, where 0 means there is no possibility that you will and 100 means that you definitely will."
Perceived risk of unknowingly spreading COVID-19	Categorical variable (ordered). Participants were asked " How concerned are you that you might unknowingly spread COVID-19 to others?" and could answer on the following scale " 1, Not at all concerned | 2, A little concerned | 3, Quite concerned | 4, Very concerned | 99, Prefer not to answer"
Cohabitation with those over 65 years old	Binary variable. Either does or does not live with someone over the age of 65 years. Participants were asked to give the ages of each member of their household.

For further information on questionnaire variables, refer to the UK-REACH data dictionary (https://www.uk-reach.org/data-dictionary).

Supplementary information

Supplementary Table 2. Description of the cohort stratified by response to the questionnaire item "Have you been offered an NHS COVID-19 risk assessment at work?"

Variable	Total N=8649	Not heard of COVID-19 risk assessments N=544	Not been offered a COVID-19 risk assessment N=1,022	Offered a COVID-19 risk assessment but chose not to complete it N=508	Offered a COVID-19 risk assessment and completed it N=6,575
Ethnicity					
White	5,900 (68.2)	437 (80.3)	833 (81.5)	385 (75.8)	4,245 (64.6)
Asian	1,820 (21.0)	63 (11.6)	129 (12.6)	74 (14.6)	1,554 (23.6)
Black	371 (4.3)	8 (1.5)	21 (2.1)	14 (2.8)	328 (5.0)
Mixed	360 (4.2)	20 (3.7)	24 (2.4)	22 (4.3)	294 (4.5)
Other	198 (2.3)	16 (2.9)	15 (1.5)	13 (2.6)	154 (2.3)
Age in years, med (IQR)	44 (34-53)	43 (33 – 53)	45 (35 – 54)	43 (33 – 52)	44 (34 – 53)
Sex					
Male	2,202 (25.5)	166 (30.7)	238 (23.3)	150 (29.6)	1,648 (25.1)
Female	6,429 (74.5)	374 (69.3)	783 (76.7)	356 (70.4)	4,916 (74.9)
Occupation					
Medical / medical support	2,366 (28.3)	114 (21.8)	254 (26.0)	148 (30.0)	1,850 (29.1)
Nursing (inc. midwives, nursing associates)	1,903 (22.8)	107 (20.4)	243 (24.9)	107 (21.7)	1,446 (22.7)
Allied health professionals*	3,360 (40.2)	254 (48.5)	388 (39.7)	199 (40.4)	2,519 (39.6)
Dental	289 (3.5)	29 (5.5)	50 (5.1)	7 (1.4)	203 (3.2)
Administrative / estates / other	446 (5.3)	20 (3.8)	43 (4.4)	32 (6.5)	351 (5.5)
Migration status					
Born in the UK	6,249 (72.4)	422 (77.6)	835 (81.9)	393 (77.8)	4,599 (70.1)
Born overseas	2,379 (27.6)	122 (22.4)	185 (18.1)	112 (22.2)	1,960 (29.9)
Exposure to COVID-19 patients during lockdown					
None (or remote contact only)	4,122 (48.0)	226 (41.7)	459 (45.5)	204 (40.5)	3,233 (49.6)
Face-to-face with social distancing only	520 (6.1)	22 (4.1)	51 (5.1)	42 (8.3)	405 (6.2)
Physical contact	3,938 (45.9)	294 (54.2)	500 (49.5)	258 (51.2)	2,886 (44.2)
Number of long-term physical health conditions†					
0	5,819 (73.1)	407 (83.4)	713 (76.3)	379 (83.1)	4,320 (71.0)
1	1,721 (21.6)	67 (13.7)	189 (20.2)	61 (13.4)	1,404 (23.1)
≥2	419 (5.3)	14 (2.9)	32 (3.4)	16 (3.5)	357 (5.9)
Body mass index (kg/m^2)					
< 25	3,675 (48.7)	212 (45.5)	430 (49.2)	210 (49.9)	2,823 (48.8)
≥ 25 & < 30	2,360 (31.3)	149 (32.0)	276 (31.6)	132 (31.4)	1,803 (31.2)

