

# Investigating associations between ethnicity and outcome from COVID-19

Ewen Harrison, Annemarie Docherty, Calum Semple, CO-CIN

25/04/2020

[OFFICIAL-SENSITIVE PROTECT]

## Aim

To identify any difference in HDU/ICU admission and overall survival by self-defined ethnicity in hospitalised patients with COVID-19.

## Summary

More admissions to hospital are seen in the Black and Minority Ethnic group in this cohort, compared with that expected from the population proportion at a country level. Analysis at a Trust/Healthboard level is well developed and will characterise any selection bias that exists in this cohort.

More admissions to HDU/ITU are seen in the Black, Asian and Minority Ethnic (BAME) group, compared to the White ethnic group. These are explained by differences in patient characteristics such as comorbidity. No difference in HDU/ICU admission is seen after adjusting for patient characteristics.

The White ethnic group has higher mortality than the BAME group.

In robust matched models (propensity-score matched), no excess mortality is seen in the BAME group.

In conclusion, Black and Minority Ethnic individuals might be more likely to be admitted to hospital with COVID-19. BAME groups are more likely to be admitted to HDU/ICU. When patient characteristics are taken into account, no excess HDU/ICU admissions or deaths are seen in the BAME group.

## Methods

CO-CIN is a clinical study of 23577 COVID-19 patients (as of 2020-04-25 12:27:21) admitted to UK hospitals. To avoid bias in the assessment of outcomes, patients admitted to hospital in the most recent 2 weeks were excluded.

Self-defined ethnicity is reported from patients' hospital records as: East Asian, South Asian, West Asian, Black, White, Arab, Latin American, Aboriginal/First Nations, and Other. For the purposes of this analysis, these are collapsed to Black, Asian, Minority Ethnic and White, based on frequency.

HDU/ICU admission is modelled using hierarchical logistic regression models adjusting for patient characteristics at level 1 and hospital of treatment at level 2. Index of multiple deprivation is aggregated by Trust/Healthboard.

Cox proportional hazards approaches are used to model survival accounting for the clustering of patients within hospitals (robust standard errors).

Propensity-score matching was used to match individuals in the BAME group to individuals with similar characteristics in the White ethnic group. In brief, the probability of group membership was predicted using logistic regression and patients matched using this on a one-to-one/nearest-neighbour basis. Balance tables and plots were checked. Differences in survival in the matched groups was determined with Cox proportional hazards, both using robust standard errors by incorporating the one-to-one match as a cluster, and also by discarding the matching variable.

## Number of patients by ethnicity

All results in this report exclude patients admitted in most recent 2 weeks.

Ethnic groups collected are East Asian, South Asian, West Asian, Black, White, Arab, Latin American, and Aboriginal/First Nations. For the purposes of this analysis, these are collapsed to Black, Asian, Minority Ethnic (BAME) and White,.

Table 1: Number of patients in cohort stratified by self-defined ethnicity. Data are n (%).

		All patients	England and Wales Census 2011 (2019 update)*
Ethnicity	Black	568 (4.0)	3.4%
	Asian	835 (5.9)	7.5%
	Minority ethnic	1135 (8.0)	1.0-3.0%
	White	11690 (82.2)	-

- <https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/national-and-regional-populations/population-of-england-and-wales/latest>

## Variation in age, sex, and comorbidities by ethnic group

BAME groups are younger and more likely to have diabetes. BAME groups were less likely to have other comorbidities such as cardiorespiratory disease and chronic neurological disease/dementia.

Table 2: Patient characteristics by self-defined ethnic group. Chi-squared p-value.

Ethnicity		Black	Asian	Minority ethnic	White	p
Age on admission (years)	<50	146 (27.1)	248 (31.0)	306 (28.3)	1238 (10.9)	<0.001
	50-69	227 (42.2)	318 (39.8)	393 (36.4)	3204 (28.3)	
	70-79	66 (12.3)	120 (15.0)	196 (18.1)	2810 (24.8)	
	80+	99 (18.4)	114 (14.2)	185 (17.1)	4064 (35.9)	
Sex at Birth	Male	311 (55.0)	509 (61.1)	672 (59.8)	6973 (59.9)	0.115
	Female	254 (45.0)	324 (38.9)	452 (40.2)	4671 (40.1)	
Obesity	No	445 (88.5)	612 (90.1)	852 (91.0)	8889 (89.7)	0.453
	Yes	58 (11.5)	67 (9.9)	84 (9.0)	1016 (10.3)	
Diabetes	No	320 (59.5)	446 (60.7)	694 (68.0)	8115 (74.6)	<0.001
	Yes	218 (40.5)	289 (39.3)	327 (32.0)	2756 (25.4)	
Chronic cardiac disease	No	441 (83.5)	567 (77.7)	811 (80.4)	7338 (67.7)	<0.001
	Yes	87 (16.5)	163 (22.3)	198 (19.6)	3507 (32.3)	
Chronic pulmonary disease	No	487 (92.9)	655 (90.8)	917 (90.9)	8699 (80.5)	<0.001
	Yes	37 (7.1)	66 (9.2)	92 (9.1)	2111 (19.5)	
Asthma	No	459 (87.1)	615 (84.2)	870 (85.7)	9161 (85.1)	0.502
	Yes	68 (12.9)	115 (15.8)	145 (14.3)	1607 (14.9)	
Chronic kidney disease	No	430 (81.6)	623 (85.9)	894 (88.7)	8997 (83.8)	<0.001
	Yes	97 (18.4)	102 (14.1)	114 (11.3)	1743 (16.2)	
Moderate/severe liver disease	No	514 (97.9)	706 (98.2)	985 (98.2)	10497 (98.4)	0.748
	Yes	11 (2.1)	13 (1.8)	18 (1.8)	168 (1.6)	
Mild Liver disease	No	516 (98.9)	707 (98.3)	983 (98.3)	10477 (98.4)	0.857
	Yes	6 (1.1)	12 (1.7)	17 (1.7)	172 (1.6)	
Chronic neurological disorder	No	486 (92.9)	670 (92.7)	916 (91.5)	9463 (88.7)	<0.001
	Yes	37 (7.1)	53 (7.3)	85 (8.5)	1210 (11.3)	
Malignancy	No	478 (90.5)	686 (95.3)	933 (93.1)	9535 (89.6)	<0.001
	Yes	50 (9.5)	34 (4.7)	69 (6.9)	1109 (10.4)	
Chronic hematologic disease	No	487 (92.2)	690 (96.1)	964 (96.5)	10198 (96.0)	<0.001
	Yes	41 (7.8)	28 (3.9)	35 (3.5)	430 (4.0)	
AIDS/HIV	No	505 (97.1)	711 (99.4)	985 (99.5)	10546 (99.6)	<0.001
	Yes	15 (2.9)	4 (0.6)	5 (0.5)	39 (0.4)	
Rheumatologic disorder	No	495 (93.8)	675 (94.9)	929 (93.4)	9477 (89.4)	<0.001
	Yes	33 (6.2)	36 (5.1)	66 (6.6)	1128 (10.6)	
Dementia	No	496 (93.4)	678 (94.6)	922 (92.5)	9166 (85.6)	<0.001
	Yes	35 (6.6)	39 (5.4)	75 (7.5)	1545 (14.4)	
Malnutrition	No	502 (98.6)	686 (98.3)	940 (97.7)	9986 (97.5)	0.285
	Yes	7 (1.4)	12 (1.7)	22 (2.3)	251 (2.5)	
Smoking	No	445 (97.4)	613 (96.8)	803 (95.3)	8280 (93.9)	<0.001
	Yes	12 (2.6)	20 (3.2)	40 (4.7)	540 (6.1)	
Prio immunosuppression	No	464 (89.4)	658 (91.0)	911 (91.5)	9348 (89.5)	0.157
	Yes	55 (10.6)	65 (9.0)	85 (8.5)	1097 (10.5)	
Prior infection treatment	No	420 (81.1)	592 (81.9)	809 (81.2)	8377 (80.2)	0.586
	Yes	98 (18.9)	131 (18.1)	187 (18.8)	2072 (19.8)	
Deprivation (IMD)	Mean (SD)	75.9 (53.0)	73.0 (60.2)	85.6 (59.5)	83.2 (57.5)	<0.001

