

Supplementary material: Are ethnic inequalities in COVID-19 outcomes mediated by occupation risk? Analyses of a two-year record linked national cohort study in Scotland.

Table S1: Ethnicity classifications based in 2011 Scottish Census

Dis-aggregated ethnic groups in 2011 Scottish Census	Categorical ethnicity variable	Binary ethnicity variable
White Scottish	White Scottish	White
White Other British	White Other British or Irish	
White Irish		
White Gypsy/Traveller	Other White	
White Polish		
Other White		
Pakistani, Pakistani Scottish or Pakistani British (referred to in main text as Pakistani)	South Asian	Non-White
Indian, Indian Scottish, or Indian British (referred to in main text as Indian)		
Bangladeshi, Bangladeshi Scottish or Bangladeshi British (referred to in main text as Bangladeshi)		
African, African Scottish, or African British (referred to in main text as African)	African, Caribbean, or Black	
Caribbean, Caribbean Scottish or Caribbean British/Black, Black Scottish or Black British (referred to in main text as African or Black)		
Arab, Arab Scottish, or Arab British (referred to in main text as Arab)	Other Ethnicity	
Chinese, Chinese Scottish or Chinese British (referred to in main text as Chinese)		
Other Asian		
Mixed or Multiple Ethnicity		
Other Ethnicity		

Table S2: List of occupations categorised into different COVID-19 risk levels.

3-digit SOC group	SOC Number	COVID-19 occupation risk
111 111 'Chief Executives and Senior Officials'	111	Low
112 112 'Production Managers and Directors'	112	Low
113 113 'Functional Managers and Directors'	113	Low
115 115 'Financial Institution Managers and Directors'	115	Low
116 116 'Managers and Directors in Transport and Logistics'	116	Medium
117 117 'Senior Officers in Protective Services'	117	Medium
118 118 'Health and Social Services Managers and Directors'	118	Medium
119 119 'Managers and Directors in Retail and Wholesale'	119	Medium
121 121 'Managers and Proprietors in Agriculture Related Svcs'	121	Low
122 122 'Managers and Proprietors in Hsptlty and Leisure Svcs'	122	Medium
124 124 'Managers and Proprietors in Health and Care Services'	124	Medium

125 125	'Managers and Proprietors in Other Services'	125	Medium
211 211	'Natural and Social Science Professionals'	211	Low
212 212	'Engineering Professionals'	212	Low
213 213	'IT and Telecommunications Professionals'	213	Low
214 214	'Conservation and Environment Professionals'	214	Low
215 215	'Research and Development Managers '	215	Low
221 221	'Health Professionals'	221	High
222 222	'Therapy Professionals'	222	High
223 223	'Nursing and Midwifery Professionals'	223	High
231 231	'Teaching and Educational Professionals'	231	High
241 241	'Legal Professionals'	241	Low
242 242	'Business, Research and Administrative Professionals'	242	Low
243 243	'Architects, Town Planners and Surveyors'	243	Low
244 244	'Welfare Professionals'	244	High
245 245	'Librarians and Related Professionals'	245	Low
246 246	'Quality and Regulatory Professionals'	246	Low
247 247	'Media Professionals'	247	Low
311 311	'Science, Engineering and Production Technicians'	311	Low
312 312	'Draughtspersons and Related Architectural Technicians'	312	Low
313 313	'Information Technology Technicians'	313	Low
321 321	'Health Associate Professionals'	321	High
323 323	'Welfare and Housing Associate Professionals'	323	High
331 331	'Protective Service Occupations'	331	High
341 341	'Artistic, Literary and Media Occupations'	341	Low
342 342	'Design Occupations'	342	Low
344 344	'Sports and Fitness Occupations'	344	Medium
351 351	'Transport Associate Professionals'	351	Low
352 352	'Legal Associate Professionals'	352	Low
353 353	'Business, Finance and Related Associate Professionals'	353	Low
354 354	'Sales, Marketing and Related Associate Professionals'	354	Low
355 355	'Conservation and Environmental Asst Professionals'	355	Low
356 356	'Public Services and Other Associate Professionals'	356	Low
411 411	'Administrative Occupations: Gvrnmnt and Related Orgs'	411	Low
412 412	'Administrative Occupations: Finance'	412	Low
413 413	'Administrative Occupations: Records'	413	Low
415 415	'Other Administrative Occupations'	415	Low
416 416	'Administrative Occupations: Office Mngrs and Sprvsrs'	416	Low
421 421	'Secretarial and Related Occupations'	421	Medium
511 511	'Agricultural and Related Trades'	511	Low
521 521	'Metal Forming, Welding and Related Trades'	521	Low
522 522	'Metal Machining, Fitting and Instrument Making Trades'	522	Low
523 523	'Vehicle Trades'	523	Low
524 524	'Electrical and Electronic Trades'	524	Low
525 525	'Skilled Metal, Electrical and Electronic Trds Sprvsrs'	525	Low
531 531	'Construction and Building Trades'	531	Low
532 532	'Building Finishing Trades'	532	Low

