Appendix

Discrimination, feeling undervalued, and health-care workforce attrition: an analysis from the UK-REACH study

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Appendix

Supplementary Text.

Detailed methods

Overview

The overarching aim of the UK-REACH study is to understand the impact of the pandemic on healthcare workers (HCWs) and whether this differs according to ethnicity. This analysis uses data from the 3rd questionnaire (administered between October 2021 and December 2021) of the prospective nationwide cohort study. Details of the study design, sampling and measures included in the baseline questionnaire can be found in the study protocol[1] and the data dictionary (https://www.uk-reach.org/data-dictionary). A detailed description of the cohort can be found in the cohort profile paper.[2]

Study population

We recruited individuals aged 16 years or over, living in the UK and employed (in full or part time capacity) 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).

Recruitment

Recruitment is described in detail in the study protocol[1] and in previous publications.[2-5] In short, participating healthcare regulators sent emails to their registrants informing them of the study. The sample was supplemented by direct recruitment through participating healthcare trusts, and advertising on social media and in newsletters. Those interested could access the study website, read the participant information sheet and provide online consent, after which they could access the baseline questionnaire. Invitations to complete the second and third questionnaires were emailed to all consented participants.

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Outcome measure

We derived a binary outcome measure from responses to the questionnaire item *"Has the COVID-19 pandemic made you consider or act upon any of the following in relation to your work? (select all that apply)"*. Participants could select *"No", "Yes, considered" or "Yes, acted upon"* in relation to the following options: *1, Reducing the hours you work in your current job; 2, Changing the field in which you work (e.g. changing speciality); 3, Leaving your healthcare role entirely; 4, Reducing clinical duties; 5, Taking early retirement; 6, Other (please specify); 0, None of the above; 99, Prefer not to answer".*

Responses to the questionnaire item allowed participants to be coded as either having considered or acted upon making any changes to their role in response to the COVID-19 pandemic (1) or not (0).

Exposures

The primary exposures of interest were:

1) The degree to which a participant reported feeling that their work was valued by the Government; by the public; and by their employer, with responses on a 5-point Likert scale from strongly disagree to strongly agree.
2) Whether or not a participant had experienced discrimination in the past 6 months (yes or no) and if yes, whether this discrimination was from patients, colleagues or both.

Covariates

To examine the relationship of sociodemographic and occupational parameters and to adjust for hypothesised confounders of the relationship between exposure and outcome, we included age (categorised into < 40, 40 to < 50, 50 to <60 and ≥60), sex, ethnicity (self-reported and categorised into 5 groups according the Office for National Statistics classification[6]), and occupation in the multivariable analyses.

Appendix

Statistical analysis

We excluded those with missing data for the outcome, exposures of interest or ethnicity. We summarised categorical variables as frequency and percentage and present these data for the total sample and stratified by outcome measure in the supplementary appendix. We used multivariable logistic regression to examine associations of the exposures of interest and the other covariates described above with the binary outcome considering or acting upon changing healthcare role as a result of the pandemic. In doing so we constructed a base model of age, sex, ethnicity and occupation and then added variables representing our primary exposures of interest separately to the model. We present this data in a figure showing odds ratios and 95% confidence intervals for each exposure of interest and covariate after adjustment for age, sex, ethnicity and occupation.

Multiple imputation by chained equations was used to impute missing age, sex and occupation data in the logistic regression models. The imputation models contained all variables bar those being imputed, including the outcome measure. Rubin's Rules were used to combine the parameter estimates and standard errors from 10 imputations into a single set of results.[7]

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

Subgroup and sensitivity analyses

We undertook a number of subgroup and sensitivity analyses:

1. We investigated whether interactions between demographic and occupational covariates (age, sex, ethnicity and occupation) and our primary exposures of interest (feeling work was valued and experiences of discrimination) improved model fit. We did this by comparing a model that included the interaction term with one that did not using a likelihood ratio test. Any significant interaction terms were further explored by calculating adjusted odds of attrition intentions/actions at each level of the interacting covariates.
2. We investigated the reasons that were given by HCW excluded from the main analysis on the basis of working status as to why they were not in work at the time of data collection. We also

investigated the proportion of HCW reporting attrition intentions/actions after inclusion of those excluded from the main analysis on the basis of working status. This was to ensure we were not excluding large numbers of participants who have left the workforce (which could have led to an underestimate of the proportion of HCWs with attrition intentions).

3. We repeated the main logistic regression analysis after exclusion of those who reported specific attrition actions (taking early retirement or leaving the healthcare workforce). We did this as it is possible anyone who left the workforce answered the 'feeling valued' questions with respect to their current role (as opposed to the healthcare role they had left).

