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Prevalence of and factors associated with long COVID among diverse healthcare workers in the UK: a cross-sectional analysis of a nationwide study (UK-REACH)

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ABSTRACT

Objectives To assess the prevalence of UK healthcare workers (HCWs) who reported symptoms of COVID-19 lasting for longer than 5 weeks and examine associated factors with experiencing long COVID in an ethnically diverse cohort.

Design A cross-sectional study using data from the UK Research study into Ethnicity And COVID-19 Outcomes in HCWs cohort study.

Setting Data were collected electronically between December 2020 and March 2021.

Participants Individuals aged 16 years or older, residing in the UK, and working as HCWs or ancillary workers in a healthcare setting and/or registered with one of the seven major UK healthcare professional regulators.

Primary and secondary outcome measures The main outcome was long COVID (symptoms>5 weeks). The primary exposure of interest was self-reported ethnicity. We employed univariable and multivariable logistic regression to identify associations. We adjusted for demographic information, health status and existing long-term conditions in our multivariate analysis.

Results In our analysis of 11 513 HCWs, we found that 2331 (20.25%) reported COVID-19, of whom 525 (22.52%) experienced long COVID. There were no significant differences in risk of long COVID by ethnic group. In terms of other demographic characteristics, the majority of those experiencing long COVID were female (80.0%) and were slightly older than those who did not experience long COVID (median age 46 (IQR 36–54)). In multivariable analyses of those who reported having had COVID-19, HCWs in nursing/midwifery roles (adjusted OR (aOR) 1.76, 95% CI 1.26 to 2.46; p=0.001) and allied health professions (aOR 1.42, 95% CI 1.05 to 1.93; p=0.023) had higher odds of experiencing long COVID compared with those in medical roles. Other factors significantly associated with long COVID included self-reported psychological conditions (eg, depression and anxiety) and respiratory conditions (eg, asthma).

Conclusions In this large ethnically diverse cohort study, more than one in five UK HCWs reported experiencing long COVID after acute COVID-19 during the first year of the pandemic. We found that specific demographic (older age and female gender) and occupational factors (nursing/midwifery and allied health professions) were associated with higher odds of long COVID. Notably, there were no significant differences in the risk of long COVID by ethnic group. Further research and collaborative efforts are urgently needed to address these factors effectively, develop targeted interventions and understand the temporal and longitudinal dynamics of the condition.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study is the first and largest in the UK to examine factors associated with long COVID among healthcare workers from diverse ethnic and occupational backgrounds, providing valuable insights into this population.
⇒ The study employed rigorous multivariable logistic regression models to adjust for a wide range of demographic, occupational and health-related factors, strengthening the validity of the associations found.
⇒ The cross-sectional nature of the study limits the ability to establish causality and temporality between identified risk factors and long COVID, particularly for conditions, such as anxiety and depression that may result from long COVID.
⇒ The reliance on self-reported data introduces potential recall and social desirability biases, affecting the accuracy of the findings.

INTRODUCTION

The COVID-19 pandemic has brought unprecedented challenges to healthcare systems worldwide, with healthcare workers (HCWs) at the forefront being particularly affected.[1] This is because they face an elevated risk of contracting COVID-19 due to their close and prolonged contact with infected individuals.[2] The World Health Organization (WHO) estimated that, as of