## Ethnicity and HDU/ITU admission

On simple counts, the white ethnic group is less likely to be admitted to ICU compared to others. This does not account for other differences between groups, such as age and comorbidity.

Table 3: HDU/ICU admission by self-defined ethnicity.

HDU/ICU admission		No	Yes	p
Ethnicity	Black	424 (77.5)	123 (22.5)	<0.001
	Asian	592 (78.0)	167 (22.0)	
	Minority ethnic	831 (77.4)	243 (22.6)	
	White	9409 (84.6)	1717 (15.4)	

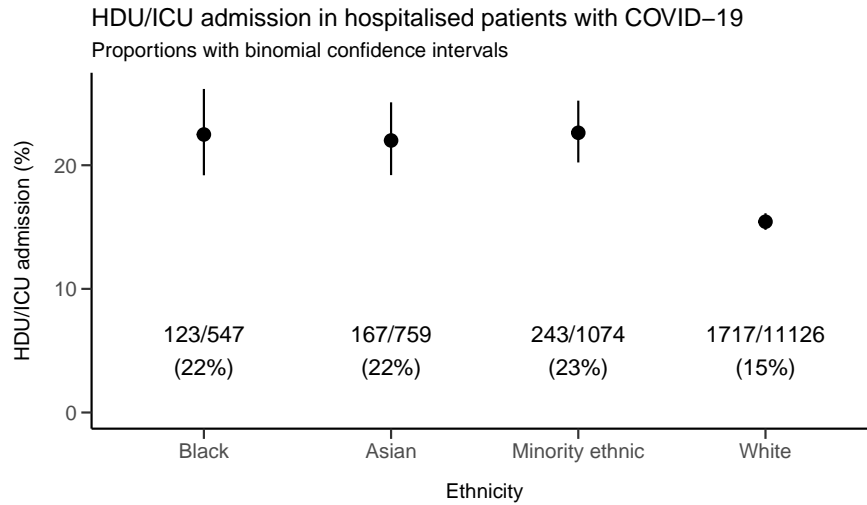


Figure 1: HDU/ICU admission in hospitalised patients with COVID-19.

### Predictors of HDU/ICU admission

After adjusting for other patients factors associated with HDU/ICU admission, those in the black ethnic group were more likely to be admitted to HDU/ICU compared to those in the White ethnic group.

Number in model = 10640, Number of groups = 153, AIC = 8266.9, C-statistic = 0.782

#### HDU/ICU admission

Ethnicity	White	-
	Black	1.19 (0.91–1.54, p=0.203)
	Asian	1.10 (0.88–1.39, p=0.391)
	Minority ethnic	1.06 (0.86–1.29, p=0.603)
Age on admission (years)	<50	-
	50–69	1.61 (1.38–1.87, p<0.001)
	70–79	0.93 (0.77–1.12, p=0.447)
	80+	0.30 (0.24–0.38, p<0.001)
Sex at Birth	Female	0.58 (0.51–0.65, p<0.001)
Obesity	Yes	1.84 (1.56–2.15, p<0.001)
Chronic cardiac disease	Yes	0.67 (0.58–0.78, p<0.001)
Chronic pulmonary disease	Yes	0.66 (0.55–0.79, p<0.001)
Chronic kidney disease	Yes	0.68 (0.56–0.83, p<0.001)
Chronic neurological disorder	Yes	0.55 (0.43–0.69, p<0.001)
Malignancy	Yes	0.62 (0.49–0.79, p<0.001)
Dementia	Yes	0.43 (0.31–0.58, p<0.001)

