Supplementary materials

Supplementary Box A: Scale of myeloimmunosuppression by chemotherapy drugs/regimens based on the risk of Grade 3/4 febrile neutropenia (CTCv4) or lymphopenia

Group A	Group B	Group C
<10 %	10-50%	>50%
• Trastuzumab +/- pertuzumab • Abiraterone • Enzalutamide • Bisphosphonate • Denosumab • Aromatase inhibitors • Fulvestrant • Tamoxifen • Single agent: Atezolizumab Pembrolizumab Ipilimumab Nivolumab • Cetuximab • Panitumumab • Durvalumab • Anagrelide • Taxane – weekly • Cisplatin based regimens • CDK4/6 inhibitors • 5FU single agent • Mitomycin C • Capecitabine single agent • Bevacizumab single agent • Pemetrexed • mTOR inhibitors • Raltitrexed • Methotrexate • PARP inhibitors • Lenvatinib • Sorafenib • Regorafinib • Tyrosine kinase inhibitors (including ALK &/or ROS) • Hydroxycarbamide • Busulfan • Interferon (all formulations)	• Etoposide based regimens • CMF • Irinotecan and Oxaliplatin based regimens • Cabazitaxel • Gemcitabine • Chorambucil • Temozolomide • Daratumumab • Rituximab • Obinutuzumab • Pentostatin • Proteosome inhibitors • IMIDs • PI3Kinase inhibitors • BTK inhibitors • JAK inhibitors • Ventoclax • Trastuzumab-emtansine • Anthracycline based regimens • FEC • MVAC • ABVD • CHOP • BEACOPP • Liposomal doxorubicin • Taxane – 3 weekly • Nab-paclitaxel • Carboplatin based regimens • Ifophosphamide based regimens • Bendamustine • Cladrabine • Topotecan • Cyclophosphamide/Fludarabine combinations • ICE • GDP	• All ALL/AML regimens • BEP • Highly immunosuppressive chemotherapy (e.g. FluDAP, high dose Methotrexate & Cytarabine) • Trifuradine/ Tipracil

	• DHAP • ESHAP • CVAD • Dacarbazine based regimens • Lomustine • Mogalizumab • Brentuximab vedotin • Asparaginase based regimens	

Supplementary Table A: Baseline characteristics of the validation cohort for period 1 (24.01.2020 to 30.04.2020)

	Validation cohort total (%)	Validation COVID deaths	Validation COVID admission
total	2173056	1722	3703
males	1075788 (49.51)	978 (56.79)	2076 (56.06)
mean age (SD)	48.08 (18.69)	80.40 (11.67)	70.56 (17.23)
19-29 years	424125 (19.52)	*	81 (2.19)
30-39 years	417590 (19.22)	*	143 (3.86)
40-49 years	358695 (16.51)	22 (1.28)	269 (7.26)
50-59 years	358820 (16.51)	77 (4.47)	470 (12.69)
60-69 years	270340 (12.44)	183 (10.63)	568 (15.34)
70-79 years	209557 (9.64)	390 (22.65)	759 (20.50)
80-89 years	106349 (4.89)	655 (38.04)	993 (26.82)
90+ years	27580 (1.27)	389 (22.59)	420 (11.34)
Geographical region			
East Midlands	56377 (2.59)	45 (2.61)	85 (2.30)
East of England	109558 (5.04)	78 (4.53)	173 (4.67)
London	483127 (22.23)	511 (29.67)	1164 (31.43)
North East	31768 (1.46)	26 (1.51)	78 (2.11)
North West	393451 (18.11)	363 (21.08)	718 (19.39)
South Central	280072 (12.89)	252 (14.63)	427 (11.53)
South East	239836 (11.04)	135 (7.84)	338 (9.13)
South West	319539 (14.70)	111 (6.45)	296 (7.99)
West Midlands	171473 (7.89)	142 (8.25)	317 (8.56)
Yorkshire & Humber	87855 (4.04)	59 (3.43)	107 (2.89)
Ethnicity			
White	1420278 (65.36)	1169 (67.89)	2380 (64.27)
Indian	50831 (2.34)	39 (2.26)	108 (2.92)
Pakistani	32866 (1.51)	24 (1.39)	75 (2.03)
Bangladeshi	23424 (1.08)	22 (1.28)	50 (1.35)
Other Asian	34412 (1.58)	21 (1.22)	72 (1.94)
Caribbean	24135 (1.11)	68 (3.95)	138 (3.73)
Black African	47933 (2.21)	37 (2.15)	135 (3.65)
Chinese	23885 (1.10)	*	18 (0.49)
Other ethnic group	81009 (3.73)	25 (1.45)	135 (3.65)
Ethnicity not recorded	434283 (19.98)	308 (17.89)	592 (15.99)
Townsend quintile			
1 (most affluent)	446359 (20.54)	312 (18.12)	697 (18.82)
2	428735 (19.73)	316 (18.35)	630 (17.01)
3	439846 (20.24)	373 (21.66)	736 (19.88)
4	436574 (20.09)	318 (18.47)	770 (20.79)

5 (most deprived)	409917 (18.86)	400 (23.23)	861 (23.25)
Townsend not recorded	11625 (0.53)	*	*
accommodation			
neither	2155199 (99.18)	1190 (69.11)	3316 (89.55)
Care or residential home	14057 (0.65)	529 (30.72)	373 (10.07)
Homeless	3800 (0.17)	*	*
Body mass index (kg/m^2)			
BMI < 18.5	59376 (2.73)	86 (4.99)	113 (3.05)
BMI 18.5-24.99	711186 (32.73)	575 (33.39)	955 (25.79)
BMI 25-29.99	596942 (27.47)	498 (28.92)	1183 (31.95)
BMI 30-34.99	278830 (12.83)	256 (14.87)	704 (19.01)
BMI 35+	160345 (7.38)	171 (9.93)	530 (14.31)
BMI not recorded	366377 (16.86)	136 (7.90)	218 (5.89)
smoking status			
non smoker	1242933 (57.20)	895 (51.97)	2087 (56.36)
ex smoker	460999 (21.21)	671 (38.97)	1285 (34.70)
light smoker	290738 (13.38)	91 (5.28)	231 (6.24)
moderate smoker	57297 (2.64)	14 (0.81)	27 (0.73)
heavy smoker	26332 (1.21)	10 (0.58)	26 (0.70)
Smoking not recorded	94757 (4.36)	41 (2.38)	47 (1.27)
no CKD	2087614 (96.07)	1200 (69.69)	2852 (77.02)
CKD3	76600 (3.52)	431 (25.03)	667 (18.01)
CKD4	4648 (0.21)	40 (2.32)	73 (1.97)
CKD5 only	2527 (0.12)	35 (2.03)	78 (2.11)
CKD5 with dialysis	585 (0.03)	12 (0.70)	16 (0.43)
CKD5 with transplant	1082 (0.05)	*	17 (0.46)
no learning disability	2137759 (98.38)	1645 (95.53)	3572 (96.46)
Learning disability	34257 (1.58)	75 (4.36)	125 (3.38)
Down's Syndrome	1040 (0.05)	*	*
No chemotherapy in last 12	2164341 (99.60)	1687 (97.97)	3603 (97.30)
Chemotherapy group A	3343 (0.15)	7 (0.41)	24 (0.65)
Chemotherapy group B	5032 (0.23)	24 (1.39)	71 (1.92)
Chemotherapy group C	340 (0.02)	*	*
Cancer and immunosuppression			
Blood cancer	10359 (0.48)	49 (2.85)	89 (2.40)
Bone marrow or stem cell transplant in last 6 months	73 (0.00)	*	*
Respiratory cancer	4549 (0.21)	21 (1.22)	46 (1.24)

