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Letter to the Editor

SARS-CoV-2 IgG seroprevalence in healthcare workers and other staff at North Bristol NHS Trust: A sociodemographic analysis

Dear editor,

We read with interest Blairon et al.'s[1] analysis of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) seroprevalence in a Belgian single centre study of 1499 healthcare workers (HCWs). The authors report 14.6% seroprevalence overall, with allied healthcare professionals (19.2%) and maintenance staff/technical services (16.4%) the worst affected. Many published studies on SARS-CoV-2 have been based on selected samples and are therefore at risk of selection bias induced by non-random testing patterns amongst volunteers.[2] Here we present a nested cross-sectional study to obtain seroprevalence results amongst HCWs and support staff at North Bristol NHS Trust that are robust to selection bias.

All staff employed between January and June 2020 were invited for voluntary testing using either: 1) the Abbott™ SARS-CoV-2 IgG chemiluminescent microparticle assay (Abbott Laboratories); or 2) the Roche™ Elecsys® Anti-SARS-CoV-2 (IgG/IgM) electro-chemiluminescent immunoassay (Roche Diagnostics). Results were cross-referenced with selected information extracted from employee records. Staff postcodes were aggregated to Middle Layer Super Output Areas (MSOA) to investigate spatial variation in testing uptake and seroprevalence. We used Index of Multiple Deprivation (IMD) as a proxy for socioeconomic position. Data were first analysed according to testing status to determine selection into the testing sample. We subsequently used inverse probability weighting (IPW) to standardise the tested sample to the full workforce. We used weighted regression to estimate associations between risk factors and SARS-CoV-2 seroprevalence. All analyses were performed using R (Version 4.0.0). Data were compared across groups using chi-square test of independence or Wilcoxon rank-sum test. Ethical approval for this study was granted by the North West – Greater Manchester West Research Ethics Committee (20/NW/0354).

Of the 12,254 HCWs and support staff registered during the study period, 6861 (56%) underwent SARS-CoV-2 antibody testing. Three cases were excluded due to incomplete data. Older age groups were more likely to present for testing, with those aged 51–60 (63%) and 61–70 (62%) the most likely; females (58%) were more likely to present than males (49%); White individuals (58%) were more likely to present than Black, Asian, and Minority Ethnic (BAME) (52%); and permanent staff (67%) were more likely to present than bank staff (19%) (all $p<0.001$). Attendance for testing ranged from 51% in the most deprived decile to 60% in the least deprived ($p = 0.001$ for trend). Testing was similar across frontline and non-patient facing roles ($p = 0.11$).

The overall rate of SARS-CoV-2 seroprevalence among tested HCWs and support staff was 9.3% (638/6858) (Table 1). BAME individuals were more likely to be seropositive than White (14.6% versus 8.2%, respectively; $p<0.001$). Seroprevalence was similar between females and males (9.3% versus 9.2%, respectively; $p = 0.9$). Seroprevalence generally decreased with age, being highest in those aged ≤20y (12.3%) and lowest in those aged ≥71y (5.9%) (p for trend <0.001). Seroprevalence ranged from 12.0% in the most deprived IMD decile to 8.4% in the least deprived ($p<0.01$). Staff SARS-CoV-2 seroprevalence at the MSOA level was weakly correlated with Public Health England case rate per 100,000 population ($r = 0.18$). Staff seroprevalence in the intensive care unit was 2.5% and it was 16.2% in the acute medical unit. We found 13.6% (respiratory ward) and 20.9% (elderly care) seroprevalence on the two designated COVID-19 inpatient wards. We found high seroprevalence in staff working in wards that experienced outbreaks – 50% on an elderly care step-down ward and 52.4% on a cardiology ward.

Seroprevalence was higher in BAME than White individuals across all staff groups except for Medical/Dental, where the trend was reversed (4.4% BAME versus 9.6% White). The median IMD decile for BAME staff was 4 (IQR: 2, 7) and for White staff was 7 (IQR: 4, 9). When restricting to medical and dental staff only, the median IMD decile for BAME staff (8; IQR: 4, 9) and for White staff (8; IQR: 6, 9) were similar.

Table 2 displays the weighted regression estimates for the assessed demographic and socioeconomic risk factors for SARS-CoV-2 seroprevalence. BAME individuals had increased odds of SARS-CoV-2 seroprevalence (adjusted OR 1.99, 95%CI: 1.69, 2.34; $p<0.001$) relative to White individuals. Critical care (adjusted OR 0.29, 95%CI: 0.13, 0.57; $p = 0.001$) and theatre services (adjusted OR 0.29, 95%CI: 0.15, 0.49; $p<0.001$) had decreased odds of SARS-CoV-2 seroprevalence. All medicine division clusters had increased odds of seroprevalence (adjusted OR range 1.72 to 3.35; all $p \leq 0.001$). Healthcare science assistants (adjusted OR 0.35, 95%CI: 0.14, 0.73; $p = 0.01$), healthcare science practitioners (adjusted OR 0.07, 95%CI: 0.01, 0.31; $p = 0.004$), and specialty registrars (adjusted OR 0.62, 95%CI: 0.41, 0.91; $p = 0.019$) had decreased odds of SARS-CoV-2 seroprevalence. Foundation year 2 doctors (adjusted OR 2.11, 95%CI: 1.40, 3.13; $p<0.001$), healthcare assistants (adjusted OR 1.52, 95%CI: 1.17, 1.98; $p = 0.002$), and nurses (adjusted OR 1.35, 95%CI: 1.08, 1.69; $p = 0.008$) had increased odds of SARS-CoV-2 seroprevalence.