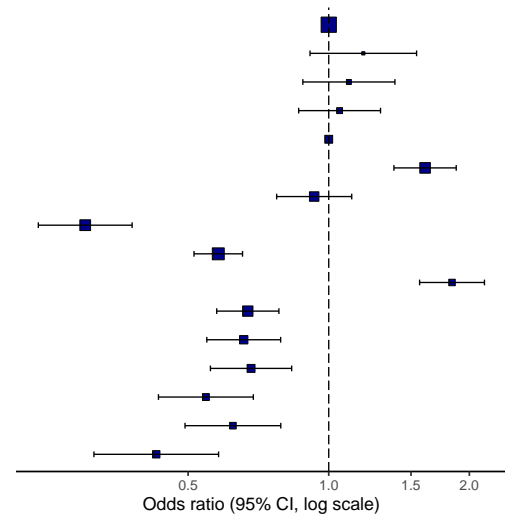
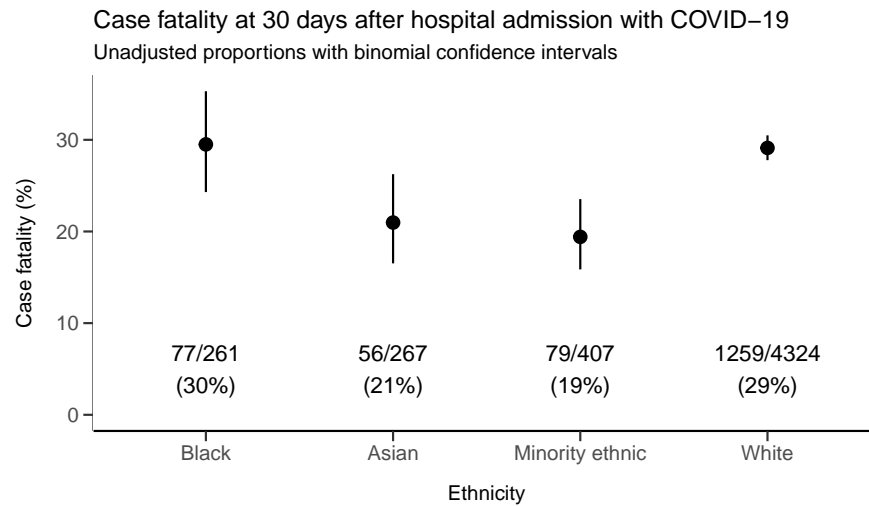
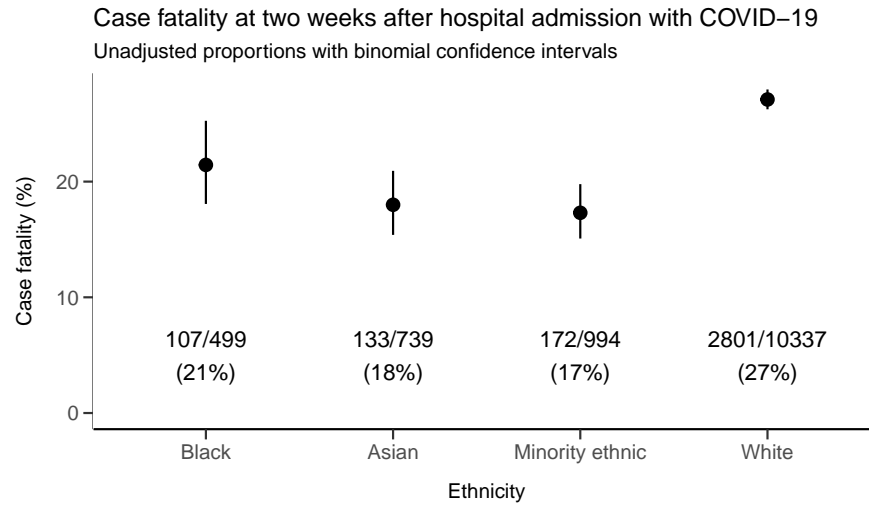


Table 4: Admission to HDU/ICU in hospitalised patients with COVID-19. Univariable and multivariable hierarchical logistic regression models including all available patients in cohort.