Supplementary information

≥30	1,513 (20.1)	105 (22.5)	168 (19.2)	79 (18.8)	1,161 (20.1)
Perceived risk of being hospitalised with COVID-19 in the next 6 months (scale 0 – 100), med(IQR)	20 (5 – 50)	15 (5 – 50)	10 (5 – 40)	10 (5 – 30)	20 (5 – 50)
Perceived likelihood of unknowingly spreading COVID-19					
Not at all likely	1,071 (13.1)	63 (12.3)	112 (11.6)	71 (14.7)	825 (13.3)
A little likely	3,023 (37.0)	187 (36.5)	351 (36.3)	181 (37.5)	2,304 (37.0)
Quite likely	2,197 (26.9)	132 (25.8)	274 (28.4)	133 (27.5)	1,658 (26.7)
Very likely	1,891 (23.1)	130 (25.4)	229 (23.7)	98 (20.3)	1,434 (23.1)
SARS-CoV-2 infection status (at 1st May 2020)					
Uninfected	7,075 (86.9)	435 (85.0)	807 (84.4)	404 (84.0)	5,429 (87.7)
Infected	1,068 (13.1)	77 (15.0)	149 (15.6)	77 (16.0)	765 (12.4)
Cohabitation with those over 65 years old					
Does not live with someone over the age of 65	7,842 (93.0)	496 (93.8)	939 (94.4)	457 (93.5)	5,950 (92.7)
Lives with someone over the age of 65	591 (7.0)	33 (6.2)	56 (5.6)	32 (6.5)	470 (7.3)

Supplementary Table 2 provides a description of the cohort stratified by their answer to the question "Have you been offered an NHS COVID-19 risk assessment at work?". All data are n(%) unless stated otherwise.
*Includes pharmacists, health scientists, ambulance workers and those in optical roles. †Includes diabetes, heart disease, hypertension, previous stroke, kidney or liver disease, asthma, lung condition other than asthma, cancer, neurological disease, organ transplant and immunosuppression.

Supplementary information

Supplementary Table 3. Description of those who completed an NHS COVID-19 risk assessment stratified by their response to the question "Did your work change as a result of the NHS COVID-19 risk assessment result?"

Variable	Total N=6,543	No, because it didn't need to N=4,579	No, because I didn't want it to N=294	No, but I did want it to N=285	Yes N=1,385
Ethnicity					
White	4,230 (64.7)	3,118 (68.1)	134 (45.6)	114 (40.0)	864 (62.4)
Asian	1,545 (23.6)	990 (21.6)	103 (35.0)	115 (40.4)	337 (24.3)
Black	324 (5.0)	198 (4.3)	18 (6.1)	26 (9.1)	82 (5.9)
Mixed	294 (4.5)	171 (3.7)	27 (9.2)	21 (7.4)	75 (5.4)
Other	150 (2.3)	102 (2.2)	12 (4.1)	9 (3.2)	27 (2.0)
Age in years, med (IQR)	44 (34 – 53)	43 (33 – 52)	46 (36 – 54)	43 (33 – 54)	49 (39 – 56)
Sex					
Male	1,638 (25.1)	1,116 (24.4)	110 (37.5)	74 (26.1)	338 (24.5)
Female	4,894 (74.9)	3,459 (75.6)	183 (62.5)	210 (73.9)	1,042 (75.5)
Occupation					
Medical / medical support	1,840 (29.0)	1,336 (30.0)	124 (43.1)	87 (31.8)	293 (22.1)
Nursing (inc. midwives, nursing associates)	1,441 (22.7)	948 (21.3)	56 (19.4)	74 (27.0)	363 (27.3)
Allied health professionals*	2,509 (39.6)	1,776 (39.9)	96 (33.3)	93 (33.9)	544 (40.9)
Dental	203 (3.2)	132 (3.0)	6 (2.1)	12 (4.4)	53 (4.0)
Administrative / estates / other	349 (5.5)	259 (5.8)	6 (2.1)	8 (2.9)	76 (5.7)
Migration status					
Born in the UK	4,586 (70.3)	3,307 (72.4)	174 (59.2)	170 (59.7)	935 (67.8)
Born overseas	1,941 (29.7)	1,262 (27.6)	120 (40.8)	115 (40.4)	444 (32.2)
Exposure to COVID-19 patients during lockdown					
None (or remote contact only)	3,221 (49.6)	2,128 (46.8)	89 (30.6)	125 (44.0)	879 (64.2)
Face-to-face with social distancing only	402 (6.2)	279 (6.1)	24 (8.3)	15 (5.3)	84 (6.1)
Physical contact	2,869 (44.2)	2,141 (47.1)	178 (61.2)	144 (50.7)	406 (29.7)
Number of long-term physical health conditions†					
0	4,299 (71.1)	3,440 (81.2)	129 (47.1)	146 (57.5)	584 (45.5)
1	1,396 (23.1)	710 (16.8)	116 (42.3)	84 (33.1)	486 (37.8)
≥2	355 (5.9)	87 (2.1)	29 (10.6)	24 (9.5)	215 (16.7)
Body mass index (kg/m^2)					
< 25	2,809 (48.8)	2,129 (52.5)	113 (42.2)	97 (40.3)	470 (39.3)
≥ 25 & < 30	1,795 (31.2)	1,235 (30.5)	84 (31.3)	88 (36.5)	388 (32.5)