Radiotherapy in last 6 months	4346 (0.20)	15 (0.87)	39 (1.05)
Solid organ transplant	1147 (0.05)	*	15 (0.41)
Prescribed immunosuppressants by GP	2814 (0.13)	10 (0.58)	13 (0.35)
Prescribed leukotriene or LABA	45905 (2.11)	155 (9.00)	311 (8.40)
prescribed regular prednisolone	11617 (0.53)	68 (3.95)	149 (4.02)
Sickle cell disease	717 (0.03)	*	*
Other co-morbidities			
Type 1 diabetes	10337 (0.48)	13 (0.75)	59 (1.59)
Type 2 diabetes	137092 (6.31)	518 (30.08)	1048 (28.30)
COPD	51026 (2.35)	246 (14.29)	400 (10.80)
asthma	299632 (13.79)	231 (13.41)	618 (16.69)
Rare pulmonary diseases	11748 (0.54)	55 (3.19)	97 (2.62)
Pulmonary hypertension or pulmonary fibrosis	1891 (0.09)	19 (1.10)	26 (0.70)
Coronary heart disease	77035 (3.55)	368 (21.37)	626 (16.91)
Stroke	47513 (2.19)	359 (20.85)	475 (12.83)
Atrial Fibrillation	52764 (2.43)	294 (17.07)	515 (13.91)
Congestive cardiac failure	25255 (1.16)	224 (13.01)	349 (9.42)
Venous thromboembolism	38962 (1.79)	157 (9.12)	290 (7.83)
Peripheral vascular disease	16463 (0.76)	101 (5.87)	178 (4.81)
Congenital heart disease	11344 (0.52)	20 (1.16)	37 (1.00)
Dementia	21984 (1.01)	603 (35.02)	521 (14.07)
Parkinson's disease	5736 (0.26)	68 (3.95)	74 (2.00)
Epilepsy	29031 (1.34)	53 (3.08)	131 (3.54)
Rare neurological conditions	6804 (0.31)	26 (1.51)	37 (1.00)
Cerebral palsy	2433 (0.11)	*	*
Severe mental illness	246668 (11.35)	333 (19.34)	681 (18.39)
Osteoporotic fracture	87595 (4.03)	301 (17.48)	413 (11.15)
Rheumatoid arthritis or SLE	21391 (0.98)	51 (2.96)	107 (2.89)
Cirrhosis of the liver	4442 (0.20)	*	34 (0.92)
On the shielded list	88170 (4.06)	364 (21.14)	817 (22.06)

* represents values which have been suppressed due to small numbers < 15

Supplementary Table B: Baseline characteristics of the validation cohort for period 2 (01.05.2020 to 30.06.2020)

category	COVID related deaths	COVID related admissions
total	621	1002
males	324 (52.17)	478 (47.70)
mean age (SD)	82.29 (11.29)	68.37 (20.92)
19-29 years	*	57 (5.69)
30-39 years	*	89 (8.88)
40-49 years	*	65 (6.49)
50-59 years	24 (3.86)	110 (10.98)
60-69 years	45 (7.25)	104 (10.38)
70-79 years	118 (19.00)	163 (16.27)
80+ years	250 (40.26)	281 (28.04)
90+ years	176 (28.34)	133 (13.27)
Geographical region		
East Midlands	39 (6.28)	49 (4.89)
East of England	21 (3.38)	53 (5.29)
London	81 (13.04)	126 (12.57)
North East	*	*
North West	175 (28.18)	294 (29.34)
South Central	51 (8.21)	95 (9.48)
South East	77 (12.40)	130 (12.97)
South West	81 (13.04)	117 (11.68)
West Midlands	73 (11.76)	91 (9.08)
Yorkshire & Humber	22 (3.54)	41 (4.09)
Ethnicity		
White	459 (73.91)	700 (69.86)
Indian	*	*
Pakistani	*	19 (1.90)
Bangladeshi	*	*
Other Asian	*	*
Caribbean	*	*
Black african	*	15 (1.50)
Chinese	*	*
Other ethnic group	*	19 (1.90)
Ethnicity not record	131 (21.10)	206 (20.56)
Townsend quintile		
1 (most affluent)	168 (27.05)	223 (22.26)
2	112 (18.04)	187 (18.66)
3	148 (23.83)	217 (21.66)

4	110 (17.71)	219 (21.86)
5 (most deprived)	80 (12.88)	154 (15.37)
Townsend not recorded	*	*
accommodation		
neither	405 (65.22)	855 (85.33)
carehome	215 (34.62)	146 (14.57)
Homeless	*	*
BMI < 18	36 (5.80)	31 (3.09)
BMI 18-24.99	230 (37.04)	303 (30.24)
BMI 25-29.99	177 (28.50)	302 (30.14)
BMI 30-34.99	66 (10.63)	170 (16.97)
BMI 35+	58 (9.34)	124 (12.38)
BMI not recorded	54 (8.70)	72 (7.19)
smoking status		
non smoker	321 (51.69)	558 (55.69)
ex smoker	234 (37.68)	317 (31.64)
light smoker	35 (5.64)	83 (8.28)
moderate smoker	*	15 (1.50)
heavy smoker	*	*
Smoking not recorded	23 (3.70)	19 (1.90)
no CKD	423 (68.12)	780 (77.84)
CKD3	178 (28.66)	180 (17.96)
CKD4	*	18 (1.80)
CKD5 only	*	15 (1.50)
CKD5 with dialysis	*	*
CKD5 with transplant	*	*
no learning disabili	600 (96.62)	970 (96.81)
Learning disability	20 (3.22)	31 (3.09)
Downs		
No chemo in last 12	601 (96.78)	984 (98.20)
Chemo group A	*	*
chemo group B	*	*
chemo group C		*
Cancer and immunosuppression		
Blood cancer	*	15 (1.50)
Bone marrow or stem cell transplant in last 6 months	*	*
Respiratory cancer	*	*

Radiotherapy in last 6 months	*	*
Solid organ transplant	*	*
Prescribed immunosuppressant medication by GP	*	*
Prescribed leukotriene or LABA	54 (8.70)	59 (5.89)
prescribed regular prednisolone	24 (3.86)	33 (3.29)
Sickle cell disease	*	*
Other co-morbidities		
Type 1 diabetes	*	*
Type 2 diabetes	172 (27.70)	233 (23.25)
COPD	74 (11.92)	94 (9.38)
asthma	83 (13.37)	167 (16.67)
Rare pulmonary diseases	17 (2.74)	19 (1.90)
Pulmonary hypertension or pulmonary fibrosis	*	*
Coronary heart disease	145 (23.35)	173 (17.27)
Stroke	126 (20.29)	160 (15.97)
Atrial Fibrillation	132 (21.26)	157 (15.67)
Congestive cardiac failure	65 (10.47)	89 (8.88)
Venous thromboembolism	53 (8.53)	80 (7.98)
Peripheral vascular disease	36 (5.80)	43 (4.29)
Congenital heart disease	*	*
Dementia	255 (41.06)	174 (17.37)
Parkinson's disease	34 (5.48)	26 (2.59)
Epilepsy	26 (4.19)	35 (3.49)
Rare neurological conditions	*	*
Cerebral palsy	*	*
Severe mental illness	110 (17.71)	195 (19.46)
Osteoporotic fracture	123 (19.81)	119 (11.88)
Rheumatoid arthritis or SLE	22 (3.54)	30 (2.99)
Cirrhosis of the liver	*	18 (1.80)