Ethical approval

The study was approved by the Health Research Authority (Brighton and Sussex Research Ethics Committee; ethics reference: 20/HRA/4718). All participants gave written informed consent.

Involvement and engagement

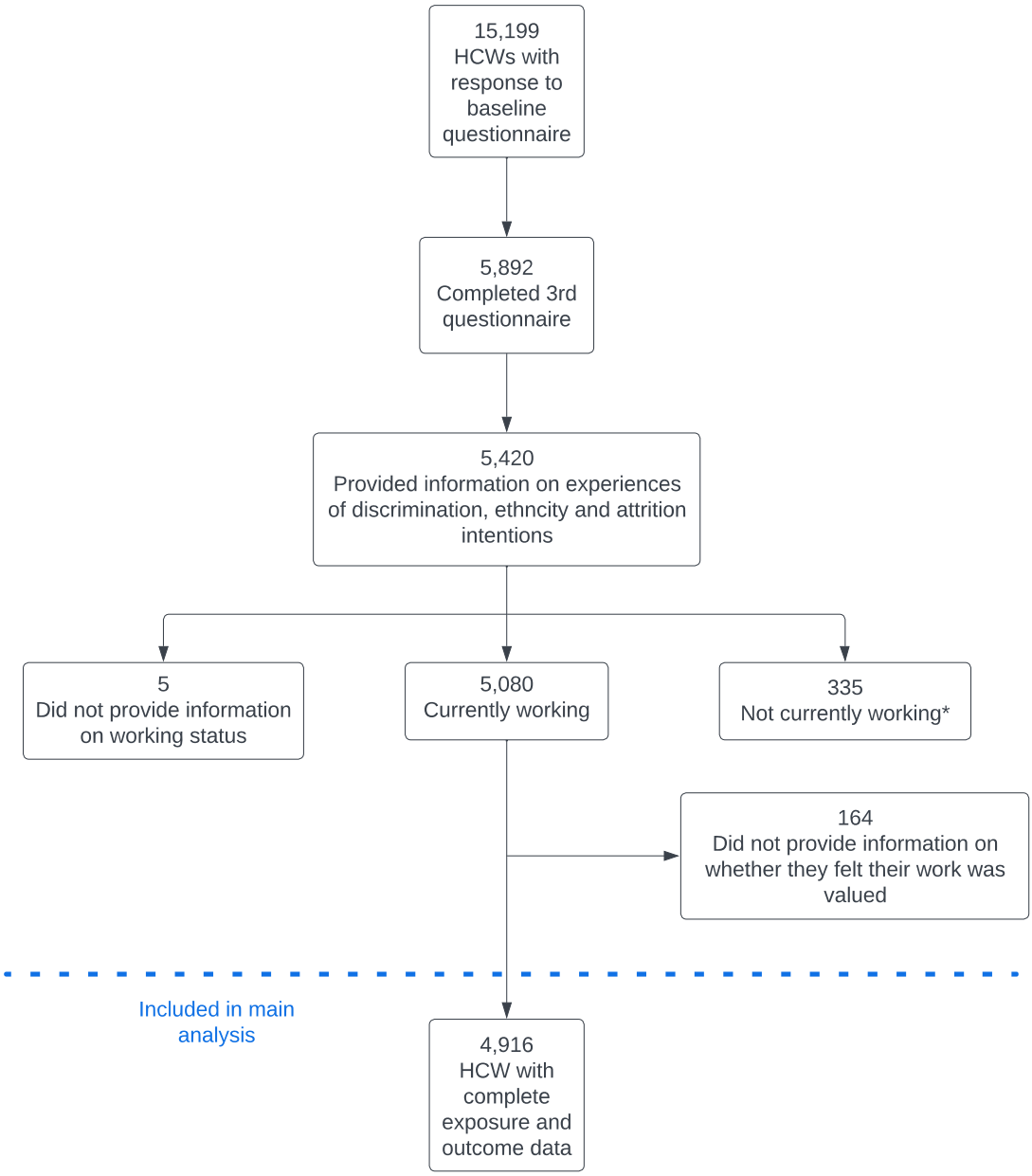
We work closely with a Professional Expert Panel comprised of an ethnically and occupationally diverse group of HCWs as well as with national and local organisations (see study protocol).[1]

Role of the funding source

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

Appendix

Supplementary Figure 1. Formation of the analysed sample.