Supplementary information

≥30	1,153 (20.0)	689 (17.0)	71 (26.5)	56 (23.2)	337 (28.2)
Perceived risk of being hospitalised with COVID-19 in the next 6 months (scale 0 – 100), med(IQR)	20 (5 – 50)	10 (5 – 30)	20 (10 – 50)	35 (10 – 52.5)	30 (10 – 50)
Perceived likelihood of unknowingly spreading COVID-19					
Not at all likely	822 (13.3)	535 (12.3)	47 (16.9)	32 (12.3)	208 (16.1)
A little likely	2,292 (37.0)	1,701 (39.1)	94 (33.7)	75 (28.7)	422 (32.6)
Quite likely	1,651 (26.7)	1,200 (27.5)	67 (24.0)	66 (25.3)	318 (24.5)
Very likely	1,426 (23.0)	919 (21.1)	71 (25.5)	88 (33.7)	348 (26.9)
SARS-CoV-2 infection status (at 1st May 2020)					
Uninfected	5,403 (87.7)	3,777 (87.2)	238 (84.4)	222 (85.7)	1,166 (90.0)
Infected	760 (12.3)	554 (12.8)	40 (15.6)	37 (14.3)	129 (10.0)
Cohabitation with those over 65 years old					
Does not live with someone over the age of 65	5,923 (92.7)	4,203 (93.9)	265 (91.4)	248 (89.5)	1,207 (89.6)
Lives with someone over the age of 65	466 (7.3)	272 (6.1)	25 (8.6)	29 (10.5)	140 (10.39)

Supplementary Table 3 provides a description of the cohort stratified by their answer to the question "Have you been offered an NHS COVID-19 risk assessment at work?". All data are n(%) unless stated otherwise.

*Includes pharmacists, health scientists, ambulance workers and those in optical roles. †Includes diabetes, heart disease, hypertension, previous stroke, kidney or liver disease, asthma, lung condition other than asthma, cancer, neurological disease, organ transplant and immunosuppression

Supplementary information

Supplementary Table 4. Logistic regression table for outcomes 1 and 2 to show numerical adjusted odds ratios and p values (data displayed graphically in Figure 2).

	OUTCOME 1 – OFFERED A RISK ASSESSMENT (n=8,649)		OUTCOME 2 – COMPLETED A RISK ASSESSMENT (n=7,083)	
	aOR (95% CI)	**P value**	**aOR (95% CI)**	**P value**
Ethnicity				
White	Ref	-	Ref	-
Asian	2.37 (1.95 – 2.87)	<0.001	2.17 (1.60 – 2.94)	<0.001
Black	3.11 (2.09 – 4.62)	<0.001	2.27 (1.28 – 4.00)	0.005
Mixed	2.03 (1.46 – 2.81)	<0.001	1.38 (0.88 – 2.18)	0.16
Other	1.47 (0.97 – 2.22)	0.07	1.24 (0.67 – 2.29)	0.50
Age, per decade increase	1.02 (0.98 – 1.08)	0.34	1.14 (1.05 – 1.23)	0.002
Sex				
Male	Ref	-	Ref	-
Female	1.20 (1.05 – 1.38)	0.007	1.41 (1.14 – 1.75)	0.002
Occupation*				
Medical	Ref	-	Ref	-
Nursing	1.15 (0.96 – 1.38)	0.12	1.34 (1.01 – 1.79)	0.046
Allied Health Professional	1.07 (0.91 – 1.26)	0.40	1.29 (1.01 – 1.66)	0.04
Dental	0.60 (0.45 – 0.80)	<0.001	2.83 (1.30 – 6.17)	0.009
Admin/estates/other	1.59 (1.18 – 2.14)	0.002	1.17 (0.77 – 1.77)	0.46
Migration status				
Born in the UK	Ref	-	Ref	-
Born overseas	1.20 (1.02 – 1.41)	0.03	1.20 (0.92 – 1.55)	0.17
Exposure to COVID-19 patients				
None (or remote only)	Ref	-	Ref	-
Face-to-face with social distancing	1.12 (0.86 – 1.45)	0.41	0.60 (0.42 – 0.85)	0.004
Physical contact	0.70 (0.62 – 0.79)	<0.001	0.72 (0.58 – 0.88)	0.002
Number of long-term physical health conditions				
0	Ref	-	Ref	-
1	1.38 (1.19 – 1.60)	<0.001	1.89 (1.43 – 2.50)	<0.001
≥2	1.93 (1.42 – 2.64)	<0.001	1.99 (1.19 – 3.32)	0.009
BMI (kg/m^2)				
< 25	Ref	-	Ref	-
≥ 25 to < 30	0.96 (0.84 – 1.10)	0.53	1.00 (0.80 – 1.26)	0.99
≥ 30	1.00 (0.85 – 1.17)	1.00	1.11 (0.84 – 1.46)	0.47
SARS-CoV-2 infection status				
Uninfected	Ref	-	Ref	-
Infected	0.81 (0.69 – 0.95)	0.01	0.78 (0.60 – 1.02)	0.07
Perceived risk of hospitalisation due to COVID-19 (scale 0 – 100), per 10 point increase	-	-	1.08 (1.04 – 1.13)	0.001
Perceived risk of spreading COVID-19				
Not at all likely	-	-	Ref	-
A little likely			1.16 (0.86 – 1.55)	0.33
Quite likely			1.20 (0.88 – 1.63)	0.26
Very likely			1.31 (0.94 – 1.83)	0.11
Cohabitation				
Does not live with someone over 65 years old	-	-	Ref	-
Lives with someone over 65 years old			0.94 (0.64 – 1.38)	0.21