HDU/ICU admission		No	Yes	OR (univariable)	OR (multilevel)
Ethnicity	White	9409 (83.6)	1717 (76.3)	-	-
	Black	424 (3.8)	123 (5.5)	1.59 (1.29-1.95, p<0.001)	1.19 (0.91-1.54, p=0.203)
	Asian	592 (5.3)	167 (7.4)	1.55 (1.29-1.84, p<0.001)	1.10 (0.88-1.39, p=0.391)
	Minority ethnic	831 (7.4)	243 (10.8)	1.60 (1.37-1.86, p<0.001)	1.06 (0.86-1.29, p=0.603)
Age on admission (years)	<50	1667 (13.6)	476 (19.2)	-	-
	50-69	3220 (26.2)	1274 (51.4)	1.39 (1.23-1.56, p<0.001)	1.61 (1.38-1.87, p<0.001)
	70-79	2881 (23.5)	527 (21.3)	0.64 (0.56-0.74, p<0.001)	0.93 (0.77-1.12, p=0.447)
	80+	4504 (36.7)	200 (8.1)	0.16 (0.13-0.18, p<0.001)	0.30 (0.24-0.38, p<0.001)
Sex at Birth	Male	7291 (57.7)	1822 (70.5)	-	-
	Female	5336 (42.3)	761 (29.5)	0.57 (0.52-0.63, p<0.001)	0.58 (0.51-0.65, p<0.001)
Obesity	No	9886 (91.3)	1825 (82.2)	-	-
	Yes	940 (8.7)	396 (17.8)	2.28 (2.01-2.59, p<0.001)	1.84 (1.56-2.15, p<0.001)
Diabetes	No	8644 (72.7)	1797 (73.8)	-	-
	Yes	3240 (27.3)	638 (26.2)	0.95 (0.86-1.05, p=0.283)	-
Chronic cardiac disease	No	8055 (67.8)	1977 (82.1)	-	-
	Yes	3819 (32.2)	430 (17.9)	0.46 (0.41-0.51, p<0.001)	0.67 (0.58-0.78, p<0.001)
Chronic pulmonary disease	No	9623 (81.4)	2135 (88.9)	-	-
	Yes	2196 (18.6)	266 (11.1)	0.55 (0.48-0.62, p<0.001)	0.66 (0.55-0.79, p<0.001)
Asthma	No	10121 (86.0)	1995 (82.6)	-	-
	Yes	1644 (14.0)	419 (17.4)	1.29 (1.15-1.45, p<0.001)	-
Chronic kidney disease	No	9774 (83.3)	2180 (90.7)	-	-
	Yes	1962 (16.7)	223 (9.3)	0.51 (0.44-0.59, p<0.001)	0.68 (0.56-0.83, p<0.001)
Moderate/severe liver disease	No	11458 (98.4)	2353 (98.7)	-	-
	Yes	192 (1.6)	30 (1.3)	0.76 (0.51-1.10, p=0.167)	-
Mild Liver disease	No	11436 (98.3)	2346 (98.5)	-	-
	Yes	194 (1.7)	35 (1.5)	0.88 (0.60-1.25, p=0.488)	-
Chronic neurological disorder	No	10289 (88.2)	2248 (94.5)	-	-
	Yes	1375 (11.8)	131 (5.5)	0.44 (0.36-0.52, p<0.001)	0.55 (0.43-0.69, p<0.001)
Malignancy	No	10399 (89.3)	2244 (94.3)	-	-
	Yes	1246 (10.7)	136 (5.7)	0.51 (0.42-0.60, p<0.001)	0.62 (0.49-0.79, p<0.001)
Chronic hematologic disease	No	11110 (95.7)	2315 (97.3)	-	-
	Yes	504 (4.3)	65 (2.7)	0.62 (0.47-0.80, p<0.001)	-
AIDS/HIV	No	11523 (99.6)	2343 (99.1)	-	-
	Yes	48 (0.4)	22 (0.9)	2.25 (1.33-3.69, p=0.002)	-
Rheumatologic disorder	No	10414 (89.9)	2206 (92.9)	-	-
	Yes	1176 (10.1)	169 (7.1)	0.68 (0.57-0.80, p<0.001)	-
Dementia	No	9968 (85.2)	2324 (97.4)	-	-
	Yes	1735 (14.8)	62 (2.6)	0.15 (0.12-0.20, p<0.001)	0.43 (0.31-0.58, p<0.001)
Malnutrition	No	10900 (97.4)	2262 (98.9)	-	-
	Yes	287 (2.6)	26 (1.1)	0.44 (0.28-0.64, p<0.001)	-
Smoking	Yes	565 (5.9)	104 (5.0)	-	-
	Never Smoked	6125 (63.7)	1354 (64.6)	1.20 (0.97-1.50, p=0.099)	-
	Former Smoker	2921 (30.4)	639 (30.5)	1.19 (0.95-1.50, p=0.134)	-
Prio immunosuppression	No	10336 (89.9)	2065 (89.8)	-	-
	Yes	1161 (10.1)	234 (10.2)	1.01 (0.87-1.17, p=0.907)	-
Prior infection treatment	No	9287 (80.8)	1852 (80.3)	-	-
	Yes	2206 (19.2)	453 (19.7)	1.03 (0.92-1.15, p=0.610)	-
Deprivation (IMD)	Mean (SD)	-0.0 (1.0)	-0.1 (1.0)	0.96 (0.92-1.00, p=0.048)	1.00 (0.87-1.15, p=0.992)

## Ethnicity and survival from Covid-19



Looking at ethnicity in isolation, BAME groups have the same or better survival than the White ethnic group.

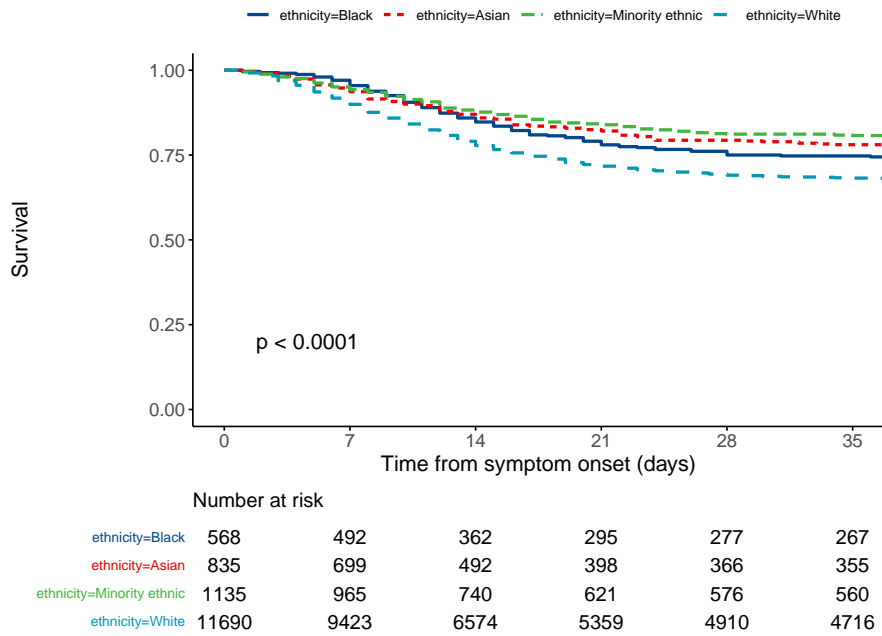


Figure 2: Kaplan Meier analysis for death in those diagnosed with Covid-19 stratified by ethnicity.

### Ethnicity and risk factors for death from Covid-19

No association was seen between self-defined ethnicity and survival in patients hospitalised with COVID-19 after adjustment for other factors.