Supplementary Figure 1 shows the formation of the analysed sample from those who completed the first UK-REACH questionnaire. For details of the initial recruitment into the study, see cohort profile[2].

*included in subgroup and sensitivity analyses presented in Supplementary Tables 4 and 5. HCW – healthcare worker.

Appendix

Supplementary Table 1. Description of the analysed sample

Variable	Total	Has not considered changing or leaving role	Has considered changing or leaving role	Has acted upon changing or leaving role	Has either considered or acted upon changing or leaving role
	n=4,916	n=2,558 (52.0)	n=1,668 (33.9)	n=690 (14.0)	n=2,358 (48.0)
Age (years)					
< 40	1,652 (33.6)	872 (34.1)	569 (34.1)	211 (30.6)	780 (33.1)
40 to < 50	1,257 (25.6)	683 (26.7)	420 (25.1)	154 (22.3)	574 (24.3)
50 to < 60	1,452 (29.5)	681 (26.6)	530 (31.8)	241 (34.9)	771 (32.7)
≥ 60	534 (10.9)	312 (12.2)	142 (8.5)	80 (11.6)	222 (9.4)
Missing	21 (0.4)	10 (0.4)	7 (0.4)	4 (0.6)	11 (0.5)
Sex					
Male	1,180 (24.0)	701 (27.4)	351 (21.0)	128 (18.6)	479 (20.3)
Female	3,728 (75.8)	1,852 (72.4)	1,315 (78.8)	561 (81.3)	1,876 (79.6)
Missing	8 (0.2)	5 (0.2)	2 (0.1)	1 (0.1)	3 (0.1)
Ethnicity					
White	3,640 (74.0)	1,890 (73.9)	1,228 (73.6)	522 (75.7)	1,750 (74.2)
Asian	819 (16.7)	441 (17.2)	281 (16.9)	97 (14.1)	378 (16.0)
Black	172 (3.5)	98 (3.8)	50 (3.0)	24 (3.5)	74 (3.1)
Mixed	193 (3.9)	82 (3.2)	80 (4.8)	31 (4.5)	111 (4.7)
Other	92 (1.9)	47 (1.8)	29 (1.7)	16 (2.3)	45 (1.9)
Occupation					
Medical	1,142 (23.2)	603 (23.6)	401 (24.0)	138 (20.0)	539 (22.9)
Nursing (inc. midwifery, NA, HCA)	1,078 (21.9)	476 (18.6)	410 (24.6)	192 (27.8)	602 (25.5)
Allied Health Professionals	1,405 (28.6)	767 (30.0)	427 (25.6)	211 (30.6)	638 (27.1)
Pharmacy	100 (2.0)	52 (2.0)	37 (2.2)	11 (1.6)	48 (2.0)
Healthcare scientist	247 (5.0)	156 (6.1)	75 (4.5)	16 (2.3)	91 (3.9)
Ambulance	178 (3.6)	98 (3.8)	68 (4.1)	12 (1.7)	80 (3.4)
Dental	265 (5.4)	123 (4.8)	97 (5.8)	45 (6.5)	142 (6.0)
Optical	104 (2.1)	59 (2.3)	34 (2.0)	11 (1.6)	45 (1.9)
Administrative	106 (2.2)	62 (2.4)	36 (2.2)	8 (1.2)	44 (1.9)
Estates/facilities	35 (0.7)	22 (0.9)	10 (0.6)	3 (0.4)	13 (0.6)
Other	131 (2.7)	77 (3.0)	33 (2.0)	21 (3.0)	54 (2.3)
Missing	125 (2.5)	63 (2.5)	40 (2.4)	22 (3.2)	62 (2.6)
Sources of discrimination† (in past 6 months)					
Not experienced discrimination*	3,875 (78.8)	2,196 (85.9)	1,200 (71.9)	479 (69.4)	1,679 (71.2)
Patients	403 (8.2)	161 (6.3)	166 (10.0)	76 (11.0)	242 (10.3)
Colleagues	449 (9.1)	142 (5.6)	212 (12.7)	95 (13.8)	307 (13.0)
Patients & colleagues	189 (3.8)	59 (2.3)	90 (5.4)	40 (5.8)	130 (5.5)
"I feel my work is valued by the Government" †					
Strongly disagree	1,091 (22.1)	389 (15.2)	493 (29.6)	209 (30.3)	702 (29.8)
Disagree	1,247 (25.4)	581 (22.7)	490 (29.4)	176 (25.5)	666 (28.2)
Neither agree nor disagree	1,277 (26)	737 (28.8)	369 (22.1)	171 (24.8)	540 (22.9)
Agree	909 (18.5)	578 (22.6)	238 (14.3)	93 (13.5)	331 (14.0)
Strongly agree	392 (8)	273 (10.7)	78 (4.7)	41 (5.9)	119 (5.1)
"I feel my work is valued by my employer" †					
Strongly disagree	318 (6.5)	98 (3.8)	160 (9.6)	60 (8.7)	220 (9.3)
Disagree	691 (14.1)	247 (9.7)	324 (19.4)	120 (17.4)	444 (18.8)
Neither agree nor disagree	884 (18.0)	396 (15.5)	367 (22.0)	121 (17.5)	488 (20.7)
Agree	1,782 (36.3)	1,039 (40.6)	535 (32.1)	208 (30.1)	743 (31.5)
Strongly agree	1,241 (25.2)	778 (30.4)	282 (16.9)	181 (26.2)	463 (19.6)
"I feel my work is valued by the public" †					
Strongly disagree					
Disagree	239 (4.9)	81 (3.2)	119 (7.1)	39 (5.7)	158 (6.7)
Neither agree nor disagree	630 (12.8)	214 (8.4)	305 (18.3)	111 (16.1)	416 (17.6)
Agree	817 (16.6)	416 (16.3)	291 (17.5)	110 (15.9)	401 (17.0)
Strongly agree	2,034 (41.4)	1,124 (43.9)	659 (39.5)	251 (36.4)	910 (38.6)
	1,196 (24.4)	723 (28.3)	294 (17.6)	179 (25.9)	473 (20.1)