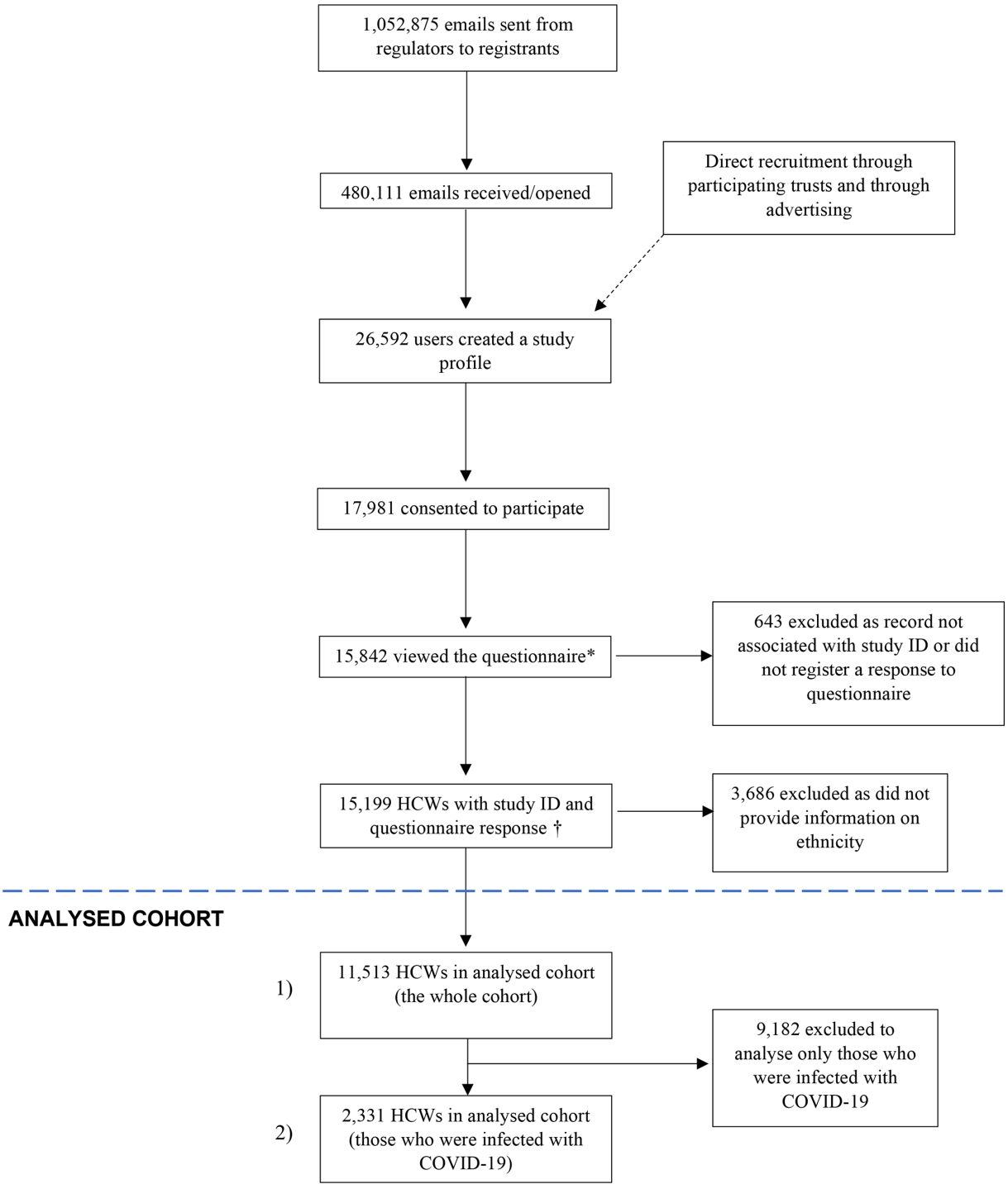

Figure 1 Formation of the analysed cohort. HCWs, healthcare workers.

May 2020, more than 152 000 infections and 1400 deaths were reported among HCWs.[3] This suggests that one HCW died for every 100 who became infected.[3] However, due to under-reporting, these figures are expected to be underestimated.[3] In the UK, a study using data from the UK Office for National Statistics (ONS) found that HCWs were among occupational groups reporting a significantly higher prevalence of symptoms persisting for four or more weeks.[4] Additionally, HCWs may experience greater exposure to workplace stressors, such as staffing shortages, which may increase workloads and reduce support, potentially exacerbating long-term symptoms.[5]

While much research has been directed towards the acute phase of COVID-19, some patients with COVID-19 experience symptoms that persist beyond the acute phase of infection.[6] These persistent symptoms are now widely known as 'long COVID'.[7 8] Long COVID refers to *'signs and symptoms that continue or develop after acute COVID-19'*, which include both ongoing symptomatic COVID-19

Figure 2 Take-home messages.

(4–12 weeks) and post-COVID-19 syndrome (from after 12 weeks).[9]

Long COVID symptoms, such as fatigue, breathlessness and cognitive impairments, can severely impact HCWs' quality of life and functional capacity, posing risks to patient safety and care quality.[10] The sustained health burden on HCWs is compounded by increased sick leave and workforce shortages, leading to disruptions in healthcare delivery.[11 12] These dynamic highlights the urgent need for targeted research on long COVID risk factors specifically within the healthcare workforce to mitigate its impact on service provision and staff well-being. Furthermore, understanding the intersection of ethnicity, sociocultural factors and long COVID prevalence among HCWs can inform interventions that promote equity and accessibility within the National Health Service (NHS), ensuring that the support and rehabilitation efforts are inclusive and tailored to diverse HCW groups.[9 10]

The economic burden on healthcare systems, such as the NHS, is substantial due to increased healthcare utilisation and long-term management of these patients.[11] Although various rehabilitation and support services are being established for long COVID patients, their effectiveness remains an area of active research. From a patient perspective, HCWs—who are often both caregivers and patients themselves—offer unique insights into living with long COVID, making them a critical group for focused research.[12]

Although recent literature has examined long COVID in the general population, there remains a significant gap in understanding its effects on HCWs. Existing studies often exclude HCWs or rely on data from small or homogeneous samples due to practical and logistical challenges, as their high workloads and stress during the pandemic limited their availability to participate.[13] Additionally, researchers frequently prioritised the general population or hospitalised patients to capture broader public health trends or severe disease outcomes, inadvertently overlooking HCWs and their unique risks and experiences. This limits insights into the prevalence, risk factors and socio-occupational impacts of long COVID in this high-risk group.

This gap is especially critical from an equity, diversity and inclusion (EDI) perspective, as comprehensive research can illuminate potential disparities among diverse HCW groups, providing insights that contribute to more equitable healthcare policies and resources.[14 15] The diversity within the UK HCW population, with substantial representation of ethnic minority groups, underscores the importance of research on potential disparities in long COVID prevalence and risk factors. Ethnicity, socioeconomic status and cultural perceptions of illness may influence the reporting and management of long COVID symptoms, raising concerns about healthcare equity within the workforce.[16]

Identifying the risk factors for developing long COVID has been highlighted as a research priority in the National Institute for Health and Care Excellence (NICE) guidelines on managing the long-term effects of COVID-19.[17] Several studies have found that female sex, presence of long-term conditions, obesity, socioeconomic deprivation and smoking are considered risk factors for long COVID.[18–21] However, the existing evidence on long COVID risk factors is inconsistent and varies between different studies.[22 23] According to the Office for National Statistics (ONS) data from March 2023, self-reported prevalence of long COVID in the UK is higher in those who work in healthcare (4.41%) than in the general population (2.92%), regardless of whether they had previously tested positive for COVID-19.[24] This highlights the unique vulnerabilities faced by this workforce.

While several studies have explored the impact of COVID-19 on HCWs, specific insights into the prevalence and risk factors of long COVID among HCWs remain limited. For instance, a study in an English teaching hospital found that 45% of HCWs reported ongoing symptoms 3–4 months postinfection; however, its findings are limited by a small, single centre, predominantly female respondent pool.[25] The limitations of existing studies—such as small sample sizes and limited diversity—hinder robust conclusions, particularly when considering the high representation of ethnic minority groups in the UK healthcare workforce.