Supplementary Table 6 shows the results of multivariable logistic regression as adjusted odds ratios, 95% confidence intervals and p values for the association of sociodemographic, occupational and perceived risk variables with outcome 1 (offered a risk assessment) and outcome 2 (completed a risk assessment once offered). Odds ratios are adjusted for age, sex, ethnicity, occupation and migration status. We did not include the 'perceived risk' variables in the analysis of outcome 1 as we felt these would not have influenced whether a HCW was offered a risk assessment.

*In the occupation variable, nursing includes midwives, nursing associates and healthcare assistants; allied health professionals includes pharmacists, healthcare scientists, ambulance workers and those in optical roles.

BMI - Body mass index; COVID-19 - coronavirus disease 2019; SARS-CoV-2 - Severe acute respiratory syndrome coronavirus-2

Supplementary information

Supplementary Table 5. Logistic regression table for outcomes 3 and 4 to show numerical adjusted odds ratios and p values (data displayed graphically in Figure 2).

	OUTCOME 3 – WORKING PRACTICES CHANGED (n=1,964)		OUTCOME 4 – WANTED CHANGES BUT WORK DIDN'T CHANGE (n=442)	
	aOR (95% CI)	P value	aOR (95% CI)	P value
Ethnicity				
White	Ref	-	Ref	-
Asian	0.55 (0.41 – 0.73)	<0.001	2.18 (1.33 – 3.59)	0.002
Black	0.60 (0.39 – 0.92)	0.02	2.15 (1.05 – 4.42)	0.04
Mixed	0.51 (0.34 – 0.76)	0.001	1.12 (0.58 – 2.16)	0.73
Other	0.45 (0.24 – 0.86)	0.02	1.48 (0.55 – 4.03)	0.44
Age, per decade increase	1.31 (1.19 – 1.43)	<0.001	0.89 (0.77 – 1.04)	0.14
Sex				
Male	Ref	-	Ref	-
Female	1.28 (1.00 – 1.63)	0.048	1.59 (1.08 – 2.34)	0.02
Occupation				
Medical	Ref	-	Ref	-
Nursing	1.36 (0.99 – 1.87)	0.06	2.39 (1.41 – 4.03)	0.001
Allied Health Professional*	1.72 (1.31 – 2.27)	<0.001	1.61 (1.03 – 2.52)	0.04
Dental	1.70 (0.94 – 3.05)	0.08	3.07 (1.07 – 8.79)	0.04
Admin/estates/other	3.04 (1.63 – 5.66)	<0.001	2.47 (0.79 – 7.78)	0.44
Migration status				
Born in the UK	Ref	-	Ref	-
Born overseas	1.17 (0.90 – 1.52)	0.23	0.92 (0.60 – 1.41)	0.70
Exposure to COVID-19 patients				
None (or remote only)	Ref	-	Ref	-
Face-to-face with social distancing	0.52 (0.34 – 0.79)	0.002	0.50 (0.24 – 1.03)	0.06
Physical contact	0.38 (0.31 – 0.48)	<0.001	0.58 (0.39 – 0.85)	0.006
Number of long-term physical health conditions				
0	Ref	-	Ref	-
1	1.08 (0.86 – 1.35)	0.53	0.71 (0.47 – 1.06)	0.10
≥2	1.73 (1.23 – 2.45)	0.002	0.87 (0.45 – 1.68)	0.68
BMI (kg/m^2)				
< 25	Ref	-	Ref	-
≥ 25 to < 30	1.00 (0.77 – 1.30)	0.98	1.22 (0.79 – 1.88)	0.38
≥ 30	0.98 (0.74 – 1.29)	0.89	1.08 (0.67 – 1.75)	0.75
SARS-CoV-2 infection status				
Uninfected	Ref	-	Ref	-
Infected	0.63 (0.46 – 0.87)	0.005	1.02 (0.61 – 1.68)	0.95
Perceived risk of hospitalisation due to COVID-19 (scale 0 – 100), per 10 point increase	1.06 (1.02 – 1.10)	0.003	1.16 (1.08 – 1.24)	<0.001
Perceived risk of spreading COVID-19				
Not at all likely	Ref	-	Ref	-
A little likely	0.96 (0.70 – 1.33)	0.82	1.15 (0.65 – 2.03)	0.64
Quite likely	0.89 (0.63 – 1.25)	0.50	1.33 (0.73 – 2.41)	0.35
Very likely	0.78 (0.56 – 1.09)	0.15	1.58 (0.89 – 2.80)	0.12
Cohabitation				
Does not live with someone over 65 years old	Ref	-	Ref	-
Lives with someone over 65 years old	0.90 (0.64 – 1.28)	0.57	1.15 (0.64 – 2.08)	0.64