Supplementary Table C: Performance of the risk models to predict risk of COVID-19 death in the validation cohort by subgroup using Harrell's C statistic (95% CI) in study period 1 (24.01.2020 to 30.04.2020) and period 1 (01.05.2020 to 30.06.2020)

	period 1	period 1	period 2	period 2
	death	death	death	death
groupcat	females	males	females	males
overall	.933 (.923 to .944)	.928 (.919 to .938)	.952 (.938 to .965)	.933 (.918 to .949)
<50 years	*	*	*	*
50-59 years	.618 (.519 to .717)	.678 (.612 to .744)	.517 (.516 to .517)	.717 (.601 to .833)
60-69 years	.77 (.712 to .828)	.831 (.79 to .872)	.794 (.678 to .91)	.753 (.665 to .84)
70-79 years	.866 (.832 to .9)	.812 (.782 to .841)	.845 (.78 to .91)	.845 (.793 to .897)
80+ years	.821 (.803 to .838)	.814 (.796 to .833)	.817 (.79 to .843)	.801 (.771 to .831)
East Midlands	.952 (.895 to 1.01)	.927 (.865 to .989)	.943 (.89 to .996)	.927 (.86 to .994)
East of England	.925 (.874 to .976)	.904 (.849 to .959)	.905 (.799 to 1.01)	.96 (.932 to .989)
London	.937 (.917 to .958)	.912 (.893 to .932)	.967 (.936 to .997)	.936 (.894 to .978)
North East	.971 (.947 to .994)	.957 (.937 to .976)	.975 (.973 to .977)	*
North West	.929 (.905 to .953)	.942 (.924 to .959)	.945 (.917 to .973)	.925 (.89 to .961)
South Central	.946 (.922 to .971)	.947 (.928 to .966)	.94 (.9 to .981)	.88 (.81 to .949)
South East	.918 (.879 to .958)	.918 (.881 to .955)	.94 (.893 to .986)	.955 (.93 to .981)
South West	.952 (.918 to .985)	.931 (.898 to .965)	.961 (.925 to .996)	.937 (.892 to .982)
West Midlands	.907 (.864 to .949)	.923 (.887 to .958)	.958 (.924 to .992)	.924 (.872 to .975)
Yorkshire & Humber	.92 (.842 to .998)	.98 (.972 to .988)	.993 (.989 to .996)	.969 (.948 to .99)
White	.932 (.921 to .944)	.93 (.92 to .94)	.953 (.94 to .967)	.936 (.92 to .952)
Indian	.915 (.842 to .987)	.886 (.802 to .97)	.987 (.975 to .999)	.864 (.666 to 1.06)
Pakistani	.915 (.805 to 1.03)	.933 (.869 to .996)	*	.849 (.654 to 1.04)
Bangladeshi	.954 (.923 to .986)	.916 (.845 to .987)	.72 (.333 to 1.11)	.991 (.98 to 1)
Other Asian	.862 (.701 to 1.02)	.91 (.835 to .985)	*	.948 (.945 to .951)
Caribbean	.96 (.941 to .978)	.938 (.903 to .973)	.919 (.834 to 1)	.97 (.94 to .999)
Black african	.877 (.774 to .981)	.915 (.851 to .978)	.905 (.901 to .908)	.947 (.89 to 1)
Chinese	.981 (.966 to .996)	.976 (.955 to .998)	*	*
Other ethnic group	.981 (.97 to .992)	.884 (.796 to .972)	.858 (.63 to 1.09)	.867 (.709 to 1.02)
1 (most affluent)	.941 (.919 to .964)	.922 (.898 to .945)	.925 (.89 to .96)	.936 (.907 to .965)
2	.947 (.926 to .969)	.922 (.898 to .946)	.963 (.938 to .987)	.944 (.915 to .973)
3	.918 (.892 to .944)	.927 (.907 to .947)	.964 (.943 to .985)	.912 (.869 to .955)
4	.936 (.911 to .961)	.924 (.901 to .946)	.957 (.926 to .988)	.939 (.905 to .973)
5 (most deprived)	.927 (.904 to .951)	.944 (.927 to .961)	.96 (.93 to .991)	.932 (.889 to .974)

* could not be evaluated due to small number of events

Supplementary Table D: Performance of the risk models to predict risk of COVID-19 hospital admission in the validation cohort by subgroup using Harrell's C statistic (95% CI) in study period 1 (24.01.2020 to 30.04.2020) and period 2 (01.05.2020 to 30.06.2020)

	period 1	period 1	period 2	period 2
	hospital	hospital	hospital	hospital
groupcat	females	males	females	males
overall	.847 (.836 to .857)	.86 (.852 to .868)	.776 (.753 to .8)	.833 (.812 to .853)
<50 years	.693 (.659 to .726)	.744 (.713 to .775)	.689 (.601 to .777)	.66 (.569 to .751)
50-59 years	.744 (.708 to .779)	.695 (.664 to .727)	.667 (.597 to .738)	.686 (.621 to .75)
60-69 years	.73 (.696 to .765)	.771 (.745 to .797)	.672 (.575 to .768)	.746 (.69 to .803)
70-79 years	.801 (.773 to .828)	.764 (.742 to .786)	.792 (.743 to .841)	.769 (.721 to .817)
80+ years	.712 (.693 to .73)	.717 (.698 to .735)	.715 (.685 to .746)	.714 (.677 to .751)
East Midlands	.867 (.812 to .922)	.9 (.861 to .939)	.817 (.73 to .903)	.858 (.782 to .935)
East of England	.824 (.773 to .876)	.838 (.8 to .875)	.804 (.704 to .904)	.874 (.798 to .95)
London	.854 (.835 to .873)	.868 (.855 to .882)	.696 (.625 to .767)	.869 (.814 to .924)
North East	.776 (.69 to .862)	.848 (.792 to .905)	.848 (.687 to 1.01)	.948 (.918 to .978)
North West	.859 (.837 to .88)	.86 (.841 to .88)	.812 (.77 to .853)	.82 (.781 to .858)
South Central	.825 (.793 to .856)	.867 (.845 to .889)	.753 (.679 to .827)	.812 (.742 to .882)
South East	.864 (.834 to .895)	.836 (.805 to .867)	.771 (.704 to .838)	.849 (.788 to .909)
South West	.812 (.777 to .847)	.825 (.792 to .858)	.751 (.676 to .827)	.827 (.772 to .882)
West Midlands	.843 (.808 to .877)	.833 (.801 to .865)	.789 (.71 to .867)	.808 (.736 to .88)
Yorkshire & Humber	.867 (.812 to .922)	.941 (.922 to .96)	.79 (.673 to .908)	.83 (.746 to .914)
White	.852 (.84 to .863)	.863 (.854 to .872)	.786 (.761 to .81)	.848 (.827 to .869)
Indian	.822 (.755 to .889)	.796 (.743 to .849)	.749 (.606 to .892)	.836 (.712 to .96)
Pakistani	.735 (.636 to .834)	.8 (.742 to .858)	.836 (.635 to 1.04)	.693 (.557 to .83)
Bangladeshi	.696 (.575 to .818)	.843 (.753 to .934)	.79 (.581 to 1)	.783 (.511 to 1.05)
Other Asian	.748 (.669 to .827)	.851 (.803 to .9)	.584 (.348 to .819)	.53 (.332 to .728)
Caribbean	.865 (.825 to .905)	.864 (.825 to .902)	.845 (.669 to 1.02)	.933 (.877 to .989)
Black african	.855 (.805 to .905)	.84 (.797 to .883)	.566 (.411 to .721)	.688 (.537 to .84)