Comprehensive research is essential to identify whether ethnicity plays a role in long COVID risk factors or prevalence. Understanding long COVID risk factors in an ethnically diverse HCW cohort can provide critical insights into cultural and social factors, including health perceptions,

Table 1 Description of the analysed cohort

Variable	Total cohort N=11 513 Analysed cohort Those who were infected with COVID-19 N=2331
Ethnicity	
White	1699 (72.9%)
Asian	389 (16.7%)
Black	95 (4.1%)
Mixed	107 (4.6%)
Other	41 (1.8%)
Missing	0 (0.0%)
Migration status	
Born in UK	1786 (76.6%)
Born abroad	544 (23.3%)
Missing	1 (0.0%)
Age, median (IQR)	42 (33–52)
Missing	17 (0.7%)
Sex	
Male	559 (24.0%)
Female	1762 (75.6%)
Missing	10 (0.4%)
IMD quintile	
1 (most deprived)	226 (9.7%)
2	369 (15.8%)
3	412 (17.7%)
4	492 (21.1%)
5 (least deprived)	579 (24.8%)
Missing	253 (10.9%)
Comorbidities	
Not diabetic	1666 (92.3%)
Diabetic	57 (3.2%)
Missing	83 (4.6%)
Comorbidities	
No other lung conditions	2206 (94.6%)
Other lung conditions	20 (0.9%)
Missing	105 (4.5%)
Comorbidities	
No depression	1964 (84.3%)
Depression	262 (11.2%)
Missing	105 (4.5%)
Comorbidities	
No anxiety	1875 (80.4%)
Anxiety	351 (15.1%)
Missing	105 (4.5%)
Comorbidities	
Not asthmatic	1913 (82.1%)
Asthmatic	313 (13.4%)
Missing	105 (4.5%)
Comorbidities	
No other CVDs*	2012 (86.3%)
Other CVDs*	214 (9.2%)
Missing	105 (4.5%)
BMI	
<25	990 (42.5 %)
≥25 and <30	659 (28.3%)
≥30 and <40	380 (16.3%)
≥40	63 (2.7%)
Missing	239 (10.3%)
Alcohol consumption	
1 (non-drinker)	371 (15.9%)
2 (monthly or less)	545 (23.4%)
3 (2–4 times per month)	594 (25.5%)
4 (2–3 times per week)	559 (24.0%)
5 (4+ times per week)	251 (10.8%)
Missing	11 (0.5%)
Smoking status	
Never/ex-smoker	2205 (94.6%)
Current smoker	101 (4.3%)
Missing	25 (1.1%)
Occupation	
Doctor or medical support	496 (21.3%)
Nurse, NA or midwife	524 (22.5%)
Allied health professional†	1018 (43.7%)
Dental	111 (4.8%)
Admin, estates or other	97 (4.2%)
Missing	85 (3.7%)

* heart diseases, heart problem, stroke, hypertension (HTN).
†Also includes pharmacists, healthcare scientists, ambulance workers and those in optical roles.
‡Includes those who have not had COVID-19 and those who have had COVID-19 without prolonged symptoms.
BMI, body mass index; CVDs, cardiovascular diseases; IMD, index of multiple deprivation; NA, Nursing Assistant; Ref, reference category for categorical variables.

that impact prevalence and self-reporting among ethnic minority groups. These findings could improve healthcare equity and inform strategies to enhance workforce resilience.[15] We sought to address these knowledge gaps using data from The United Kingdom Research study into Ethnicity And COVID-19 outcomes in Healthcare (UK-REACH) longitudinal cohort study. Specifically, we aimed to assess the prevalence of UK HCWs who reported having experienced long COVID and to examine its

Table 2 Description of the cohort with unadjusted ORs for the association of covariates with long COVID (those who were infected with COVID-19)

Variable	Total N=2331	
	Unadjusted OR	P value
Ethnicity		
White	Ref	
Asian	0.68 (0.51 to 0.90)	0.007
Black	0.50 (0.27 to 0.90)	0.021
Mixed	0.91 (0.57 to 1.45)	0.68
Other	0.76 (0.35 to 1.66)	0.49
Migration status		
Born in UK	Ref	–
Born abroad	0.62 (0.49 to 0.80)	<0.001
Age, per decade increase	1.24 (1.14 to 1.35)	<0.001
Sex		
Male	Ref	–
Female	1.37 (1.08 to 1.74)	0.01
IMD quintile		
1 (most deprived)	Ref	–
2	0.75 (0.51 to 1.11)	0.15
3	0.75 (0.52 to 1.09)	0.128
4	0.74 (0.52 to 1.05)	0.088
5 (least deprived)	0.72 (0.51 to 1.03)	0.07
Comorbidities		
Not diabetic	Ref	–
Diabetic	1.69 (1.07 to 2.69)	0.026
Comorbidities		
No depression	Ref	–
Depression	2.30 (1.75 to 3.01)	<0.001
Comorbidities		
No anxiety	Ref	–
Anxiety	2.08 (1.62 to 2.66)	<0.001
Comorbidities		
No other CVDs	Ref	–
Other CVDs	1.86 (1.38 to 2.52)	<0.001
Comorbidities		
Not asthmatic	Ref	–
Asthmatic	1.90 (1.47 to 2.47)	<0.001
Comorbidities		
No other lung conditions	Ref	–
Other lung conditions	5.31 (2.17 to 12.95)	<0.001
BMI		
<25	Ref	–
>=25 and <30	1.25 (0.99 to 1.59)	0.062
>=30 and <40	1.76 (1.33 to 2.32)	<0.001
>=40	2.15 (1.25 to 3.71)	0.006
Alcohol consumption		
1 (non-drinker)	Ref	–
2 (monthly or less)	1.10 (0.81 to 1.50)	0.53
3 (2–4 times per month)	0.92 (0.68 to 1.25)	0.596
4 (2–3 times per week)	0.76 (0.55 to 1.05)	0.095
5 (4+ times per week)	1.02 (0.70 to 1.48)	0.924
Smoking status		
Never/ex-smoker	Ref	–
Current smoker	0.89 (0.54 to 1.45)	0.64
Occupation		
Doctor or medical support	Ref	–
Nurse, NA or midwife	2.12 (1.57 to 2.87)	<0.001
Allied health professional*	1.52 (1.15 to 2.02)	0.003
Dental	1.07 (0.61 to 1.87)	0.808
Admin, estates or other	1.54 (0.90 to 2.62)	0.113