Studies in other centres have consistently shown higher rates of seroprevalence in HCWs – London (31.6%),[3] Birmingham (24.4%),[4] and Oxford (11%).[5] As expected, working within areas of the hospital that provided care to acutely unwell patients was associated with higher rates of seroprevalence. However, in contrast to findings from a Danish study of HCWs,[6] seroprevalence did not asso-

Table 1

SARS-CoV-2 IgG seroprevalence of HCWs and support staff according to sociodemographic characteristics. Both unweighted and inverse probability weighted data are presented. The *p* values were calculated using unweighted data. Abbreviations: +ve – positive; % – proportion; BAME – Black, Asian and Minority Ethnic; IMD – Indices of Multiple Deprivation.

Variable	Serology +ve		Total	p value for unweighted data	Weighted seroprevalence % (estimated)
	n	%			
Sex					
Female	498	9.3%	5338		9.4%
Male	140	9.2%	1520		8.6%
Ethnicity				<0.001	
BAME	160	14.6%	1095		15.7%
Undisclosed	22	11.9%	185		9.1%
White	456	8.2%	5578		7.9%
Age[b]				<0.001	
<=20 years	14	12.3%	114		13.9%
21–30	192	10.9%	1757		11.1%
31–40	118	7.3%	1624		6.8%
41–50	158	10.3%	1536		9.8%
51–60	120	8.5%	1408		9.2%
61–70	35	8.7%	402		8.0%
Assignment				<0.001	
Bank	67	14.2%	472		13.7%
Fixed term temporary	75	10.1%	740		7.8%
Permanent	496	8.8%	5644		9.1%
Staff group				<0.001	
Additional clinical services	180	12.7%	1420		12.2%
Estates and ancillary	63	12.2%	516		11.6%
Nursing and midwifery	201	10.2%	1962		10.5%
Medical and dental	74	8.6%	856		7.9%
Allied health professionals	31	7.5%	413		7.8%
Administrative and clerical	73	5.9%	1233		6.1%
Additional scientific and technical	11	5.2%	211		6.3%
Healthcare scientists	4	1.6%	245		1.9%
Division				<0.001	
Medicine	242	18.3%	1322		17.2%
Clinical governance	8	15.7%	51		6.4%
Bank staff	67	14.2%	472		13.6%
Neurosciences and musculoskeletal	71	8.8%	811		8.5%
Facilities	43	8.6%	499		9.4%
Anaesthesia, surgery, critical, renal	87	6.1%	1418		5.9%
Core clinical services	73	6.0%	1224		6.0%
Admin A[a]	6	5.7%	106		6.2%
Admin B[a]	1	5.3%	19		6.9%
Admin C[a]	2	3.3%	61		6.4%
Admin D[a]	7	5.0%	139		5.9%
Women and children's	26	4.5%	577		5.9%
Admin E[a]	3	3.8%	79		6.7%
Admin F[a]	2	3.1%	65		7.2%
IMD decile				<0.01	
1 (most deprived)	44	12.0%	375		–
2	73	11.0%	663		–
3	55	11.0%	480		–
4	56	9.1%	617		–
5	48	7.6%	628		–
6	46	9.4%	488		–
7	62	8.3%	745		–
8	66	9.2%	717		–
9	57	8.2%	694		–
10 (least deprived)	98	8.4%	1160		–
Total	**638**	**9.3%**	**6858**		**–**

[a] Administrative groups de-identified to preserve anonymity. These groups share a common exposure risk – they are office-based and do not routinely have contact with clinical areas.

[b] The percentages do not total 100% as we removed one row to preserve anonymity.

ciate with wards designated for COVID-19 cohorting. As observed elsewhere,[4] seroprevalence rates were low in the intensive care unit, where infection risk was likely mitigated by enhanced PPE use and probable reduced infectivity of cases that had progressed to the characterised immune-mediated disease phase. We found the highest seroprevalence rates in wards with known nosocomial outbreaks. Further supporting a role for transmission between staff groups, administrative and clerical staff (frequent contact with clinical staff) had higher seroprevalence than healthcare scientists (infrequent contact with clinical staff).

Our data highlight the complex interplay between biological, social, and economic factors that determine risk of infection during a pandemic. Identifying HCWs at increased risk of infection with SARS-CoV-2 will support the implementation of targeted interventions designed to ensure the entire workforce is protected during future COVID-19 outbreaks. As hospitals consider routine staff PCR testing for SARS-CoV-2 they should account for the decreased uptake in certain staff groups and ensure equity as much as possible.