Chinese	.87 (.739 to 1)	.894 (.804 to .985)	*	.983 (.975 to .992)
Other ethnic group	.796 (.74 to .852)	.84 (.798 to .883)	.546 (.385 to .706)	.703 (.539 to .867)
1 (most affluent)	.834 (.81 to .859)	.826 (.805 to .847)	.821 (.774 to .868)	.878 (.844 to .913)
2	.855 (.832 to .879)	.855 (.834 to .875)	.753 (.695 to .811)	.827 (.777 to .876)
3	.84 (.817 to .863)	.859 (.841 to .877)	.785 (.734 to .836)	.802 (.754 to .85)
4	.838 (.814 to .861)	.867 (.85 to .884)	.779 (.731 to .827)	.835 (.789 to .88)
5 (most deprived)	.858 (.837 to .878)	.883 (.867 to .9)	.728 (.665 to .791)	.818 (.766 to .871)

*could not be evaluated due to small number of events

Supplementary Table E: Performance of the risk models to predict risk of COVID-19 death in the validation cohort by subgroup (D statistic and R^2 explained variation) in study period 1 (24.01.2020 to 30.04.2020) and period 2 (01.05.2020 to 30.06.2020)

		period 1	period1	period 2	period 2
		death	death	death	death
statistic	group	females	males	females	males
R2	overall	74 (72.7 to 75.3)	73.1 (71.9 to 74.3)	75.4 (73.5 to 77.4)	73.6 (71.6 to 75.6)
D statistic	overall	3.46 (3.34 to 3.57)	3.37 (3.27 to 3.47)	3.59 (3.4 to 3.77)	3.42 (3.24 to 3.59)
R2	<50 years	67.9 (53.3 to 82.5)	54.2 (37.7 to 70.7)	*	49.2 (3.38 to 95)
D statistic	<50 years	2.98 (1.98 to 3.97)	2.23 (1.49 to 2.97)	*	2.02 (.172 to 3.87)
R2	50-59 years	53.2 (37.2 to 69.2)	52.4 (42.6 to 62.1)	*	50.6 (33.1 to 68)
D statistic	50-59 years	2.18 (1.48 to 2.88)	2.15 (1.73 to 2.56)	1.5 (.101 to 2.9)	2.07 (1.35 to 2.79)
R2	60-69 years	50.6 (41.6 to 59.6)	57 (50.8 to 63.2)	51.6 (33.6 to 69.6)	42.3 (25.8 to 58.9)
D statistic	60-69 years	2.07 (1.7 to 2.44)	2.36 (2.06 to 2.66)	2.11 (1.35 to 2.87)	1.75 (1.16 to 2.35)
R2	70-79 years	62.8 (57.9 to 67.8)	53.2 (48.7 to 57.7)	62.6 (54.2 to 71)	56.7 (48.9 to 64.6)
D statistic	70-79 years	2.66 (2.38 to 2.94)	2.18 (1.99 to 2.38)	2.65 (2.18 to 3.13)	2.34 (1.97 to 2.72)
R2	80+ years	47.7 (44.2 to 51.3)	47.6 (44.1 to 51.1)	46.6 (41.1 to 52)	44.7 (38.6 to 50.7)
D statistic	80+ years	1.96 (1.82 to 2.09)	1.95 (1.81 to 2.09)	1.91 (1.7 to 2.12)	1.84 (1.61 to 2.06)
R2	White	73.5 (72 to 74.9)	73.4 (72.1 to 74.6)	75.3 (73.3 to 77.2)	74.1 (72.1 to 76.2)
D statistic	White	3.4 (3.28 to 3.53)	3.4 (3.28 to 3.51)	3.57 (3.38 to 3.76)	3.46 (3.28 to 3.65)
R2	Indian	73.4 (65.1 to 81.7)	70.6 (61 to 80.2)	76.8 (51 to 103)	68.8 (47.9 to 89.6)
D statistic	Indian	3.4 (2.68 to 4.12)	3.17 (2.45 to 3.9)	3.75 (1.23 to 6.28)	3.05 (1.58 to 4.53)
R2	Pakistani	72.1 (56.2 to 88)	70.7 (60.8 to 80.6)	*	66.6 (41.3 to 92)
D statistic	Pakistani	3.3 (2 to 4.6)	3.18 (2.42 to 3.94)	*	2.91 (1.24 to 4.58)
R2	Bangladeshi	70.4 (49.6 to 91.3)	71.1 (61.3 to 80.8)	68.7 (36.1 to 101)	75.9 (43.4 to 108)
D statistic	Bangladeshi	3.16 (1.6 to 4.73)	3.21 (2.45 to 3.97)	3.03 (.735 to 5.32)	3.67 (.477 to 6.86)
R2	Other Asian	78.4 (68.4 to 88.5)	68.2 (55.8 to 80.6)	*	62 (4.65 to 119)

D statistic	Other Asian	3.9 (2.74 to 5.07)	3 (2.14 to 3.85)	*	2.64 (-.421 to 5.71)
R2	Caribbean	74.5 (68.2 to 80.8)	69.6 (62.5 to 76.7)	62 (21.1 to 103)	75.4 (57.2 to 93.5)
D statistic	Caribbean	3.5 (2.92 to 4.08)	3.1 (2.58 to 3.62)	2.66 (.389 to 4.94)	3.59 (1.82 to 5.36)
R2	Black african	77.4 (68.6 to 86.1)	69.4 (60.6 to 78.2)	*	70.7 (48.4 to 92.9)
D statistic	Black african	3.78 (2.84 to 4.73)	3.08 (2.44 to 3.72)	*	3.2 (1.53 to 4.88)
R2	Chinese	84.2 (71.3 to 97.2)	80.2 (69.1 to 91.4)	*	*
D statistic	Chinese	4.73 (2.42 to 7.04)	4.13 (2.68 to 5.58)	*	*
R2	Other ethnic group	78 (68.8 to 87.2)	71.5 (62.3 to 80.8)	74 (53.4 to 94.6)	66.3 (43.5 to 89)
D statistic	Other ethnic group	3.86 (2.83 to 4.89)	3.25 (2.51 to 3.98)	3.47 (1.64 to 5.29)	2.89 (1.45 to 4.33)
R2	East Midlands	75.4 (67.6 to 83.2)	74.9 (68 to 81.7)	72.3 (63.7 to 80.9)	71.2 (61.4 to 80.9)
D statistic	East Midlands	3.58 (2.83 to 4.34)	3.53 (2.89 to 4.18)	3.31 (2.6 to 4.01)	3.21 (2.45 to 3.98)
R2	East of England	73.4 (67.3 to 79.4)	70.2 (63.4 to 77)	71.5 (58.4 to 84.5)	71.5 (59.1 to 83.9)
D statistic	East of England	3.4 (2.87 to 3.92)	3.14 (2.63 to 3.65)	3.24 (2.21 to 4.27)	3.24 (2.26 to 4.22)
R2	London	75.8 (73.5 to 78.1)	72.5 (70.3 to 74.6)	76.7 (71.5 to 81.9)	72.7 (67.1 to 78.4)
D statistic	London	3.62 (3.39 to 3.85)	3.32 (3.14 to 3.5)	3.71 (3.18 to 4.25)	3.34 (2.87 to 3.82)
R2	North East	72.4 (59.3 to 85.6)	69.1 (58.2 to 80.1)	69.8 (25.8 to 114)	*
D statistic	North East	3.32 (2.22 to 4.41)	3.06 (2.28 to 3.85)	*	*
R2	North West	73.3 (70.5 to 76.2)	74.4 (71.8 to 76.9)	75.7 (72.2 to 79.1)	75.3 (71.8 to 78.9)
D statistic	North West	3.4 (3.15 to 3.64)	3.48 (3.26 to 3.71)	3.61 (3.27 to 3.95)	3.58 (3.23 to 3.92)
R2	South Central	75.7 (72.7 to 78.7)	73.5 (70.3 to 76.7)	70.8 (63 to 78.6)	69.5 (60 to 78.9)
D statistic	South Central	3.62 (3.32 to 3.91)	3.41 (3.13 to 3.69)	3.19 (2.58 to 3.79)	3.09 (2.4 to 3.78)
R2	South East	70.4 (65.1 to 75.8)	72 (67.5 to 76.6)	74.2 (67.1 to 81.3)	75.7 (71.2 to 80.3)
D statistic	South East	3.16 (2.75 to 3.57)	3.28 (2.91 to 3.66)	3.47 (2.83 to 4.11)	3.62 (3.17 to 4.07)
R2	South West	74 (68.9 to 79.1)	72.5 (67.7 to 77.4)	77.8 (73.4 to 82.2)	74.3 (68.6 to 80.1)
D statistic	South West	3.45 (3 to 3.91)	3.33 (2.92 to 3.73)	3.83 (3.34 to 4.32)	3.48 (2.96 to 4.01)
R2	West Midlands	71.5 (66.3 to 76.6)	72.2 (67.8 to 76.5)	74.7 (68.6 to 80.7)	72.2 (66 to 78.4)