*Also includes pharmacists, healthcare scientists, ambulance workers and those in optical roles.
BMI, body mass index; CVDs, cardiovascular diseases; IMD, index of multiple deprivation; NA, Nursing Assistant; Ref, reference category for categorical variables.

associations with demographic, occupational and sociocultural factors in an ethnically diverse cohort.

METHODS

This study has been reported according to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for reporting observational studies in online supplemental material 1.[25]

Overview

This analysis is based on the data from the baseline questionnaire of the UK-REACH nationwide cohort study collected between December 2020 and March 2021. The study protocol,[26] cohort profile[27] and data dictionary (https://www.uk-reach.org/data-dictionary) provide detailed information on the study design, sampling and measures.

Study population

Participants included individuals aged 16 years or older—aligning with the UK definition of an adult as anyone 16 years or older—residing in the UK and working as HCWs or ancillary workers in a healthcare setting and/or registered with one of the seven major UK healthcare professional regulators.[26]

Table 3 Minimally aORs (for the basic demographic and occupational factors)

Variable	Total N=2331 Minimally aOR (95% CI)	P value
Ethnicity		
White	Ref	
Asian	1.03 (0.74 to 1.42)	0.88
Black	0.66 (0.36 to 1.23)	0.19
Mixed	1.22 (0.75 to 1.97)	0.425
Other	1.30 (0.58 to 2.95)	0.524
Migration status		
Born in UK	Ref	–
Born abroad	0.55 (0.55 to 0.97)	0.031
Age*	1.23 (1.13 to 1.34)	<0.001
Sex		
Male	Ref	–
Female	1.24 (0.97 to 1.60)	0.089
Occupation		
Doctor or medical support	Ref	–
Nurse, NA or midwife	1.76 (1.26 to 2.46)	0.001
Allied health professional†	1.42 (1.05 to 1.93)	0.023
Dental	0.97 (0.55 to 1.71)	0.906
Admin, estates or other	1.42 (0.82 to 2.46)	0.21

*for each decade increase in age.
†Also includes pharmacists, healthcare scientists, ambulance workers and those in optical roles.
NA, Nursing Assistant; Ref, reference category for categorical variables.

Recruitment

Professional regulatory bodies sent emails in December 2020 to their registrants containing a hyperlink to the study website. The sample was supplemented by direct recruitment through healthcare trusts and advertisement on social media and newsletters. Interested individuals could create a user profile, access the participant information sheet and provide online consent before completing the questionnaire. The UK-REACH cohort profile paper provides detailed information on how the cohort was recruited.[28]

Outcome measures

Our primary outcome was long COVID. Long COVID was defined in our study as symptoms that persisted for more than 5 weeks. The questionnaire's response categories included 'Less than 3 weeks', '3–5 weeks', 'More than 5 weeks but less than 3 months', 'More than 3 months but less than 6 months' and 'More than 6 months'. Consequently, we conducted our primary analysis using the 'More than 5 weeks' category as the closest approximation to our desired definition. This is because the questionnaire was developed early in the pandemic before long COVID became a recognised term and its definition was established. To align with the current standard definition of post-COVID-19 syndrome by NICE,[9] we conducted a sensitivity analysis using the 12-week cut-off and included these findings in our results.

Our cohort consisted of participants who reported being infected with COVID-19. A participant's history of COVID-19 was derived from answers to the question 'Do you think that you currently have or have had COVID-19?'. Those who answered 'Yes, my own suspicions', 'Yes, suspected by a doctor but not tested' or 'Yes, confirmed by a positive test' were considered to have had COVID-19. Those who reported having had COVID-19 were additionally asked 'How long have you been unwell since having COVID-19?'. Those who indicated that they were unwell for 5 weeks or longer since having COVID-19 were considered to have had long COVID. Those who indicated they were unwell for 3–5 weeks or shorter were considered not to have had long COVID.

Exposure

Our primary exposure of interest was self-reported ethnicity, which we classified according to the 5- and 18-level ethnic group categories provided by the UK's ONS.[29] We used the five-level variable (White, Asian, Black, Mixed and Other) in the primary analysis to ensure sufficient statistical power for detecting differences between these groups.

Covariates

The selection of additional variables for inclusion in models that are potentially linked to the outcome was predetermined as there is a possibility that they are associated risk factors. Demographic characteristics were included, such as age, sex and migration status. Job roles were categorised into five groups: (1) Doctor or medical support; (2) Nurse, Nursing Assistant (NA) or Midwife; (3) Allied Health Professional (AHP), which also includes pharmacists, healthcare scientists, ambulance workers and those in optical roles; (4) Dental and (5) Admin, estates or other roles.