Supplementary Table 7 shows the results of multivariable logistic regression as adjusted odds ratios, 95% confidence intervals and p values for the association of sociodemographic, occupational and perceived risk variables with outcome 3 (work changed as a result of risk assessment) and outcome 4 (work did not change, but changes were wanted). Odds ratios are adjusted for age, sex, ethnicity, occupation and migration status. We did not include the 'perceived risk' variables in the analysis of outcome 1 as we felt these would not have influenced whether a HCW was offered a risk assessment.

*In the occupation variable, nursing includes midwives, nursing associates and healthcare assistants; allied health professionals includes pharmacists, healthcare scientists, ambulance workers and those in optical roles.

BMI - Body mass index; COVID-19 - coronavirus disease 2019; SARS-CoV-2 - Severe acute respiratory syndrome coronavirus-2

Supplementary information

Supplementary Table 6. Adjusted analysis of outcomes 1 and 2 in complete cases

	OUTCOME 1 – OFFERED A RISK ASSESSMENT (n=6,767)		OUTCOME 2 – COMPLETED A RISK ASSESSMENT (n=5,503)	
	aOR (95% CI)	**P value**	**aOR (95% CI)**	**P value**
Ethnicity				
White	Ref	-	Ref	-
Asian	2.35 (1.89 – 2.91)	<0.001	2.79 (1.95 – 3.99)	<0.001
Black	2.37 (1.54 – 3.66)	<0.001	3.00 (1.43 – 6.30)	0.004
Mixed	2.31 (1.56 – 3.41)	<0.001	1.40 (0.85 – 2.31)	0.19
Other	1.47 (0.90 – 2.40)	0.13	1.42 (0.68 – 2.95)	0.35
Age, per decade increase	1.03 (0.97 – 1.08)	0.39	1.17 (1.06 – 1.28)	0.001
Sex				
Male	Ref	-	Ref	-
Female	1.16 (1.00 – 1.35)	0.06	1.47 (1.15 – 1.87)	0.002
Occupation*				
Medical	Ref	-	Ref	-
Nursing	1.13 (0.92 – 1.37)	0.24	1.50 (1.08 – 2.07)	0.02
Allied Health Professional	1.12 (0.94 – 1.33)	0.19	1.40 (1.07 – 1.83)	0.02
Dental	0.60 (0.43 – 0.82)	0.002	3.23 (1.29 – 8.07)	0.01
Admin/estates/other	1.53 (1.08 – 2.16)	0.02	1.42 (0.85 – 2.37)	0.18
Migration status				
Born in the UK	Ref	-	Ref	-
Born overseas	1.24 (1.03 – 1.48)	0.02	1.08 (0.81 – 1.45)	0.58
Exposure to COVID-19 patients				
None (or remote only)	Ref	-	Ref	-
Face-to-face with social distancing	1.21 (0.89 – 1.65)	0.23	0.55 (0.37 – 0.82)	0.004
Physical contact	0.74 (0.64 – 0.85)	<0.001	0.73 (0.57 – 0.93)	0.009
Number of long-term physical health conditions				
0	Ref	-	Ref	-
1	1.44 (1.22 – 1.71)	<0.001	1.71 (1.27 – 2.30)	<0.001
≥2	2.06 (1.43 – 2.97)	<0.001	1.92 (1.05 – 3.49)	0.03
BMI (kg/m^2)				
< 25	Ref	-	Ref	-
≥ 25 to < 30	0.93 (0.81 – 1.08)	0.37	0.91 (0.71 – 1.16)	0.45
≥ 30	1.03 (0.87 – 1.23)	0.70	1.02 (0.76 – 1.35)	0.91
SARS-CoV-2 infection status				
Uninfected	Ref	-	Ref	-
Infected	0.80 (0.67 – 0.96)	0.01	0.83 (0.62 – 1.11)	0.20
Perceived risk of hospitalisation due to COVID-19 (scale 0 – 100), per 10 point increase	-	-	1.08 (1.03 – 1.14)	0.002
Perceived risk of spreading COVID-19				
Not at all likely	-	-	Ref	-
A little likely			1.18 (0.85 – 1.63)	0.32
Quite likely			1.31 (0.93 – 1.85)	0.13
Very likely			1.45 (1.00 – 2.10)	0.049
Cohabitation				
Does not live with someone over 65 years old	-	-	Ref	-
Lives with someone over 65 years old			0.77 (0.50 – 1.16)	0.21