533 533	'Construction and Building Trades Supervisors'	533	Low
541 541	'Textiles and Garments Trades'	541	Low
542 542	'Printing Trades'	542	Low
543 543	'Food Preparation and Hospitality Trades'	543	Medium
544 544	'Other Skilled Trades'	544	Low
612 612	'Childcare and Related Personal Services'	612	High
613 613	'Animal Care and Control Services'	613	Low
614 614	'Caring Personal Services'	614	High
621 621	'Leisure and Travel Services'	621	Medium
622 622	'Hairdressers and Related Services'	622	Medium
623 623	'Housekeeping and Related Services'	623	Medium
624 624	'Cleaning and Housekeeping Managers and Supervisors'	624	Medium
711 711	'Sales Assistants and Retail Cashiers'	711	Medium
712 712	'Sales Related Occupations'	712	Medium
713 713	'Sales Supervisors'	713	Medium
721 721	'Customer Service Occupations'	721	Low
722 722	'Customer Service Managers and Supervisors'	722	Low
811 811	'Process Operatives'	811	Medium
812 812	'Plant and Machine Operatives'	812	Low
813 813	'Assemblers and Routine Operatives'	813	Low
814 814	'Construction Operatives'	814	Low
821 821	'Road Transport Drivers'	821	Medium
822 822	'Mobile Machine Drivers and Operatives'	822	Low
823 823	'Other Drivers and Transport Operatives'	823	Low
911 911	'Elementary Agricultural Occupations'	911	Low
912 912	'Elementary Construction Occupations'	912	Low
913 913	'Elementary Process Plant Occupations'	913	Medium
921 921	'Elementary Administration Occupations'	921	Medium
923 923	'Elementary Cleaning Occupations'	923	Medium
924 924	'Elementary Security Occupations'	924	Medium
925 925	'Elementary Sales Occupations'	925	Medium
926 926	'Elementary Storage Occupations'	926	Medium
927 927	'Other Elementary Services Occupations'	927	Medium

Occupation as mediator (sensitivity)

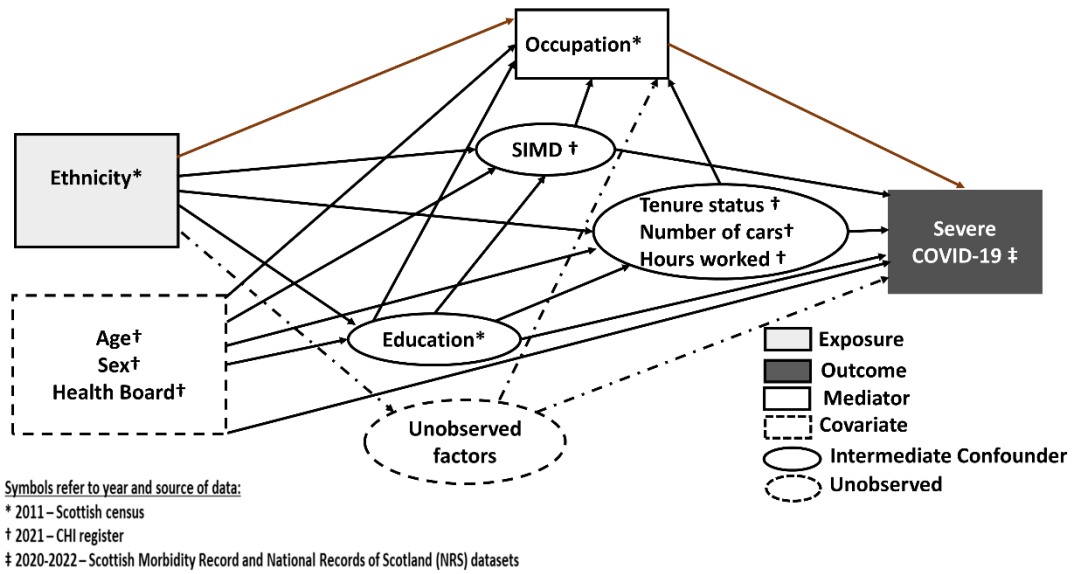


Figure S1: Directed acyclic graph summarising the relationship between ethnicity, occupation (SOC3) and Covid-19 outcomes – sensitivity analysis.

Table S3: Distribution of inverse propensity weights (IPW) distribution for aggregated (White vs Non-White) ethnic groups.

Category of IPW	Minimum	1st quantile	Median	Mean	3rd quantile	Maximum
Exposure	0.51	0.98	0.99	0.99	1.01	1.09
Mediation	0.34	0.69	0.84	0.99	1.13	3.12
Final (Exposure * Mediation)	0.17	0.69	0.84	0.97	1.13	3.4
mediation (sensitivity)	0.24	0.66	0.83	0.98	1.14	3.29
final (Exposure * Mediation (sensitivity))	0.12	0.66	0.82	0.97	1.13	3.58

Table S4: Distribution of inverse propensity weights (IPW) distribution for disaggregated (White Scottish, White British or Irish, Other White, South Asian, African, Caribbean or Black and Other) ethnic groups.