*also includes those who have not worked in the last 6 months; † participants were excluded if they were missing information in these fields (as these were the exposures/outcomes of interest) All data are n(%). Percentages are computed column-wise apart from the totals in the uppermost cells which are computed row-wise.

Appendix

Supplementary Table 2. Investigating interaction effects

Interaction	Result of likelihood ratio test (p value). Interaction vs no interaction
Valued by Government	
Age	0.09
Sex	0.49
Ethnicity	0.60
Occupation	0.52
Valued by public	
Age	0.001
Sex	0.26
Ethnicity	0.20
Job	0.14
Valued by employer	
Age	0.42
Sex	0.52
Ethnicity	0.52
Job	0.28
Sources of discrimination	
Age	0.62
Sex	0.45
Ethnicity	0.61
Job	0.58

Supplementary Table 2 shows the results of likelihood ratio tests comparing nested multivariable logistic regression models (a model containing an interaction term between the sociodemographic covariates and our primary exposures of interest and a model without such a term). Models included the other covariates used in the main analysis. The only interaction that improved model fit was between age and feeling that work was valued by the public. This is explored in greater detail in Supplementary Table 3. It should be noted that some of the subgroups were very small necessitating their exclusion from models with the interaction term and thus from the comparator models to ensure models were based on the same observations.

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Supplementary Table 3. Exploring the interaction between age and feeling work was valued by the public

Age	Work valued by public	Odds ratio (95%CI)
< 40	Strongly disagree	2.00 (1.22 – 3.27)
	Disagree	1.75 (1.22 – 2.50)
	Neither agree nor disagree	0.61 (0.43 – 0.88)
	Agree	0.57 (0.42 – 0.77)
	Strongly agree	0.43 (0.30 – 0.62)
40 to < 50	Strongly disagree	1.73 (0.92 – 3.23)
	Disagree	1.23 (0.81 – 1.88)
	Neither agree nor disagree	1 (ref)
	Agree	0.55 (0.40 – 0.75)
	Strongly agree	0.46 (0.32 – 0.66)
50 to < 60	Strongly disagree	1.67 (0.89 – 3.13)
	Disagree	1.78 (1.14 – 2.77)
	Neither agree nor disagree	0.86 (0.60 – 1.23)
	Agree	0.96 (0.70 – 1.30)
	Strongly agree	0.62 (0.45 – 0.87)
Age > 60	Strongly disagree	0.38 (0.14 – 1.06)
	Disagree	1.20 (0.51 – 2.81)
	Neither agree nor disagree	0.86 (0.50 – 1.49)
	Agree	0.51 (0.35 – 0.75)
	Strongly agree	0.56 (0.38 – 0.83)

Supplementary Table 3 shows an exploration of the significant interaction between age and the variable reflecting agreement with the statement "I feel that my work is valued by the general public". After adjustment for the other covariates (sex, ethnicity and occupation), we derived odds ratios for attrition intentions/actions for each level of the 'feeling valued by the public' variable at each level of the age variable. The odds of attrition intentions/actions were significantly higher in those < 40 who strongly disagreed that their work was valued by the public as compared to the reference group (those aged 40 to < 50 who neither agreed nor disagreed) but this was the only age group where this was the case. In all age groups those that strongly agreed (and in age groups other than 50 to < 60, those that agreed) their work was valued by the public had lower odds of attrition intentions/actions than the reference group. The difference between the odds of attrition intentions/actions between the 'neither agree nor disagree' groups and the 'agree' groups was more pronounced in the 40 to < 50 age group than in the other age groups.