Supplementary Table 8 shows the results of multivariable logistic regression as adjusted odds ratios, 95% confidence intervals and p values for the association of sociodemographic, occupational and perceived risk variables with outcome 1 (offered a risk assessment) and outcome 2 (completed a risk assessment once offered). Odds ratios are adjusted for age, sex, ethnicity, occupation and migration status. Exclusions for each outcome are the same as the main analysis with the addition of exclusion of those with missing data in any of the variables of interest.

*In the occupation variable, nursing includes midwives, nursing associates and healthcare assistants; allied health professionals includes pharmacists, healthcare scientists, ambulance workers and those in optical roles.

BMI - Body mass index; COVID-19 - coronavirus disease 2019; SARS-CoV-2 - Severe acute respiratory syndrome coronavirus-2

Supplementary information

Supplementary Table 7. Adjusted analysis of outcomes 3 and 4 in complete cases

	OUTCOME 3 – WORKING PRACTICES CHANGED (n=1,492)		OUTCOME 4 – WANTED CHANGES BUT WORK DIDN'T CHANGE (n=442)	
	aOR (95% CI)	P value	aOR (95% CI)	P value
Ethnicity				
White	Ref	-	Ref	-
Asian	0.49 (0.35 – 0.68)	<0.001	2.02 (1.17 – 3.49)	0.01
Black	0.60 (0.36 – 1.01)	0.05	2.83 (1.19 – 6.74)	0.02
Mixed	0.47 (0.30 – 0.74)	0.001	1.36 (0.66 – 2.81)	0.41
Other	0.34 (0.16 – 0.71)	0.004	1.25 (0.40 – 3.95)	0.70
Age, per decade increase	1.25 (1.13 – 1.39)	<0.001	0.88 (0.74 – 1.06)	0.17
Sex				
Male	Ref	-	Ref	-
Female	1.27 (0.96 – 1.67)	0.09	1.74 (1.11 – 2.70)	0.02
Occupation				
Medical	Ref	-	Ref	-
Nursing	1.24 (0.87 – 1.77)	0.23	1.89 (1.06 – 3.38)	0.03
Allied Health Professional*	1.47 (1.09 – 2.00)	0.01	1.52 (0.92 – 2.49)	0.10
Dental	1.36 (0.72 – 2.57)	0.34	3.63 (1.16 – 11.35)	0.03
Admin/estates/other	3.71 (1.69 – 8.15)	0.001	4.70 (0.87 – 25.3)	0.07
Migration status				
Born in the UK	Ref	-	Ref	-
Born overseas	1.14 (0.85 – 1.53)	0.39	0.93 (0.58 – 1.51)	0.78
Exposure to COVID-19 patients				
None (or remote only)	Ref	-	Ref	-
Face-to-face with social distancing	0.44 (0.27 – 0.71)	0.001	0.47 (0.21 – 1.09)	0.08
Physical contact	0.35 (0.27 – 0.46)	<0.001	0.53 (0.34 – 0.82)	0.005
Number of long-term physical health conditions				
0	Ref	-	Ref	-
1	1.05 (0.82 – 1.35)	0.68	0.51 (0.33 – 0.79)	0.002
≥2	1.69 (1.15 – 2.48)	0.008	0.79 (0.39 – 1.63)	0.53
BMI (kg/m^2)				
< 25	Ref	-	Ref	-
≥ 25 to < 30	1.03 (0.78 – 1.35)	0.84	1.30 (0.82 – 2.08)	0.27
≥ 30	1.02 (0.76 – 1.36)	0.91	1.16 (0.69 – 1.93)	0.58
SARS-CoV-2 infection status				
Uninfected	Ref	-	Ref	-
Infected	0.58 (0.41 – 0.82)	0.002	0.73 (0.41 – 1.29)	0.28
Perceived risk of hospitalisation due to COVID-19 (scale 0 – 100), per 10 point increase	1.06 (1.02 – 1.11)	0.005	1.15 (1.06 – 1.24)	<0.001
Perceived risk of spreading COVID-19				
Not at all likely	Ref	-	Ref	-
A little likely	0.96 (0.67 – 1.38)	0.84	1.23 (0.65 – 2.32)	0.52
Quite likely	0.85 (0.58 – 1.25)	0.41	1.36 (0.70 – 2.62)	0.36
Very likely	0.85 (0.59 – 1.25)	0.42	1.43 (0.74 – 2.77)	0.29
Cohabitation				
Does not live with someone over 65 years old	Ref	-	Ref	-
Lives with someone over 65 years old	0.96 (0.63 – 1.47)	0.86	1.03 (0.49 – 2.15)	0.94