Table 2

Demographic and socioeconomic factors associated with SARS-CoV-2 seroprevalence in HCWs and support staff. Both unadjusted and inverse probability weight-adjusted regression data are presented. For factors with multiple categories, the 15 most populous are presented and the remaining collated into "other", which forms the reference group. Abbreviations: IPW – inverse probability weight; OR – odds ratio; CI – confidence interval; BAME – Black, Asian and Minority Ethnic.

Characteristic	Unadjusted model			IPW-adjusted model		
	OR[a]	95% CI[a]	p-value	OR[a]	95% CI[a]	p-value
Ethnicity						
White	—	—		—	—	
BAME	1.76	1.40, 2.21	<0.001	1.99	1.69, 2.34	<0.001
Undisclosed	1.33	0.76, 2.18	0.3	1.16	0.81, 1.61	0.4
Gender						
Female	—	—		—	—	
Male	1.01	0.80, 1.28	>0.9	0.96	0.81, 1.14	0.7
Age						
31–40	—	—		—	—	
<=20 years	1.06	0.53, 1.98	0.9	1.47	0.96, 2.20	0.071
>=71 years	0.86	0.05, 4.47	0.9	0.74	0.17, 2.08	0.6
21–30	1.5	1.16, 1.95	0.002	1.64	1.36, 1.99	<0.001
41–50	1.32	1.01, 1.74	0.045	1.36	1.11, 1.67	0.003
51–60	1.23	0.92, 1.64	0.2	1.45	1.17, 1.80	<0.001
61–70	1.31	0.85, 1.98	0.2	1.28	0.94, 1.73	0.1
Neighbourhood deprivation	1.01	0.97, 1.04	0.7	0.99	0.96, 1.02	0.5
specialty						
Other	—	—		—	—	
Cluster 1 – Neurosurgery, spines and pain	0.89	0.50, 1.49	0.7	0.84	0.51, 1.32	0.5
Cluster 2 – Trauma and orthopaedics	1.46	0.91, 2.27	0.11	1.44	0.96, 2.10	0.067
Cluster 3	0.96	0.56, 1.56	0.9	0.94	0.61, 1.41	0.8
Critical care services	0.31	0.11, 0.70	0.013	0.29	0.13, 0.57	0.001
Domestics	0.94	0.53, 1.65	0.8	0.99	0.66, 1.48	>0.9
General surgery services	0.62	0.31, 1.12	0.14	0.62	0.35, 1.03	0.081
Imaging	0.8	0.46, 1.31	0.4	0.86	0.55, 1.28	0.5
Maternity services	0.67	0.31, 1.31	0.3	0.75	0.41, 1.29	0.3
Medicine Cluster 1	1.75	1.24, 2.43	0.001	1.72	1.30, 2.25	<0.001
Medicine Cluster 2	3.43	2.51, 4.67	<0.001	3.35	2.61, 4.30	<0.001
Medicine Cluster 4	3.01	2.05, 4.37	<0.001	2.84	2.07, 3.85	<0.001
Other bank services	1.42	0.95, 2.07	0.077	1.17	0.93, 1.46	0.2
Pathology services	0.51	0.22, 1.03	0.083	0.53	0.28, 0.90	0.028
Theatre services	0.3	0.14, 0.57	<0.001	0.29	0.15, 0.49	<0.001
Therapies services	1.21	0.72, 1.96	0.4	1.29	0.83, 1.93	0.2
Role						
Other	—	—		—	—	
Assistant	1.56	0.97, 2.44	0.059	1.39	0.99, 1.93	0.051
Clerical worker	0.74	0.48, 1.12	0.2	0.81	0.59, 1.11	0.2
Consultant	0.86	0.52, 1.37	0.5	0.84	0.57, 1.23	0.4
Foundation year 2	1.46	0.71, 2.80	0.3	2.11	1.40, 3.13	<0.001
Health care support worker	2.28	1.27, 4.07	0.005	2.79	2.05, 3.82	<0.001
Healthcare assistant	1.57	1.12, 2.19	0.008	1.52	1.17, 1.98	0.002
Healthcare science assistant	0.41	0.12, 1.06	0.1	0.35	0.14, 0.73	0.01
Healthcare science practitioner	0.09	0.01, 0.45	0.022	0.07	0.01, 0.31	0.004
Housekeeper	1.67	0.97, 2.77	0.054	1.52	1.01, 2.26	0.041
Manager	0.89	0.43, 1.69	0.7	0.86	0.48, 1.43	0.6
Midwife	0.76	0.28, 1.94	0.6	0.59	0.27, 1.21	0.2
Officer	0.85	0.51, 1.36	0.5	0.84	0.56, 1.22	0.4
Porter	2.11	1.04, 4.00	0.029	1.57	1.01, 2.40	0.041
Specialty registrar	0.75	0.43, 1.25	0.3	0.62	0.41, 0.91	0.019
Staff Nurse	1.24	0.94, 1.64	0.14	1.35	1.08, 1.69	0.008

[a] OR = Odds Ratio, CI = Confidence Interval.

Declaration of Competing Interest

None.

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