D statistic	West Midlands	3.24 (2.83 to 3.65)	3.29 (2.94 to 3.65)	3.52 (2.95 to 4.08)	3.3 (2.79 to 3.81)
R2	Yorkshire & Humber	75.4 (67.6 to 83.1)	79.2 (74.9 to 83.6)	80.1 (71.4 to 88.9)	73.9 (63.8 to 84)
D statistic	Yorkshire & Humber	3.58 (2.83 to 4.33)	4 (3.47 to 4.53)	4.11 (2.98 to 5.24)	3.44 (2.54 to 4.34)
R2	Quintile 1	73.8 (70.6 to 76.9)	73.3 (70.5 to 76)	74.1 (70.2 to 78)	73.7 (69.8 to 77.6)
D statistic	Quintile1	3.43 (3.16 to 3.71)	3.39 (3.15 to 3.63)	3.46 (3.11 to 3.81)	3.43 (3.08 to 3.77)
R2	2	75.5 (72.7 to 78.2)	73.1 (70.3 to 75.9)	75.6 (70.9 to 80.3)	74.3 (69.9 to 78.7)
D statistic	2	3.59 (3.32 to 3.86)	3.37 (3.13 to 3.62)	3.6 (3.14 to 4.06)	3.48 (3.08 to 3.88)
R2	3	71.1 (67.9 to 74.3)	72.2 (69.5 to 74.9)	75.8 (72.1 to 79.4)	73.7 (69.3 to 78)
D statistic	3	3.21 (2.96 to 3.46)	3.3 (3.08 to 3.52)	3.62 (3.26 to 3.98)	3.43 (3.04 to 3.81)
R2	4	73.4 (70.1 to 76.6)	72.2 (69.4 to 75)	76.7 (72.3 to 81)	74.5 (70 to 79)
D statistic	4	3.4 (3.12 to 3.68)	3.3 (3.07 to 3.53)	3.71 (3.26 to 4.16)	3.5 (3.08 to 3.92)
R2	Quintile 5	76.1 (73.7 to 78.5)	74.7 (72.4 to 77)	76.2 (70.8 to 81.5)	72.4 (66.6 to 78.2)
D statistic	Quintile 5	3.65 (3.41 to 3.89)	3.52 (3.3 to 3.73)	3.66 (3.12 to 4.2)	3.32 (2.84 to 3.8)

Note pre-specified age-bands 19-39 years and 40-49 years were combined for these analyses due to small numbers of events

Supplementary Table F: Performance of the risk models to predict risk of COVID-19 hospital admission in the validation cohort by subgroup (D and R^2 explained variation) in study period 1 (24.01.2020 to 30.04.2020) and period 2 (01.05.2020 to 30.06.2020)

		period 1	period 1	period 2	period 2
		hospital	hospital	hospital	hospital
statistic	group	females	males	females	males
R2	overall	57.1 (55.5 to 58.8)	58.1 (56.7 to 59.5)	45.4 (41.7 to 49.1)	55.4 (52.2 to 58.5)
D statistic	overall	2.36 (2.28 to 2.44)	2.41 (2.34 to 2.48)	1.87 (1.73 to 2)	2.28 (2.14 to 2.42)
R2	<50 years	35.8 (29.7 to 42)	47.8 (42.8 to 52.9)	30.2 (13.1 to 47.3)	26.8 (8.1 to 45.5)
D statistic	<50 years	1.53 (1.32 to 1.73)	1.96 (1.76 to 2.16)	1.35 (.799 to 1.89)	1.24 (.647 to 1.83)
R2	50-59 years	42.1 (35.4 to 48.7)	33.6 (28 to 39.2)	22 (7.9 to 36.1)	29.5 (16.3 to 42.7)
D statistic	50-59 years	1.74 (1.51 to 1.98)	1.46 (1.27 to 1.64)	1.09 (.64 to 1.53)	1.32 (.903 to 1.74)
R2	60-69 years	41.3 (35.3 to 47.4)	40.2 (35.3 to 45)	27.5 (8.98 to 45.9)	36.4 (25.5 to 47.3)
D statistic	60-69 years	1.72 (1.5 to 1.93)	1.68 (1.51 to 1.85)	1.26 (.675 to 1.84)	1.55 (1.18 to 1.91)
R2	70-79 years	47.8 (43.1 to 52.5)	38.2 (33.8 to 42.5)	39.9 (28.7 to 51)	40.7 (31.5 to 49.9)
D statistic	70-79 years	1.96 (1.77 to 2.14)	1.61 (1.46 to 1.76)	1.67 (1.28 to 2.05)	1.69 (1.37 to 2.02)
R2	80+ years	26.2 (22.4 to 29.9)	26.6 (22.9 to 30.3)	26 (19.4 to 32.6)	26.8 (19.3 to 34.3)
D statistic	80+ years	1.22 (1.1 to 1.34)	1.23 (1.11 to 1.35)	1.21 (1.01 to 1.42)	1.24 (1 to 1.48)
R2	White	57.3 (55.5 to 59.2)	58.6 (57.1 to 60.2)	47.4 (43.6 to 51.2)	57.6 (54.2 to 61)
D statistic	White	2.37 (2.28 to 2.46)	2.44 (2.36 to 2.51)	1.94 (1.79 to 2.09)	2.39 (2.22 to 2.55)
R2	Indian	57.3 (47.2 to 67.3)	50.1 (40.8 to 59.4)	37.1 (.609 to 73.7)	52 (23.5 to 80.4)
D statistic	Indian	2.37 (1.88 to 2.86)	2.05 (1.67 to 2.43)	1.58 (.349 to 2.81)	2.14 (.919 to 3.37)
R2	Pakistani	39.1 (21.8 to 56.3)	47.5 (36.1 to 58.8)	57.8 (33.6 to 82)	36.7 (5.46 to 68)
D statistic	Pakistani	1.64 (1.05 to 2.23)	1.95 (1.5 to 2.39)	2.4 (1.22 to 3.58)	1.57 (.507 to 2.63)
R2	Bangladeshi	37.5 (17.8 to 57.2)	57.5 (45.5 to 69.5)	*	55.4 (21.6 to 89.1)
D statistic	Bangladeshi	1.59 (.918 to 2.25)	2.38 (1.8 to 2.97)	*	2.28 (.725 to 3.84)