Household, residential and social factors were also considered, specifically the index of multiple deprivation (IMD), the official measure of relative deprivation for small areas in England, expressed as quintiles.[30] Alcohol consumption was measured on a scale from 1 to 5 to represent the frequency of alcohol intake, and smoking status was also included. Body mass index (BMI) was categorised into four groups: (1) BMI<25; (2) BMI≥25 and < 30; (3) BMI≥30 and < 40 and (4) BMI≥40. Additionally, self-reported comorbidities were accounted for, including diabetes (type 1 or type 2), asthma, other lung conditions, such as chronic obstructive pulmonary disease, bronchitis

Table 4 Multivariable analysis of factors associated with long COVID for those who were infected with COVID-19 (fully aORs)

Variable	Total N=2331 Fully aOR (95% CI)	P value
Ethnicity		
White	Ref	–
Asian	0.89 (0.63 to 1.26)	0.514
Black	0.54 (0.28 to 1.02)	0.056
Mixed	1.06 (0.64 to 1.75)	0.829
Other	1.16 (0.49 to 2.75)	0.729
Migration status		
Born in UK	Ref	–
Born abroad	0.75 (0.56 to 1.01)	0.054
Age, per decade increase	1.29 (1.17 to 1.42)	<0.001
Sex		
Male	Ref	–
Female	1.30 (1.00 to 1.70)	0.054
IMD quintile		
1 (most deprived)	Ref	–
2	0.73 (0.48 to 1.11)	0.139
3	0.68 (0.46 to 1.01)	0.059
4	0.66 (0.45 to 0.97)	0.036
5 (least deprived)	0.66 (0.45 to 0.97)	0.035
Comorbidities		
Not diabetic	Ref	–
Diabetic	1.30 (0.78 to 2.15)	0.318
Comorbidities		
No depression	Ref	–
Depression	1.50 (1.07 to 2.11)	0.018
Comorbidities		
No anxiety	Ref	–
Anxiety	1.59 (1.17 to 2.17)	<0.001
Comorbidities		
No other CVDs	Ref	–
Other CVDs	1.42 (1.01 to 2.00)	0.047
Comorbidities		
Not asthmatic	Ref	–
Asthmatic	1.88 (1.43 to 2.48)	<0.001
Comorbidities		
No other lung conditions	Ref	–
Other lung conditions	3.56 (1.36 to 9.32)	0.01
BMI		
<25	Ref	–
>=25 and <30	1.12 (0.87 to 1.44)	0.374
>=30 and <40	1.32 (0.98 to 1.80)	0.072
>=40	1.46 (0.81 to 2.64)	0.208
Alcohol consumption		
1 (non-drinker)	Ref	–
2 (monthly or less)	0.96 (0.68 to 1.34)	0.79
3 (2–4 times per month)	0.86 (0.61 to 1.20)	0.375
4 (2–3 times per week)	0.63 (0.44 to 0.91)	0.012
5 (4+ times per week)	0.74 (0.49 to 1.13)	0.159
Smoking status		
Never/ex-smoker	Ref	–
Current smoker	0.72 (0.43 to 1.22)	0.226
Occupation		
Doctor or medical support	Ref	–
Nurse, NA or midwife	1.32 (0.93 to 1.87)	0.126
Allied health professional*	1.28 (0.94 to 1.75)	0.123
Dental	0.86 (0.48 to 1.55)	0.626
Admin, estates or other	1.07 (0.60 to 1.91)	0.828

*Also includes pharmacists, healthcare scientists, ambulance workers and those in optical roles.
BMI, body mass index; CVDs, cardiovascular diseases; IMD, index of multiple deprivation; NA, Nursing Assistant; Ref, reference category for categorical variables.

and emphysema, as well as depression, anxiety and other cardiovascular diseases (CVDs).

[30]A description of each variable and how it was derived from questionnaire responses can be found in derivation of covariates from questionnaire data in online supplemental material 2 in the supplementary materials.

Statistical analysis

We excluded those with missing data for the primary exposure and outcome of interest from all analyses. We were primarily interested in determining factors associated with long COVID in those with a history of acute COVID-19 infection and in the association of ethnicity with long COVID. As a secondary analysis, we additionally included those without a history of acute COVID-19 infection to determine whether the same factors were also associated experiencing long COVID in HCW generally and to establish whether risk factors for long COVID

differ from risk factors for initial SARS-CoV-2 infection identified in previous work.

We summarised categorical variables as frequency and percentage, and non-normally distributed continuous variables as median (interquartile range [IQR]). We compared demographic, household, occupational and other factors between ethnic groups using χ^2 tests as all our variables were categorical data and Kruskal–Wallis tests for continuous data.

We used univariable and multivariable logistic regression to determine unadjusted and adjusted associations of the variables described above with long COVID and report results as unadjusted and adjusted ORs (aORs) and 95% CIs.

We reported frequency and percentage of observations with missing data for each variable of interest both overall and stratified by ethnicity.

We used multiple imputations by chained equations to impute missing data in these logistic regression models.[31] We also used Rubin's rules to combine the parameter estimates and standard errors from ten imputations into a single set of results.[32] Although indices of deprivation are available for UK countries outside England (ie, Scotland, Wales and Northern Ireland), it is recognised that these are not directly comparable with English IMD. We, therefore, elected to code IMD as missing for those outside England and impute the missing information.

The imputation models used in the final analyses included all variables, including the outcome measure.

To investigate the extent to which differences in long COVID risk by ethnic group could be explained by other related risk factors, we generated a base logistic regression model (ie, the minimally adjusted model), in which we adjusted for basic demographic/occupational variables (ie, age, sex, migration status and job role). We then added additional variables to explore the health and lifestyle factors, including, IMD, long-term conditions, BMI, smoking status and alcohol consumption, to this base model, which we called 'fully adjusted model' to assess whether these factors may contribute to ethnic differences in long COVID prevalence.