Number in dataframe = 16345, Number in model = 10995, Missing = 5350, Number of events = 2571, Concordance = 0.711 (SE = 0.009), R-squared = 0.124 (Max possible = 0.984), Likelihood ratio test = 1461.397 (df = 16, p = 0.000)

#### Survival: Hazard ratio (95% confidence interval)

Ethnicity	Hazard ratio (95% CI, log scale)
Black	1.19 (0.97–1.46, p=0.094)
Asian	1.09 (0.90–1.31, p=0.388)
Minority ethnic	0.92 (0.78–1.08, p=0.312)
White	–

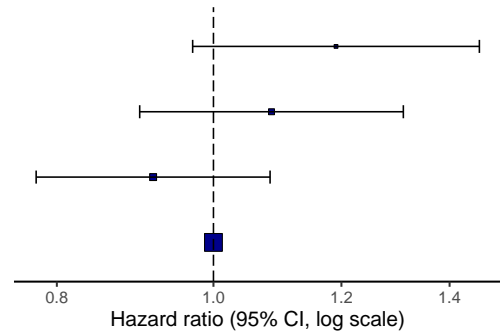


Figure 3: Survival in hospitalised patients with COVID-19. Multivariable Cox proportional hazards adjusted for variables in table above with only effects for ethnicity shown. Hospital of treatment clustering incorporated.

Table 5: Survival in hospitalised patients with COVID-19. Multivariable Cox proportional hazards incorporating clustering of patients in hospital of treatment (robust standard errors).

			HR (univariable)	HR (multivariable)
Ethnicity	White	11690 (82.2)	-	-
	Black	568 (4.0)	0.72 (0.60-0.87, p=0.001)	1.19 (0.97-1.46, p=0.094)
	Asian	835 (5.9)	0.64 (0.54-0.75, p<0.001)	1.09 (0.90-1.31, p=0.388)
	Minority ethnic	1135 (8.0)	0.56 (0.49-0.66, p<0.001)	0.92 (0.78-1.08, p=0.312)
Age on admission (years)	<50	2307 (14.7)	-	-
	50-69	4782 (30.5)	3.91 (3.14-4.87, p<0.001)	3.99 (3.06-5.19, p<0.001)
	70-79	3619 (23.1)	9.72 (7.84-12.05, p<0.001)	9.09 (6.96-11.86, p<0.001)
	80+	4982 (31.8)	13.59 (11.00-16.79, p<0.001)	11.72 (8.85-15.51, p<0.001)
Sex at Birth	Male	9705 (60.0)	-	-
	Female	6467 (40.0)	0.84 (0.78-0.89, p<0.001)	0.78 (0.72-0.85, p<0.001)
Obesity	No	12108 (89.8)	-	-
	Yes	1376 (10.2)	0.95 (0.84-1.07, p=0.362)	1.29 (1.13-1.47, p<0.001)
Diabetes	No	10802 (72.9)	-	-
	Yes	4010 (27.1)	1.34 (1.25-1.44, p<0.001)	1.11 (1.00-1.23, p=0.049)
Chronic cardiac disease	No	10377 (70.3)	-	-
	Yes	4390 (29.7)	1.99 (1.86-2.13, p<0.001)	1.20 (1.09-1.31, p<0.001)
Chronic pulmonary disease	No	12156 (82.6)	-	-
	Yes	2553 (17.4)	1.72 (1.59-1.86, p<0.001)	1.24 (1.11-1.39, p<0.001)
Asthma	No	12503 (85.3)	-	-
	Yes	2156 (14.7)	0.78 (0.71-0.87, p<0.001)	-
Chronic kidney disease	No	12376 (84.7)	-	-
	Yes	2242 (15.3)	1.95 (1.80-2.11, p<0.001)	1.28 (1.16-1.41, p<0.001)
Moderate/severe liver disease	No	14279 (98.4)	-	-
	Yes	233 (1.6)	1.30 (1.02-1.66, p=0.035)	1.59 (1.19-2.11, p=0.001)
Mild Liver disease	No	14252 (98.4)	-	-
	Yes	235 (1.6)	0.87 (0.66-1.16, p=0.356)	-
Chronic neurological disorder	No	12961 (89.3)	-	-
	Yes	1556 (10.7)	1.60 (1.46-1.76, p<0.001)	-
Malignancy	No	13089 (90.3)	-	-
	Yes	1409 (9.7)	1.54 (1.40-1.71, p<0.001)	1.11 (0.98-1.27, p=0.106)
Chronic hematologic disease	No	13888 (96.0)	-	-
	Yes	579 (4.0)	1.56 (1.35-1.80, p<0.001)	-
AIDS/HIV	No	14340 (99.5)	-	-
	Yes	71 (0.5)	1.05 (0.66-1.67, p=0.827)	-
Rheumatologic disorder	No	13046 (90.4)	-	-
	Yes	1381 (9.6)	1.26 (1.13-1.40, p<0.001)	-
Dementia	No	12699 (87.2)	-	-
	Yes	1864 (12.8)	2.33 (2.14-2.53, p<0.001)	1.40 (1.24-1.58, p<0.001)
Malnutrition	No	13610 (97.7)	-	-
	Yes	318 (2.3)	1.58 (1.30-1.91, p<0.001)	-
Smoking	Yes	699 (5.8)	-	-
	Never Smoked	7696 (63.9)	0.87 (0.74-1.03, p=0.110)	-
	Former Smoker	3653 (30.3)	1.24 (1.04-1.47, p=0.014)	-
Prior immunosuppression	No	12775 (89.9)	-	-
	Yes	1439 (10.1)	1.19 (1.07-1.32, p=0.001)	-
Prior infection treatment	No	11466 (80.6)	-	-
	Yes	2753 (19.4)	1.07 (0.99-1.17, p=0.101)	-
Deprivation (IMD)	Mean (SD)	0.0 (1.0)	1.10 (1.07-1.14, p<0.001)	1.09 (1.00-1.18, p=0.037)

## Propensity score matched analysis

In order to account for potential confounding, a propensity-score matched model was constructed. Membership of the BAME or the White ethnic group was predicted using the variables included in tables below.

BAME and white individuals were matched using the propensity score. Good balance was achieved between groups.

No difference was seen in risk of death from COVID-19 between ethnic groups in this matched analysis.