Category of IPW	Minimum	1st quantile	Median	Mean	3rd quantile	Maximum
Exposure	0.38	0.94	0.98	0.99	1.04	2.02
Mediation	0.33	0.69	0.84	0.99	1.12	3.17
Final (Exposure * Mediation)	0.13	0.67	0.82	0.98	1.14	6.41
mediation (sensitivity)	0.24	0.66	0.83	0.98	1.13	3.34
final (Exposure * Mediation (sensitivity))	0.09	0.63	0.81	0.97	1.14	6.77

Table S5: Distribution of inverse propensity weights (IPW) distribution for aggregated (White vs Non-White) ethnic groups.

Category of IPW	Minimum	1st quantile	Median	Mean	3rd quantile	Maximum
Exposure	0.51	0.98	0.99	0.99	1.01	1.09
Mediation	0.34	0.69	0.84	0.99	1.13	3.12
Final (Exposure * Mediation)	0.17	0.69	0.84	0.97	1.13	3.4
mediation (sensitivity)	0.24	0.66	0.83	0.98	1.14	3.29
final (Exposure * Mediation (sensitivity))	0.12	0.66	0.82	0.97	1.13	3.58

Table S6: Distribution of inverse propensity weights (IPW) distribution for disaggregated (White Scottish, White British or Irish, Other White, South Asian, African, Caribbean or Black and Other) ethnic groups.

Category of IPW	Minimum	1st quantile	Median	Mean	3rd quantile	Maximum
Exposure	0.38	0.94	0.98	0.99	1.04	2.02
Mediation	0.33	0.69	0.84	0.99	1.12	3.17
Final (Exposure * Mediation)	0.13	0.67	0.82	0.98	1.14	6.41
mediation (sensitivity)	0.24	0.66	0.83	0.98	1.13	3.34
final (Exposure * Mediation (sensitivity))	0.09	0.63	0.81	0.97	1.14	6.77

Table S7: Total effects (TE) controlled direct effects (CDE), and percentage change (PC) in relative inequalities in COVID 19 hospitalisation or death according to both aggregated and disaggregated ethnicity if differences in occupation risk were eliminated using sensitivity weights.

Variable	Category (reference)	Total Effects (Model 1) ^a HR (95% CI)	Controlled Direct Effects (Model 2) ^b HR (95% CI)	Percentage Change Estimate (95% CI)
Aggregated ethnicity	White (ref)	1.00	1.00	
	Non White	1.57 (1.45-1.76)	1.69(1.35 -2.13)	-6.12(-6.21—6.03)
Disaggregated ethnicity	White Scottish (Ref)	1.00	1.00	
	White British or Irish	0.69 (0.05 - -8.21)	0.73 (0.07 -4.33)	-5.70 (-5.12 – 0.29)
	Other White	0.86 (0.08 - -2.04)	0.68 (0.16 -2.42)	19.00 (18.04 – 19.90)
	South Asian	2.02 (0.07 - 1.34)	1.75 (0.18 - 3.06)	11.78 (10.70 – 13.80)
	African, Caribbean, or Black	1.33 (0.15 - 2.00)	1.44 (0.32 - 1.13)	-16.39 (-19.00 - -13.80)
	Other	1.09 (0.10 - 0.85)	1.68 (0.20 - 2.54)	-59.01 (-31.31 – -56.71)

^a Adjusted for confounders (i.e. age, sex, and health board) for doubly robustness

^b Adjusted for occupation risk and confounders (i.e., age, sex, and health board) for doubly robustness

Table S8: Total effects (TE), controlled direct effects (CDE), and percentage change (PC) in relative inequalities in COVID 19 hospitalisation or death according to both aggregated and disaggregated ethnicity if differences in occupation risk were eliminated (non-doubly robust)

Variable	Category (reference)	Total Effects (Model 1) ^a HR (95% CI)	Controlled Direct Effects (Model 2) ^b HR (95% CI)	Percentage Change Estimate (95% CI)
Aggregated ethnicity	White (ref)	1.00	1.00	
	Non White	1.46 (1.33-160)	1.38 (1.10 – 1.73)	5.22 (5.14 – 5.30)
Disaggregated ethnicity	White Scottish (Ref)	1.00	1.00	
	White British or Irish	0.68 (0.63 – 0.75)	0.73 (0.63 – 0.85)	-7.56 (-8.14 – -6.98)
	Other White	0.79 (0.68 – 0.92)	0.65 (0.48 – 0.89)	17.29 (16.43 – 18.16)
	South Asian	1.96 (1.71- 2.24)	1.45 (1.02 – 2.08)	24.24 (23.33 – 25.16)
	African, Caribbean, or Black	1.24 (0.93 – 1.65)	1.29 (0.69 – 2.43)	-10.79 (-13.41 - -8.18)
	Other	1.04 (0.86 – 1.26)	1.51 (1.01 – 2.25)	-59.19 (-52.37 – -48.01)