In order to assess the potential impact of imputing missing data on our results, we conducted a sensitivity analysis using only observations with complete data in all covariates. This analysis aimed to evaluate the robustness of our findings when dealing with missing data.

We conducted a sensitivity analysis of HCWs reporting symptoms persisting for more than 3 months, consistent with the NICE definition of long COVID. This analysis aimed to identify specific factors associated with prolonged symptom duration, thereby contributing to a more nuanced understanding of long COVID and exploring potential variations from the findings of our primary analysis.

All analyses and multiple imputations were performed using Stata 17 (StataCorp. 2021. Stata Statistical Software: Release 17. College Station, TX: StataCorp LLC.).

Patient and public involvement

We worked closely with a Professional Expert Panel of HCWs from a diverse ethnic and occupational background who helped with shaping the research question and designing the questionnaire of this study.

RESULTS

Cohort recruitment and formation of the analysis sample

Figure 1 illustrates the recruitment of the cohort. This is explained in detail, including the response rates in previous publications.[26 33] In summary, 11 513 HCWs formed the analysis sample, of whom 2331 (20.2%) reported having had COVID-19.

Description of the analysed cohort

Tables in the main manuscript present the description and analysis of the cohort that reported having had COVID-19 (2331 HCWs). A description of the analysed cohort (N=2331), stratified by ethnicity, is shown in online supplemental material 3 in the supplementary materials. Almost all of the predictor variables significantly differed by ethnicity. Age was significantly different by ethnic group (p<0.001), Black and Asian cohorts were younger on average than White cohorts (Black 39 (IQR 33–53), Asian 39 (IQR 31–48) and White 44 (IQR 33–54)). A greater proportion of Black HCWs lived in areas corresponding to lower IMD quintiles than White HCWs. Migration status was also significantly different by ethnic group (p<0.001) with much greater proportions of Black, Asian and Other HCWs being born outside the UK compared with the White cohort (63.2% (Black), 55.3% (Asian) and 73.2% (Other) vs 12.6% (White)). Ethnic distribution was not equal across different reported long-term conditions. Self-reported depression and anxiety were notably higher in the White cohort compared with Asian, Black, Mixed and Other groups, while comorbidities such as asthma and other lung conditions showed less variability across the ethnic groups (online supplemental material 3 in the supplementary materials).

Table 1 presents a description of the analysed cohort. The majority of participants (75.6%) identified as female, and the median age was 42 years (IQR 33–52). Approximately, 27% of the cohorts were from an ethnic minority group (16.7% Asian, 4.1% Black, 4.6% Mixed and 1.8% Other). 23.3% were born outside the UK. Online supplemental material 4–online supplemental material 8 in the supplementary materials present the description and analysis of the whole cohort (11 513 HCWs).

Prevalence of long COVID

Overall, we found that among HCWs with a self-reported history of acute COVID-19 (2331) 22.5% (525/2331) experienced long COVID. Among the whole cohort (11513), 4.6% (525) of HCWs experienced long COVID. 21.7% (114) of those who experienced long COVID were from ethnic minority groups, compared with 28.6% (518) who did not experience long COVID. Among those

who reported long COVID, 17.3% were born abroad, compared with 25.1% among those who did not report long COVID. Differences in prevalence between other variables are shown in the table of online supplemental material 9 (Characteristics and distribution of the variables in the cohort) in the supplementary materials and table 1. In sensitivity analyses, we found that 316/2331 (13.6%) HCWs experienced symptoms lasting more than 3 months, and 215/2331 (9.2%) experienced symptoms lasting more than 6 months. Of those, 65/316 (20.6%) and 38/215 (17.7%) were from ethnic minorities, respectively (see online supplemental material 10—Prevalence of long COVID by duration of symptoms—and online supplemental material 11—Ethnic distribution of HCWs experiencing long COVID symptoms by duration—online supplemental tables in the supplementary materials).

Univariable analysis of risk factors for long COVID

Demographic risk factors

Table 2 presents the unadjusted ORs for the association of covariates with long COVID. The odds of HCWs of Black ethnicity (OR 0.50, 95% CI 0.27 to 0.90; p=0.021) or Asian ethnicity (OR 0.68, 95% CI 0.51 to 0.90; p=0.007) experiencing long COVID were lower than for HCWs of White ethnicity. HCWs who were born abroad also had lower odds of experiencing long COVID than those born in the UK (OR 0.62, 95% Cl 0.49 to 0.80; p<0.001).

Compared with HCW participants who did not have long COVID, participants with long COVID were older (OR 1.24, 95% Cl 1.14 to 1.35; p=<0.001) and more likely to be female (OR 1.37, 95% CI 1.08 to 1.74; p=0.010) (table 2).

Occupational risk factors

The odds of experiencing long COVID for HCWs in a nursing role were higher than that of those in medical roles (OR 2.12, 95% CI 1.57 to 2.87; p<0.001), as shown in table 2. Additionally, Allied Health Professionals (which in our study includes ambulance workers, optometrists and pharmacists) had higher odds of experiencing long COVID compared with medical roles (OR 1.52, 95% Cl 1.15 to 2.02; p=0.003).

Health risk factors

HCWs with self-reported comorbidities diabetes, asthma, other lung conditions, CVDs, depression, anxiety and/or asthma were more likely to experience long COVID compared with those who did not report having these conditions (table 2). Those who had a BMI of ≥30 to <40 kg/m^2 were more likely to have reported long COVID compared with those with BMI<25 kg/m^2 (OR 1.76, 95% CI 1.33 to 2.23; p<0.001).