## Balance between groups



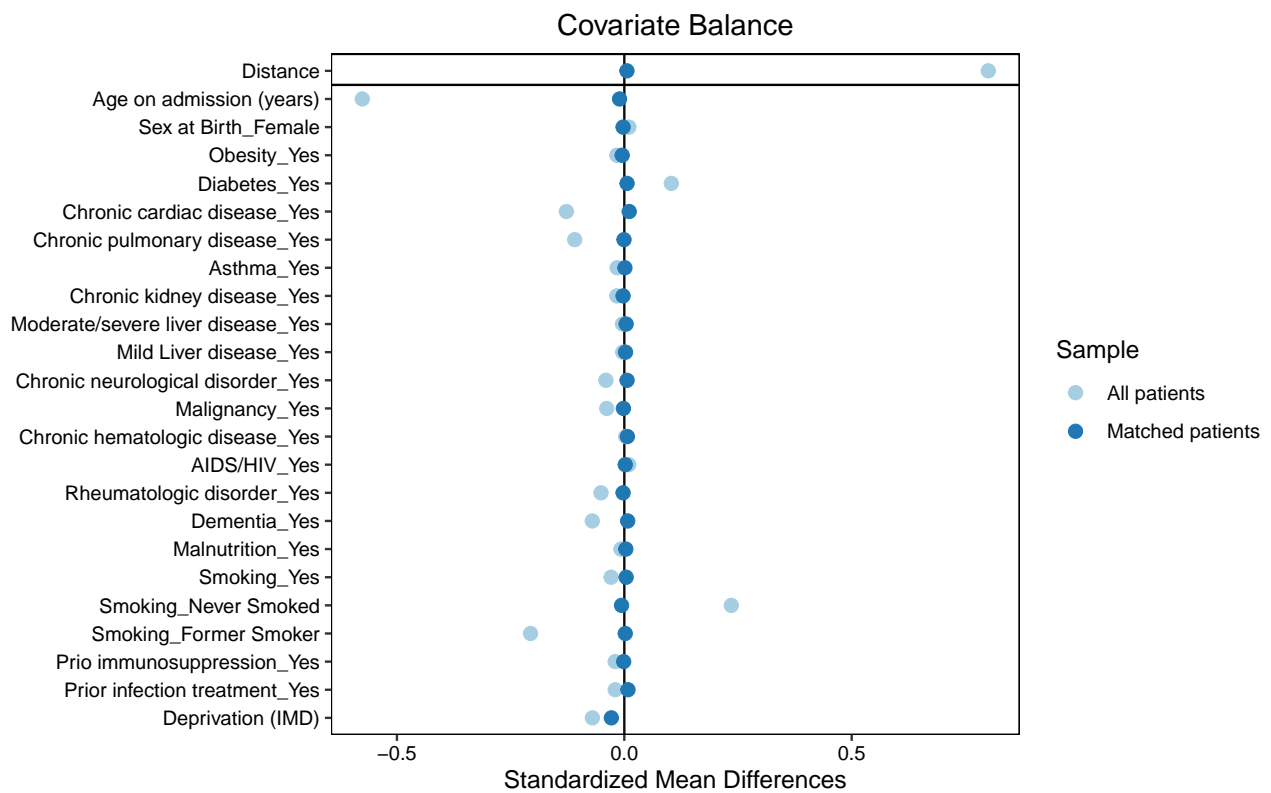


Figure 4: Balance between patient characteristics before and after matching.