Appendix

Supplementary Table 4. Reasons given for not working in those excluded due to working status

Reason	Number (%) Total 335
Sick leave	71 (21)
Carers leave	< 5
Parental leave	64 (19)
Bank / locum – not currently working	10 (3)
Study leave / sabbatical	6 (2)
Unemployed	12 (4)
Retired	124 (37)
Other	23 (7)
Multiple selections	19 (6)
No reason given	3 (1)

Supplementary Table 4 shows the reasons given for not currently working in the 335 people who were excluded on this basis.

Supplementary Table 5. Contingency table showing the analysed cohort and the 335 HCWs excluded on the basis of working status stratified by the main outcome measure

Outcome	Number (%) Total 5,335
Has not considered changing or leaving role	2,769 (51.1)
Has considered changing or leaving role	1,803 (33.3)
Has acted upon changing or leaving role	843 (15.6)

Supplementary 5 shows the cohort (including those excluded from the main analysis on the basis of working status) stratified by our outcome measure.

Appendix

Supplementary Table 6. Sensitivity analysis - the association of discrimination experiences, feeling valued and demographic and occupational factors with attrition intentions or actions (after exclusion of 209 HCW who indicated they had taken early retirement or had left their healthcare role entirely)

Variable	Adjusted odds ratio (95% CI)
Age (years)	
< 40	1.08 (0.93 – 1.26)
40 to < 50	Ref
50 to < 60	1.22 (1.04 – 1.43)
≥ 60	0.77 (0.62 – 0.96)
Sex	
Male	Ref
Female	1.45 (1.25 – 1.68)
Ethnicity	
White	Ref
Asian	1.01 (0.85 – 1.20)
Black	0.84 (0.61 – 1.17)
Mixed	1.45 (1.07 – 1.97)
Other	1.17 (0.76 – 1.80)
Occupation	
Medical	Ref
Nursing (inc. midwifery, NA, HCA)	1.20 (0.99 – 1.45)
Allied Health Professionals	0.81 (0.68 – 0.97)
Pharmacy	0.91 (0.60 – 1.40)
Healthcare scientist	0.60 (0.44 – 0.81)
Ambulance	1.00 (0.72 – 1.40)
Dental	1.16 (0.87 – 1.53)
Optical	0.76 (0.50 – 1.16)
Administrative	0.71 (0.47 – 1.09)
Estates/facilities	0.59 (0.28 – 1.24)
Other	0.62 (0.41 – 0.92)
Sources of discrimination† (in past 6 months)	
Not experienced discrimination*	Ref
Patients	2.03 (1.63 – 2.54)
Colleagues	2.86 (2.30 – 3.55)
Patients & colleagues	2.98 (2.15 – 4.13)
"I feel my work is valued by the Government"	
Strongly disagree	2.46 (2.07 – 2.93)
Disagree	1.55 (1.31 – 1.82)
Neither agree nor disagree	Ref
Agree	0.79 (0.65 – 0.94)
Strongly agree	0.62 (0.48 – 0.80)
"I feel my work is valued by my employer"	
Strongly disagree	1.80 (1.35 – 2.38)
Disagree	1.47 (1.19 – 1.82)
Neither agree nor disagree	Ref
Agree	0.59 (0.50 – 0.70)
Strongly agree	0.46 (0.39 – 0.56)
"I feel my work is valued by the public"	
Strongly disagree	2.04 (1.49 – 2.78)
Disagree	2.07 (1.66 – 2.59)
Neither agree nor disagree	Ref
Agree	0.83 (0.70 – 0.98)
Strongly agree	0.65 (0.54 – 0.79)

Supplementary Table 5 shows the results of a sensitivity analysis. The main analysis was repeated after exclusion of those who indicated that they had either taken early retirement or left their healthcare role entirely. This was to ensure that the findings relating to feeling that their work was valued remained the same (as these could have been answered with respect to any new role they had subsequently taken on). Odds ratios are adjusted for ethnicity, age, sex and . occupation

*or had not worked in the last 6 months. Ref – reference group for categorical variable

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