Multivariable analysis of risk factors for long COVID

Minimally adjusted model

Demographic and occupational factors

On multivariable analysis in a minimally adjusted model where we adjusted for migration status, age, sex and job role, we found that older HCWs were more likely to experience long COVID (adjusted OR [aOR] 1.23, 95% CI 1.13 to 1.34; p<0.001) for each decade increase in age. HCWs who were born outside the UK were less likely to experience long COVID compared with those born in the UK (aOR 0.55, 95% CI 0.55 to 0.97; p=0.031). Compared with medical roles, those working in nursing and midwifery roles (aOR 1.76, 95% CI 1.26 to 2.46; p=0.001) and AHPs (aOR 1.42, 95% CI 1.05 to 1.93; p=0.023) were more likely to experience long COVID (table 3).

Fully adjusted model

Demographic, occupational and health risk factors

On multivariable analysis in a fully adjusted model where we adjusted for migration status, age, sex, job role, IMD, self-reported comorbidities (ie, diabetes, other lung conditions, depression, anxiety, asthma and other CVDs), BMI, alcohol consumption and smoking status, we found that older HCWs had an increased risk, with each decade increase in age leading to higher odds of experiencing long COVID (aOR 1.23, 95% CI 1.13 to 1.34; p<0.001). Additionally, self-reported depression (aOR 1.50, 95% CI 1.07 to 2.11; p=0.018) and anxiety (aOR 1.59, 95% CI 1.17 to 2.17; p<0.001) were associated with an elevated risk of long COVID (table 4). Asthma was also a significant risk factor (aOR 1.88, 95% CI 1.43 to 2.48; p<0.001). Alcohol consumption 2–3 times per week was associated with a lower risk of long COVID compared with those drinking no alcohol (aOR 0.63, 95% CI 0.44 to 0.91; p=0.012).

Association of ethnicity with long COVID risk

There were no significant differences in risk of long COVID by ethnic group.

Sensitivity analyses

Conducting the analysis on observations with complete data in all covariates for the fully adjusted model for the univariable analysis and fully adjusted and minimally adjusted models (see online supplemental material 8—Sensitivity analysis of factors associated with long COVID for those who were infected with COVID-19 and the whole cohort preceding imputation of the data—online supplemental table in the supplementary materials) did not significantly alter interpretation of the results of the primary analysis (i.e., the significant predictors remained the same).

We conducted both fully and minimally adjusted multivariable analyses (see online supplemental material 12—Sensitivity analysis: multivariable analysis of factors associated with long COVID that persists for longer than 3 months (fully aOR)—and online supplemental material 13—Sensitivity analysis: multivariable analysis of factors associated with long COVID that persists for longer than 3 months (minimally aOR)—online supplemental tables in the supplementary materials) to identify unique factors related to prolonged symptoms for more than 3 months. A key finding in the fully adjusted model (online supplemental material 12) was that HCWs, who self-reported COVID-19 were born outside the UK and

experienced symptoms for more than 3 months, were less likely to experience long COVID compared with those born in the UK (aOR 0.65, 95% CI 0.44 to 0.94; p=0.022). This was not significant in the fully adjusted model of our primary analysis (see table 4).

DISCUSSION

Prevalence of long COVID

We report the first findings from the largest nationwide study of long COVID and its associated risk factors in HCWs across the UK. Among the whole cohort (11 513), 4.6% (525) of HCWs reported long COVID. Our study findings align with a report by the ONS, which estimated that the prevalence of self-reported long COVID among HCWs in the UK is approximately 4.4%.[24] While ONS data underscore the heightened risk of long COVID among HCWs compared with non-HCWs (2.9%), largely attributed to their occupational exposure and unique risk factors, our study adds to the literature by now highlighting the subgroups of HCWs with an increased long COVID prevalence, providing important insights into occupational and sociodemographic disparities.[34]Similarly, a systematic review by Cruickshank *et al* (2024) reported long COVID prevalence among HCWs ranging from 23% to 73%, reflecting variations in study design, population characteristics and geographic context.[35] While our findings fall within this range, they highlight the importance of a standardised approach to defining and measuring long COVID across studies to enable meaningful comparisons.[36]

The ongoing relevance of long COVID research extends beyond the immediate consequences of the condition, as evidence indicates that long COVID continues to affect workforce capacity through increased absenteeism and reduced productivity, posing risks to healthcare system resilience.[37 38] Addressing these challenges is critical as HCWs remain a cornerstone of healthcare delivery during the postpandemic recovery phase.

Ethnicity and cultural factors in long COVID risk

One key aspect of our findings highlights the complex relationship between ethnicity and long COVID, which is influenced not just by physiological factors but by social and psychological dimensions. In our analysis, we found an association of ethnicity with long COVID risk in the univariable analysis. Additionally, in our minimally adjusted model, HCWs from Mixed and Other ethnic groups showed an increased risk of long COVID compared with White HCWs, but this association was attenuated after adjusting for other variables. Our findings are in agreement with the published literature. Notably, in the posthospitalisation COVID-19 UK-multicentred study, which sought to identify factors related to recovery from COVID-19 among 1077 patients discharged from hospitals, no significant association was found between ethnicity and the absence of full recovery.[39]