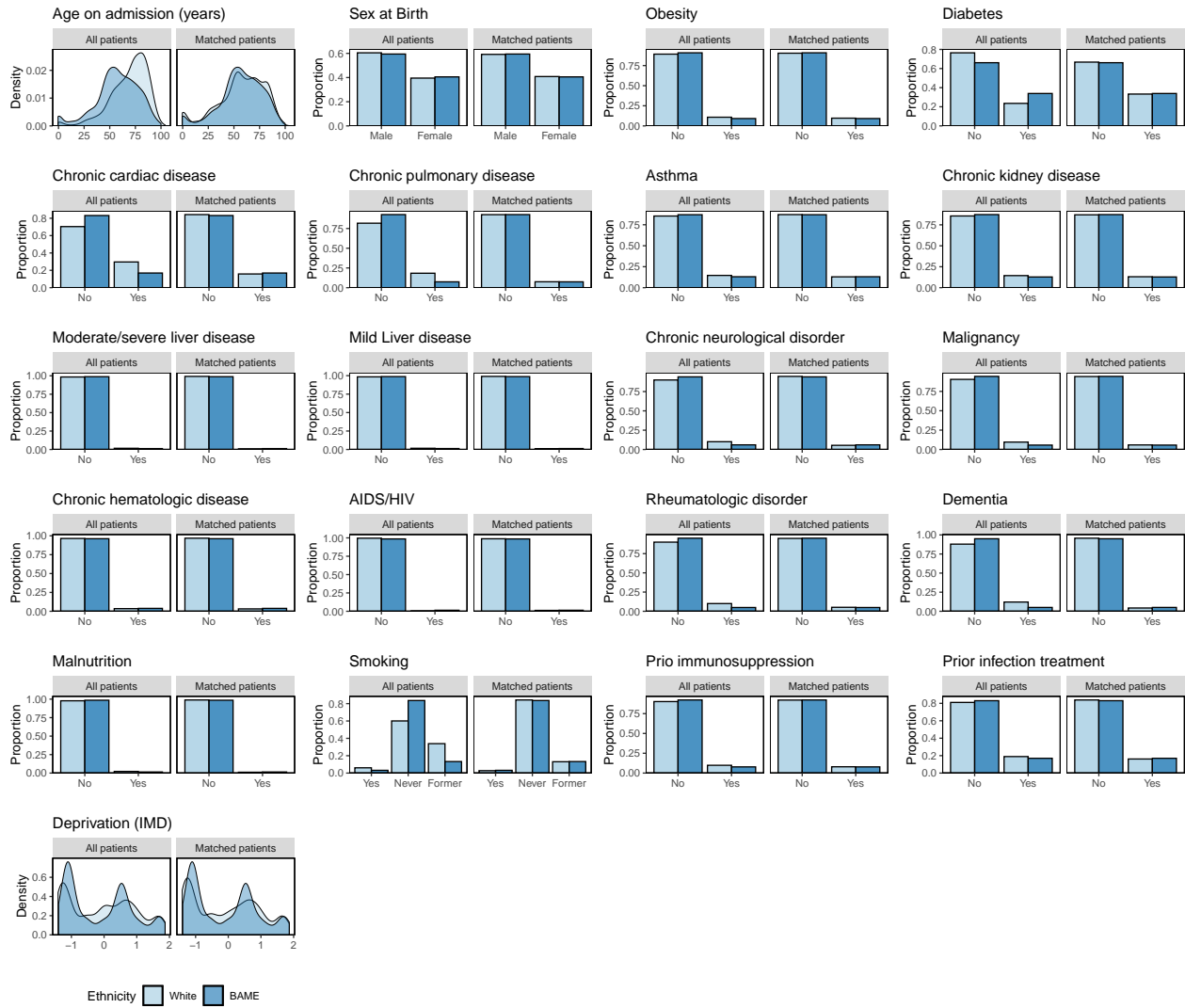


Figure 5: Distributions of patient characteristics before and after matching.

Distribution of propensity scores

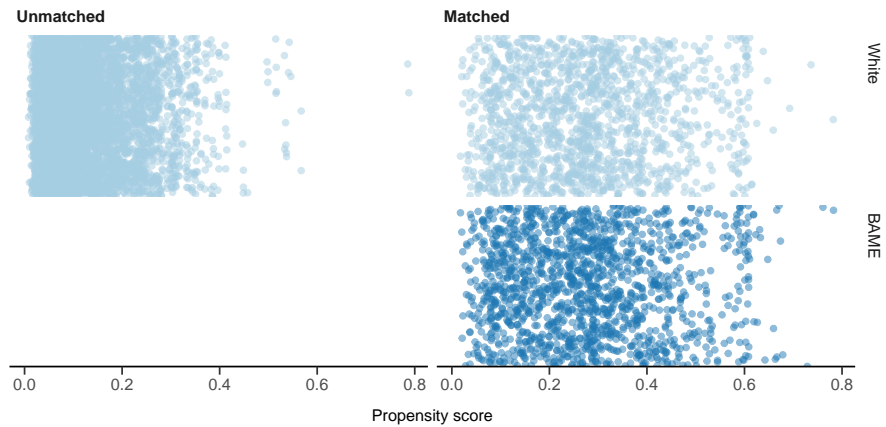


Figure 6: Matched patients by propensity score.

Table 6: Matched individuals

White	BAME
6826	1487
1487	1487
5339	0
0	0

### Propensity-score matched survival analysis

Table 7: Survival in matched patients hospitalised with COVID-19. One-to-one matching information discarded.

			HR (univariable)	HR (multivariable)
Ethnicity	White	1487 (50.0)	-	-
	BAME	1487 (50.0)	1.12 (0.92-1.35, p=0.256)	1.12 (0.92-1.35, p=0.256)

Table 8: Survival in matched patients hospitalised with COVID-19. Robust standard errors (clusters) utilising matching data.

			HR (univariable)	HR (multivariable)
Ethnicity	White	1487 (50.0)	-	-
	BAME	1487 (50.0)	1.12 (0.92-1.35, p=0.256)	1.12 (0.93-1.34, p=0.240)
cluster(subclass)			-	-

# Appendix

## Balance tables

Table 9: Balance table (all patients)

	Means Treated	Means Control	SD Control	Mean Diff	eQQ Med	eQQ Mean	eQQ Max
distance	0.2746317	0.1580168	0.1188699	0.1166150	0.1405826	0.1165650	0.1711266
age	57.2801509	69.0852625	17.8910874	-11.8051116	13.0000000	11.7892641	25.7291667
sexMale	0.5944855	0.6046001	0.4889722	-0.0101145	0.0000000	0.0100874	1.0000000
sexFemale	0.4055145	0.3953999	0.4889722	0.0101145	0.0000000	0.0100874	1.0000000
obesity_mhynYes	0.0914593	0.1078230	0.3101795	-0.0163637	0.0000000	0.0168124	1.0000000
diabetesYes	0.3389375	0.2355699	0.4243856	0.1033676	0.0000000	0.1035642	1.0000000
chrincardYes	0.1687962	0.2962203	0.4566228	-0.1274241	0.0000000	0.1277740	1.0000000
chronicpul_mhynYes	0.0739744	0.1829769	0.3866759	-0.1090024	0.0000000	0.1089442	1.0000000
asthma_mhynYes	0.1304640	0.1462057	0.3533382	-0.0157417	0.0000000	0.0161399	1.0000000
renal_mhynYes	0.1277740	0.1441547	0.3512723	-0.0163807	0.0000000	0.0168124	1.0000000
modlivYes	0.0121049	0.0161149	0.1259265	-0.0040099	0.0000000	0.0040350	1.0000000
mildliverYes	0.0127774	0.0162614	0.1264882	-0.0034839	0.0000000	0.0033625	1.0000000
chronicneu_mhynYes	0.0598521	0.1003516	0.3004902	-0.0404995	0.0000000	0.0403497	1.0000000
malignantneo_mhynYes	0.0564896	0.0950776	0.2933436	-0.0385881	0.0000000	0.0390047	1.0000000
chronichaemo_mhynYes	0.0383322	0.0351597	0.1841968	0.0031725	0.0000000	0.0026900	1.0000000
aidshiv_mhynYes	0.0141224	0.0042485	0.0650464	0.0098739	0.0000000	0.0094149	1.0000000
rheumatologic_mhynYes	0.0490921	0.1003516	0.3004902	-0.0512595	0.0000000	0.0511096	1.0000000
dementia_mhynYes	0.0504371	0.1208614	0.3259900	-0.0704243	0.0000000	0.0706120	1.0000000
malnutrition_mhynYes	0.0147949	0.0222678	0.1475640	-0.0074729	0.0000000	0.0073974	1.0000000
smoking_mhynNever Smoked	0.8359112	0.6006446	0.4898018	0.2352666	0.0000000	0.2353732	1.0000000
smoking_mhynFormer Smoker	0.1324815	0.3387050	0.4733041	-0.2062234	0.0000000	0.2064560	1.0000000
immno_cmtrtYes	0.0780094	0.0980076	0.2973467	-0.0199982	0.0000000	0.0201748	1.0000000
infect_cmtrtYes	0.1694687	0.1894228	0.3918728	-0.0199541	0.0000000	0.0201748	1.0000000
imd_rank_cn	-0.1127268	-0.0437455	1.0065532	-0.0689814	0.1213248	0.1459534	0.4506349