R2	Other Asian	48.5 (34.4 to 62.7)	53.3 (41.6 to 64.9)	*	*
D statistic	Other Asian	1.99 (1.42 to 2.55)	2.19 (1.67 to 2.7)	*	*
R2	Caribbean	57.3 (49.4 to 65.2)	55 (46.6 to 63.4)	52 (21 to 83)	64.3 (39.4 to 89.3)
D statistic	Caribbean	2.37 (1.99 to 2.76)	2.26 (1.88 to 2.65)	2.13 (.817 to 3.45)	2.77 (1.31 to 4.23)
R2	Black african	59.7 (51.2 to 68.2)	55.1 (47.6 to 62.7)	3.76 (-14.4 to 21.9)	29.9 (-6.49 to 66.3)
D statistic	Black african	2.49 (2.05 to 2.93)	2.27 (1.92 to 2.61)	.37 (-.676 to 1.42)	1.34 (.169 to 2.51)
R2	Chinese	63 (40.1 to 85.8)	67.9 (54.2 to 81.7)	24.4 (-85.2 to 134)	67.3 (35.2 to 99.4)
D statistic	Chinese	2.68 (1.39 to 3.98)	2.98 (2.04 to 3.92)	1.15 (-4.58 to 6.87)	2.98 (.787 to 5.18)
R2	Other ethnic group	48.8 (37.2 to 60.4)	56.2 (48.4 to 63.9)	15.4 (-21 to 51.8)	39.5 (9.11 to 69.8)
D statistic	Other ethnic group	2 (1.54 to 2.47)	2.32 (1.95 to 2.68)	.849 (-.435 to 2.13)	1.66 (.605 to 2.71)
R2	East Midlands	59.2 (49.3 to 69)	64.9 (57.1 to 72.8)	50.8 (37.4 to 64.1)	55.6 (38.9 to 72.4)
D statistic	East Midlands	2.46 (1.96 to 2.97)	2.79 (2.31 to 3.27)	2.08 (1.52 to 2.63)	2.29 (1.52 to 3.07)
R2	East of England	54.7 (46.6 to 62.7)	52 (44.5 to 59.4)	47.9 (31.5 to 64.3)	62 (51.4 to 72.6)
D statistic	East of England	2.25 (1.88 to 2.61)	2.13 (1.81 to 2.45)	1.96 (1.32 to 2.61)	2.61 (2.03 to 3.2)
R2	London	59.8 (57 to 62.6)	59.3 (57 to 61.7)	28.8 (16.4 to 41.2)	62.9 (55.7 to 70.1)
D statistic	London	2.5 (2.35 to 2.64)	2.47 (2.35 to 2.59)	1.3 (.906 to 1.7)	2.66 (2.25 to 3.07)
R2	North East	48 (35 to 61.1)	54.5 (43.5 to 65.6)	54.2 (19 to 89.4)	62.9 (23.3 to 102)
D statistic	North East	1.97 (1.45 to 2.48)	2.24 (1.74 to 2.74)	2.23 (.647 to 3.81)	2.66 (.404 to 4.92)
R2	North West	58.7 (55.2 to 62.2)	59.5 (56.4 to 62.6)	53.5 (47.7 to 59.3)	53.8 (47.8 to 59.9)
D statistic	North West	2.44 (2.27 to 2.61)	2.48 (2.32 to 2.64)	2.2 (1.94 to 2.45)	2.21 (1.94 to 2.48)
R2	South Central	52.9 (47.7 to 58.1)	56.6 (52.3 to 60.9)	41.8 (29.2 to 54.4)	53.8 (43.3 to 64.3)
D statistic	South Central	2.17 (1.94 to 2.39)	2.34 (2.13 to 2.54)	1.73 (1.29 to 2.18)	2.21 (1.74 to 2.68)
R2	South East	57.2 (51.8 to 62.6)	54.4 (49.3 to 59.5)	44.8 (34.7 to 55)	60.1 (52.3 to 67.9)
D statistic	South East	2.37 (2.11 to 2.62)	2.24 (2.01 to 2.47)	1.84 (1.47 to 2.22)	2.51 (2.1 to 2.92)
R2	South West	48 (41.3 to 54.7)	52.5 (46.6 to 58.3)	37.2 (25 to 49.4)	51.9 (42.2 to 61.6)
D statistic	South West	1.96 (1.7 to 2.23)	2.15 (1.9 to 2.4)	1.58 (1.16 to 1.99)	2.13 (1.71 to 2.54)
R2	West Midlands	54.9 (49 to 60.8)	54.2 (48.9 to 59.5)	44.6 (31.8 to 57.5)	46.8 (34.8 to 58.8)
D statistic	West Midlands	2.26 (1.99 to 2.53)	2.23 (1.99 to 2.46)	1.84 (1.36 to 2.32)	1.92 (1.46 to 2.38)

R2	Yorkshire & Humber	62 (53.6 to 70.5)	68.9 (63.2 to 74.7)	47.2 (28.8 to 65.7)	54.4 (39 to 69.9)
D statistic	Yorkshire & Humber	2.62 (2.15 to 3.08)	3.05 (2.64 to 3.46)	1.94 (1.22 to 2.65)	2.24 (1.54 to 2.94)
R2	Quintile 1	53.7 (49.5 to 57.8)	53.3 (49.7 to 56.8)	54.4 (47.7 to 61.1)	60.7 (55.2 to 66.3)
D statistic	Quintile1	2.2 (2.02 to 2.39)	2.19 (2.03 to 2.34)	2.23 (1.93 to 2.54)	2.55 (2.25 to 2.84)
R2	2	58.8 (55.2 to 62.4)	57.5 (53.9 to 61.1)	41.7 (32.8 to 50.6)	58.5 (51.7 to 65.2)
D statistic	2	2.45 (2.26 to 2.63)	2.38 (2.21 to 2.55)	1.73 (1.41 to 2.05)	2.43 (2.09 to 2.77)
R2	3	56 (52.2 to 59.7)	56.8 (53.6 to 60)	46.2 (38.2 to 54.2)	51.9 (44.9 to 58.9)
D statistic	3	2.31 (2.13 to 2.48)	2.35 (2.19 to 2.5)	1.9 (1.59 to 2.2)	2.13 (1.83 to 2.43)
R2	4	53.8 (49.9 to 57.7)	58.6 (55.6 to 61.6)	45.2 (37.7 to 52.7)	54.1 (46.7 to 61.5)
D statistic	4	2.21 (2.03 to 2.38)	2.44 (2.29 to 2.59)	1.86 (1.58 to 2.14)	2.22 (1.89 to 2.56)
R2	Quintile 5	60.9 (57.9 to 63.9)	61.7 (59.1 to 64.4)	37.4 (26.8 to 47.9)	52.1 (43.5 to 60.7)
D statistic	Quintile 5	2.55 (2.39 to 2.72)	2.6 (2.45 to 2.74)	1.58 (1.23 to 1.94)	2.13 (1.77 to 2.5)

Supplementary Table G. Sensitivity for COVID-19 related death over 97 days in the validation cohort consisting 2,173,056 patients with 1,722 COVID-19 related deaths in the first time period at different risk thresholds of relative risk.