Studies have shown that cultural norms and migration-related challenges can lead to different perceptions of health and illness. For example, a community study of over 600 000 individuals in England found that Asian ethnicity was associated with lower risk of persistent symptoms compared with people of White ethnicity.[40] This finding may not necessarily reflect lower symptom burden but rather differences in symptom interpretation and reporting tendencies. The complex relationship among ethnicity, COVID-19 outcomes and long COVID remains an area of active research. Socioeconomic disparities, cultural factors, migration status and differences in healthcare access may contribute to varying outcomes among different ethnic groups.[41] This raises important questions about whether the lower risk of long COVID observed in certain ethnic minority groups is reflective of actual differences in risk or whether it may be attributed to lower reporting, cultural differences in reporting of symptoms, differences in access to healthcare services or other underlying factors.[29 42] One of our findings on migration status was that HCWs who were born outside the UK were less likely to experience post-COVID-19 syndrome (ie, long COVID for more than 3 months) compared with those born in the UK. Several factors might account for this finding. Migrant HCWs in the UK on work visas may not have provisions for extended sick leave.[43] This might discourage them from reporting or acknowledging the symptoms of long COVID due to concerns about job security or potential repercussions.[29 42] Cultural or socioeconomic factors could also play a role.[44] For instance, migrant HCWs might underreport symptoms of long COVID due to a cultural tendency to endure health challenges without complaint or the pressures of being in a foreign country.[43] Moreover, stigma and cultural barriers about mental illnesses, such as depression and anxiety, in some ethnic minority communities may have influenced self-awareness and self-reporting of these conditions.[45] Research in this area has highlighted that different cultural contexts can significantly impact how mental health symptoms are perceived and reported.[40 41]This suggests that our findings on self-reported mental health conditions might be influenced by these sociocultural factors, leading to variations in reporting rather than actual differences in prevalence. By not fully accounting for these disparities, healthcare systems risk underestimating the impact of long COVID within these communities.

Occupational risk factors

Our results from the minimally adjusted model revealed that HCWs in nursing professions and AHPs were more likely to experience long COVID compared with doctors. However, this association was attenuated in the fully adjusted model. One potential explanation for this attenuation is confounding. Variables like long-term conditions, IMD, alcohol consumption and smoking status could vary by both job role and the likelihood of experiencing long COVID, which makes them potential

confounders. Furthermore, there is a possibility of statistical overadjustment. By controlling for variables that might be in the causal pathway, we could be inadvertently masking the impact of the profession on long COVID risk. As such, considering the findings of our minimally adjusted model raises important questions about the potential role of different exposures and job tasks in contributing to the risk of long COVID among HCWs.[42] Previous research has highlighted that frontline HCWs, especially those in direct patient care roles, may face a higher risk of COVID-19 infection and its consequences due to repeated exposure to the virus.[43]

Health-related risk factors and comorbidities

We also found that HCWs with self-reported comorbidities, such as diabetes, asthma, other lung conditions, CVDs, depression or anxiety, were more likely to experience long COVID. These results align with existing evidence that underlying health conditions may play a role in the development of long-term symptoms.[44] Notably, in our study, obesity was associated with an increased risk of long COVID. This finding is consistent with a study of 2053 workers in health and social services in Germany that found that participants with obesity were more affected in terms of symptoms persisting for longer than 3 months.[45]

Strengths and limitations

To the best of our knowledge, this is the first and largest study in the UK examining factors associated with long COVID in HCWs, with implications beyond the UK. The occupational and sociodemographic challenges identified here are relevant internationally, suggesting that EDI-aligned approaches can benefit HCWs in diverse healthcare settings. Adopting EDI-focused strategies informed by these findings could help enhance workforce resilience and patient care globally, providing a framework for addressing similar challenges in other countries. Limitations of this study include its cross-sectional design, which limits the ability to establish causality and temporality between the identified risk factors and long COVID. This has particular relevance to the findings related to anxiety and depression as these could potentially occur as a result of long COVID. Additionally, the study relied on self-reported data, which may introduce recall bias or social desirability bias. We defined long COVID as symptoms persisting for more than 5 weeks to be inclusive of the NICE definition of long COVID, which includes both ongoing symptomatic COVID-19 (signs/symptoms for 4–12 weeks) and post-COVID-19 syndrome (signs/symptoms for >12 weeks), and our question regarding ongoing symptoms for 5 weeks or longer, which we developed prior to the development of standardised case definitions of long COVID. However, acknowledging the current NICE definition,[9] we conducted a sensitivity analysis using the 12-week cut-off and found no significant differences in the results. Furthermore, one potential limitation of our study is the reliance on email invites and online questionnaires, which may not have been accessible to all participants, particularly those on sick leave who might have had limited access to their emails. Despite these limitations, the findings provide valuable insights into the risk factors associated with long COVID among HCWs, emphasising the importance of age, comorbidities, mental health and occupation in contributing to long-term outcomes. Furthermore, our study addresses a notable research gap by examining the predictors of long COVID within HCWs. This is particularly relevant considering the pronounced impact of the pandemic on HCWs, which has received insufficient attention so far.

Implications and conclusions

In conclusion, this study highlights several risk factors for long COVID among HCWs infected with COVID-19. Older age, females, presence of comorbidities (eg, asthma, depression and anxiety) and working in nursing or AHPs were associated with increased odds of long COVID. These findings provide valuable insights into an under-represented group, enabling the development of targeted interventions to improve outcomes for HCWs and patient care quality.

Our results underscore the need for future research to explore these social and psychological factors in depth. Longitudinal analyses to examine factors associated with recovery from long COVID in addition to qualitative study designs are recommended to better understand the experience of HCWs with long COVID, particularly migrants and those from ethnic minority backgrounds. Furthermore, our work highlights the need for further research into the recovery process from long COVID both for health services and long COVID patients themselves, which could provide valuable information for developing effective treatment and support strategies.

Future research should focus on longitudinal analyses and qualitative studies to understand recovery processes and the social and psychological factors affecting HCWs, particularly migrants and ethnic minorities. Targeted health interventions, including regular health screenings, workload adjustments and enhanced mental health support, are essential for older HCWs, females, those with specific comorbidities and professionals in nursing or allied health roles. Addressing these needs is critical to ensuring equitable health outcomes and sustaining the healthcare workforce. See figure 2 for take-home messages.

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