Table 10: Balance table (matched patients)

	Means Treated	Means Control	SD Control	Mean Diff	eQQ Med	eQQ Mean	eQQ Max
distance	0.2746317	0.2737952	0.1440546	0.0008366	0.0000608	0.0009065	0.0506402
age	57.2801509	57.4943852	22.1416274	-0.2142343	2.0000000	1.9671168	10.0000000
sexMale	0.5944855	0.5917956	0.4916667	0.0026900	0.0000000	0.0026900	1.0000000
sexFemale	0.4055145	0.4082044	0.4916667	-0.0026900	0.0000000	0.0026900	1.0000000
obesity_mhynYes	0.0914593	0.0961668	0.2949190	-0.0047075	0.0000000	0.0047075	1.0000000
diabetesYes	0.3389375	0.3328850	0.4714043	0.0060525	0.0000000	0.0060525	1.0000000
chrincardYes	0.1687962	0.1580363	0.3648978	0.0107599	0.0000000	0.0107599	1.0000000
chronicpul_mhynYes	0.0739744	0.0746469	0.2629092	-0.0006725	0.0000000	0.0006725	1.0000000
asthma_mhynYes	0.1304640	0.1291190	0.3354444	0.0013450	0.0000000	0.0013450	1.0000000
renal_mhynYes	0.1277740	0.1304640	0.3369266	-0.0026900	0.0000000	0.0026900	1.0000000
modlivYes	0.0121049	0.0080699	0.0894997	0.0040350	0.0000000	0.0040350	1.0000000
mildliverYes	0.0127774	0.0100874	0.0999619	0.0026900	0.0000000	0.0026900	1.0000000
chronicneu_mhynYes	0.0598521	0.0537996	0.2256977	0.0060525	0.0000000	0.0060525	1.0000000
malignantneo_mhynYes	0.0564896	0.0585071	0.2347787	-0.0020175	0.0000000	0.0020175	1.0000000
chronichaemo_mhynYes	0.0383322	0.0316073	0.1750110	0.0067249	0.0000000	0.0067249	1.0000000
aidshiv_mhynYes	0.0141224	0.0121049	0.1093912	0.0020175	0.0000000	0.0020175	1.0000000
rheumatologic_mhynYes	0.0490921	0.0517821	0.2216614	-0.0026900	0.0000000	0.0026900	1.0000000
dementia_mhynYes	0.0504371	0.0430397	0.2030147	0.0073974	0.0000000	0.0073974	1.0000000
malnutrition_mhynYes	0.0147949	0.0114324	0.1063453	0.0033625	0.0000000	0.0033625	1.0000000
smoking_mhynNever Smoked	0.8359112	0.8419637	0.3648978	-0.0060525	0.0000000	0.0060525	1.0000000
smoking_mhynFormer Smoker	0.1324815	0.1304640	0.3369266	0.0020175	0.0000000	0.0020175	1.0000000
immno_cmtrtYes	0.0780094	0.0793544	0.2703820	-0.0013450	0.0000000	0.0013450	1.0000000
infect_cmtrtYes	0.1694687	0.1613988	0.3680222	0.0080699	0.0000000	0.0080699	1.0000000
imd_rank_cn	-0.1127268	-0.0847064	1.0126656	-0.0280204	0.0866606	0.1145528	0.3639744

Table 11: Reduction in differences table

	Mean Diff.	eQQ Med	eQQ Mean	eQQ Max
distance	99.282634	99.95674	99.22234	70.40776
age	98.185241	84.61538	83.31434	61.13360
sexMale	73.404763	0.00000	73.33333	0.00000
sexFemale	73.404763	0.00000	73.33333	0.00000
obesity_mhynYes	71.232299	0.00000	72.00000	0.00000
diabetesYes	94.144726	0.00000	94.15584	0.00000
chrincardYes	91.555821	0.00000	91.57895	0.00000
chronicpul_mhynYes	99.383046	0.00000	99.38272	0.00000
asthma_mhynYes	91.455859	0.00000	91.66667	0.00000
renal_mhynYes	83.578319	0.00000	84.00000	0.00000
modlivYes	-0.624048	0.00000	0.00000	0.00000
mildliverYes	22.789356	0.00000	20.00000	0.00000
chronicneu_mhynYes	85.055500	0.00000	85.00000	0.00000
malignantneo_mhynYes	94.771739	0.00000	94.82759	0.00000
chronichaemo_mhynYes	-111.974412	0.00000	-150.00000	0.00000
aidshiv_mhynYes	79.567564	0.00000	78.57143	0.00000
rheumatologic_mhynYes	94.752228	0.00000	94.73684	0.00000
dementia_mhynYes	89.495891	0.00000	89.52381	0.00000
malnutrition_mhynYes	55.004482	0.00000	54.54545	0.00000
smoking_mhynNever Smoked	97.427406	0.00000	97.42857	0.00000
smoking_mhynFormer Smoker	99.021700	0.00000	99.02280	0.00000
immno_cmtrtYes	93.274446	0.00000	93.33333	0.00000
infect_cmtrtYes	59.557419	0.00000	60.00000	0.00000
imd_rank_cn	59.379693	28.57143	21.51414	19.23077