Supplementary Table 9 shows the results of multivariable logistic regression as adjusted odds ratios, 95% confidence intervals and p values for the association of sociodemographic, occupational and perceived risk variables with outcome 3 (work changed as a result of risk assessment) and outcome 4 (work did not change, but changes were wanted). Odds ratios are adjusted for age, sex, ethnicity, occupation and migration status. Exclusions for each outcome are the same as the main analysis with the addition of exclusion of those with missing data in any of the variables of interest.

*In the occupation variable, nursing includes midwives, nursing associates and healthcare assistants; allied health professionals includes pharmacists, healthcare scientists, ambulance workers and those in optical roles.

BMI - Body mass index; COVID-19 - coronavirus disease 2019; SARS-CoV-2 - Severe acute respiratory syndrome coronavirus-2

Supplementary information

Supplementary Table 8. Univariable logistic regression to show the association of ethnic group with risk assessment coverage and outcomes

	OUTCOME 1 – OFFERED A RISK ASSESSMENT N=8,649		**OUTCOME 2 – COMPLETED A RISK ASSESSMENT N=7,083**		**OUTCOME 3 – WORKING PRACTICES CHANGED N=1,964**		**OUTCOME 4 – WANTED CHANGES BUT WORK DIDN'T CHANGE N=579**	
	Odds ratio (95% CI)	**P value**	**Odds ratio (95% CI)**	**P value**	**Odds ratio (95% CI)**	**P value**	**Odds ratio (95% CI)**	**P value**
Ethnicity								
White	Ref	-	Ref	-	Ref	-	Ref	-
Asian	2.33 (1.98 – 2.73)	<0.001	1.90 (1.48 – 2.46)	<0.001	0.44 (0.36 – 0.55)	<0.001	1.31 (0.91 – 1.89)	0.14
Black	3.23 (2.20 – 4.75)	<0.001	2.12 (1.23 – 3.66)	0.007	0.53 (0.36 – 0.79)	0.002	1.70 (0.89 – 3.25)	0.11
Mixed	1.97 (1.43 – 2.72)	<0.001	1.21 (0.78 – 1.89)	0.40	0.45 (0.30 – 0.66)	<0.001	0.91 (0.49 – 1.70)	0.78
Other	1.48 (1.00 – 2.18)	0.049	1.07 (0.60 – 1.91)	0.81	0.37 (0.21 – 0.66)	0.001	0.88 (0.36 – 2.17)	0.78