top centile	total patients in each centile	age-sex relative risk centile cut off	total deaths in each relative risk centile	cumulative % deaths based on relative risk
1	21730	15.7	390	22.65
2	21731	10.1	188	33.57
3	21730	7.6	125	40.82
4	21731	6.2	94	46.28
5	21730	5.3	80	50.93
6	21731	4.7	74	55.23
7	21730	4.3	41	57.61
8	21731	4.0	44	60.16
9	21731	3.7	41	62.54
10	21730	3.5	33	64.46
11	21731	3.3	31	66.26
12	21730	3.2	34	68.23
13	21731	3.0	27	69.80
14	21730	2.9	21	71.02
15	21731	2.8	22	72.30
16	21730	2.7	16	73.23
17	21731	2.6	22	74.51
18	21731	2.5	15	75.38
19	21730	2.4	22	76.66
20	21731	2.4	15	77.53
21	21730	2.3	9	78.05
22	21731	2.2	23	79.38
23	21730	2.2	13	80.14
24	21731	2.1	14	80.95
25	21731	2.0	11	81.59

Risk threshold is the centile value giving the cut-off of predicted risk over 97 days for defining each group of relative risk compared with someone of the same age/sex with no risk factors.

Sensitivity is percentage of total deaths over 97 days that occurred within the group of patients above the predicted risk threshold.

Supplementary Figure A: Graphs of the adjusted hazard ratios for BMI, age and the interaction between age and type 2 diabetes for COVID-19 deaths.

Hazard Ratios for age: COVID-19 death

hazard ratios compared to age=40

Hazard Ratios for BMI: COVID-19 death

hazard ratios compared to BMI=25
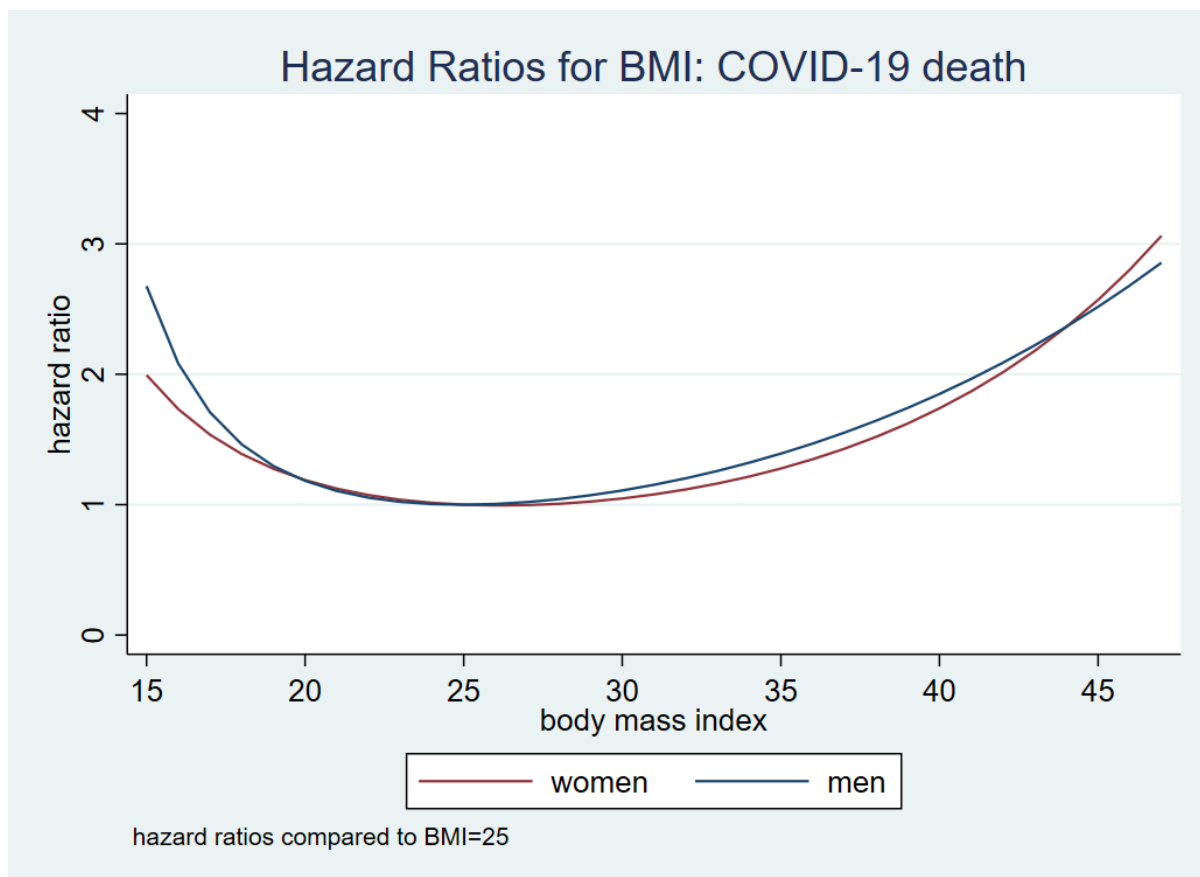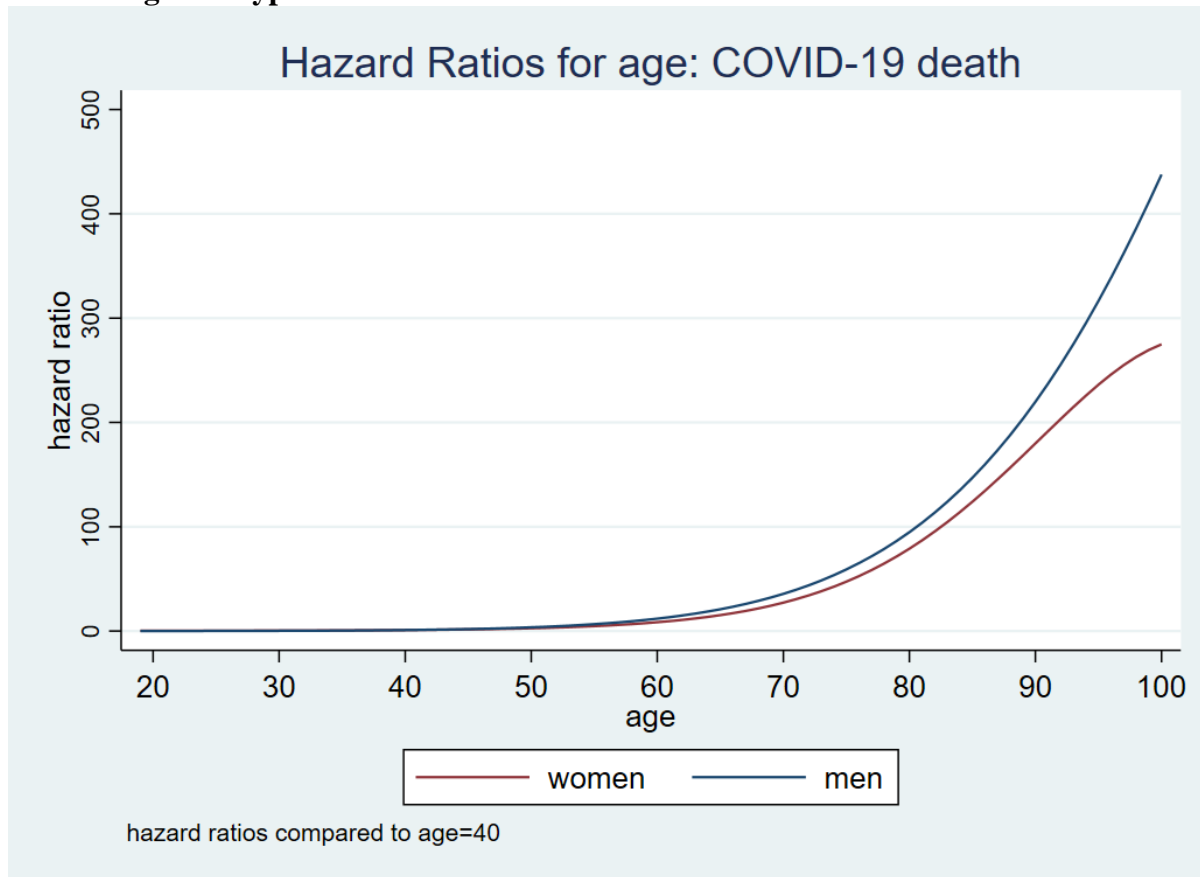
Hazard ratios by age for type 2 diabetes: COVID-19 death
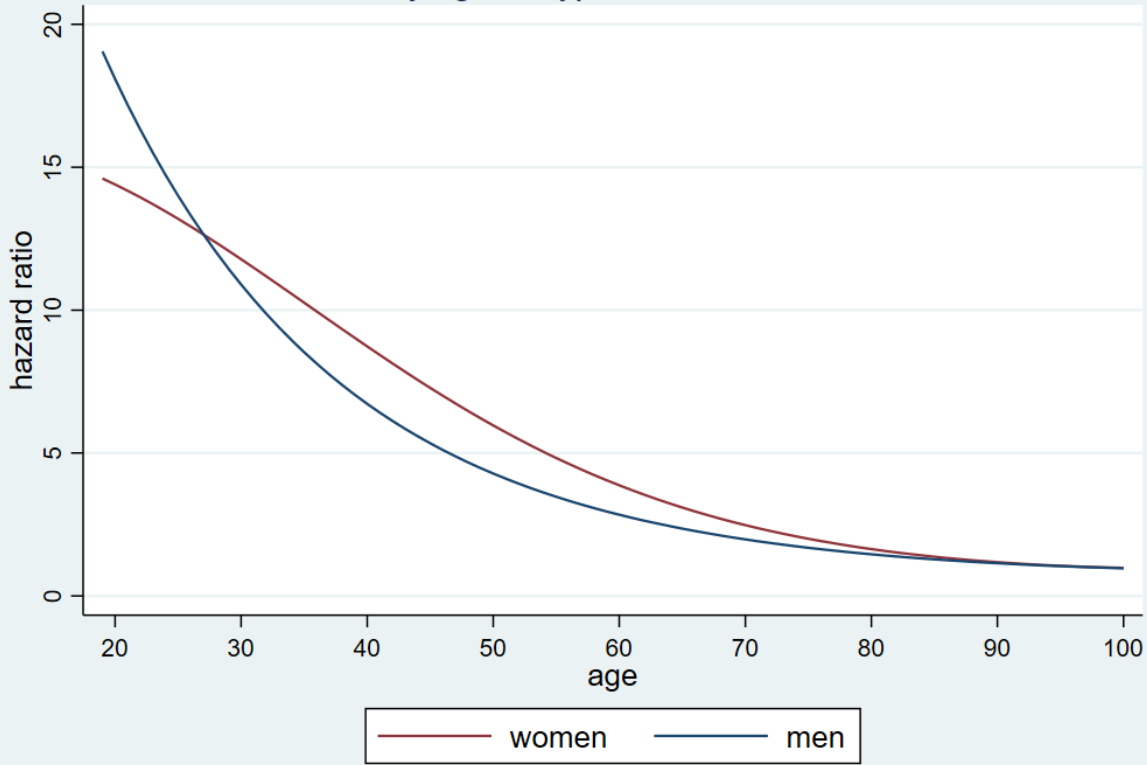
Supplementary Figure B: Graphs of the adjusted hazard ratios for BMI, age and the interaction between age and type 2 diabetes for COVID-19 hospital admissions