Supplementary information

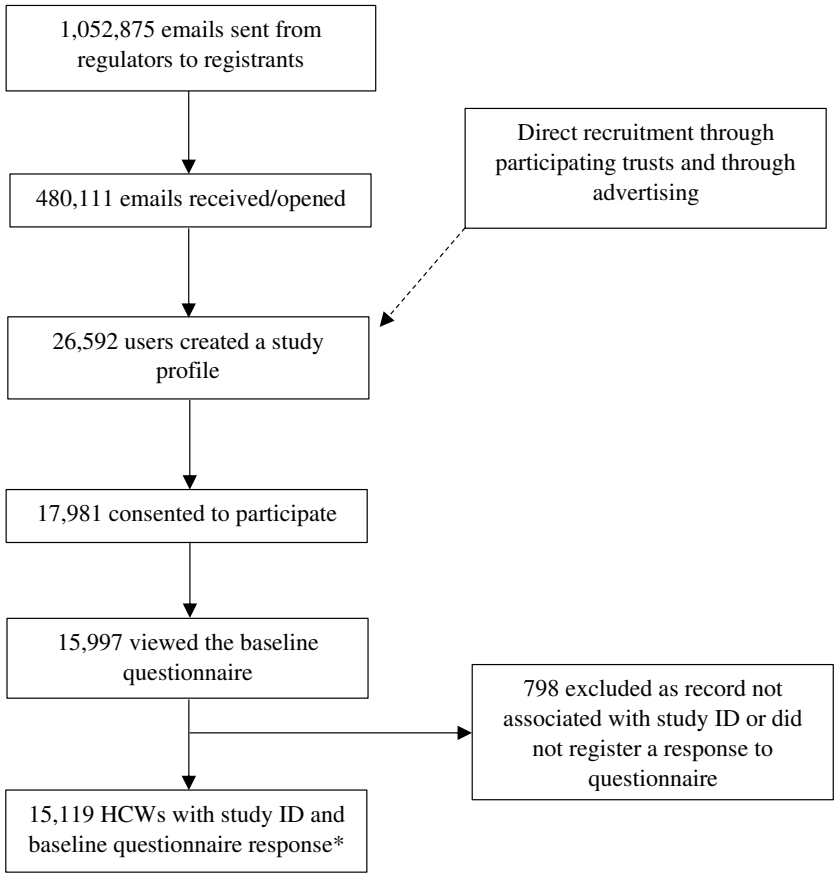
Supplementary Table 9. Analysis of the relationship between ethnicity and risk assessment coverage and outcomes in staff who reported contact with COVID patients during lockdown

	OUTCOME 1 – OFFERED A RISK ASSESSMENT N=4,458		OUTCOME 2 – COMPLETED A RISK ASSESSMENT N=3,591		OUTCOME 3 – WORKING PRACTICES CHANGED N=851		OUTCOME 4 – WANTED CHANGES BUT WORK DIDN'T CHANGE N=361	
	Adjusted odds ratio (95% CI)	**P value**	**Adjusted odds ratio (95% CI)**	**P value**	**Adjusted odds ratio (95% CI)**	**P value**	**Adjusted odds ratio (95% CI)**	**P value**
Ethnicity								
White	Ref	-	Ref	-	Ref	-	Ref	-
Asian	2.52 (1.95 – 3.27)	<0.001	2.04 (1.40 – 2.98)	<0.001	0.63 (0.42 – 0.95)	0.03	2.53 (1.28 – 5.01)	0.008
Black	3.80 (2.23 – 6.47)	<0.001	1.92 (1.02 – 3.62)	0.04	0.76 (0.44 – 1.33)	0.35	3.32 (1.34 – 8.21)	0.009
Mixed	2.28 (1.47 – 3.55)	<0.001	1.36 (0.76 – 2.41)	0.30	0.45 (0.25 – 0.82)	0.009	1.05 (0.45 – 2.45)	0.92
Other	1.43 (0.86 – 2.37)	0.17	0.90 (0.47 – 1.72)	0.75	0.56 (0.24 – 1.31)	0.18	1.76 (0.50 – 6.14)	0.38

Supplementary Table 11 shows the relationship between ethnicity and our outcome measures after exclusion of those who reported no direct contact with COVID-19 patients and after adjustment for age, sex, occupation and migration status. It should be noted that due to lower numbers of participants included in outcomes 3 and 4 and the overlap between direct patient contact and particular healthcare roles the occupation variable was collapsed into fewer categories for these analyses.

Supplementary information

Supplementary Figure 1. Recruitment



*corresponds to a response rate of 57.1% of those who registered/created a profile on the study website (and 84.5% of those who consented, 1.4% of those who were sent an email and 3.2% of those who opened the email).

For further details on the formation of the analysed sample, see Figure 1. HCW – healthcare worker.