Hazard Ratios for age: COVID-19 hospital admission

hazard ratios compared to age=40

Hazard Ratios for BMI: COVID-19 hospital admission

hazard ratios compared to BMI=25
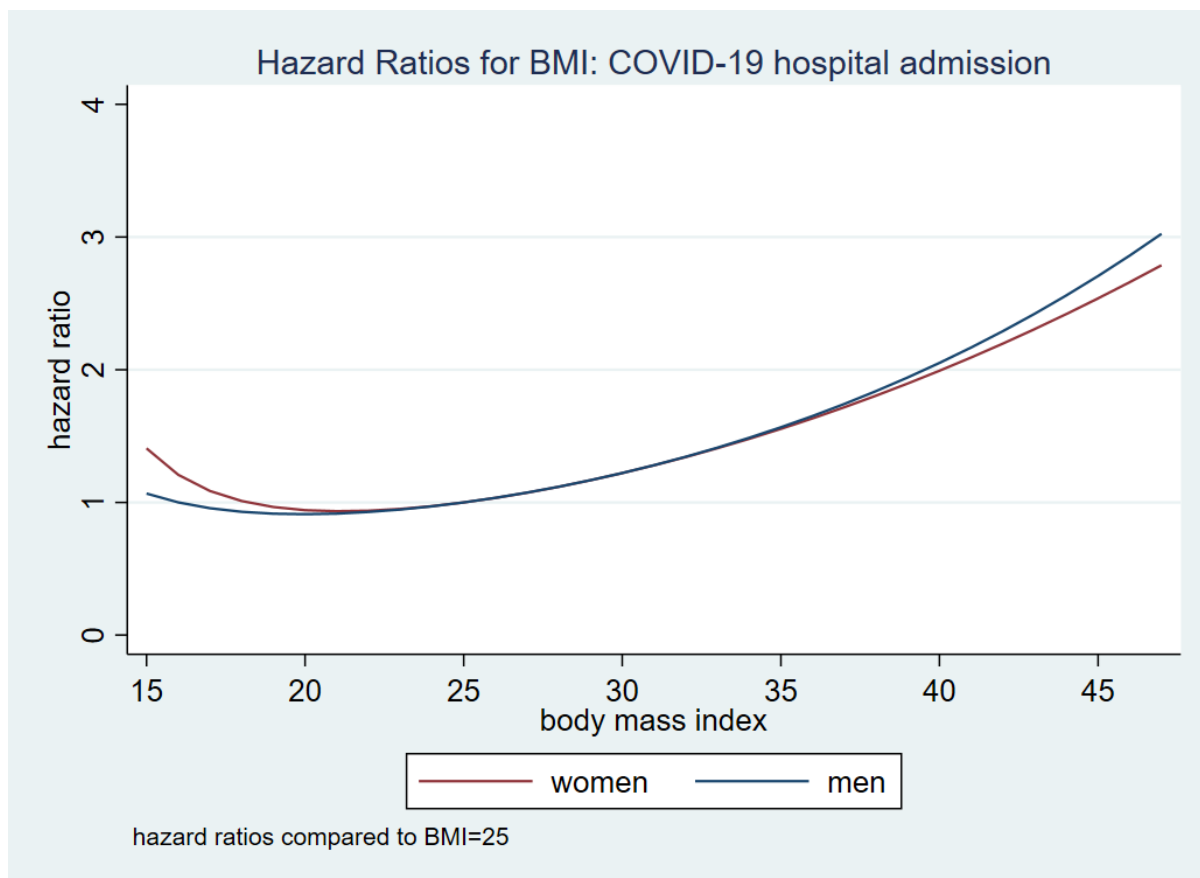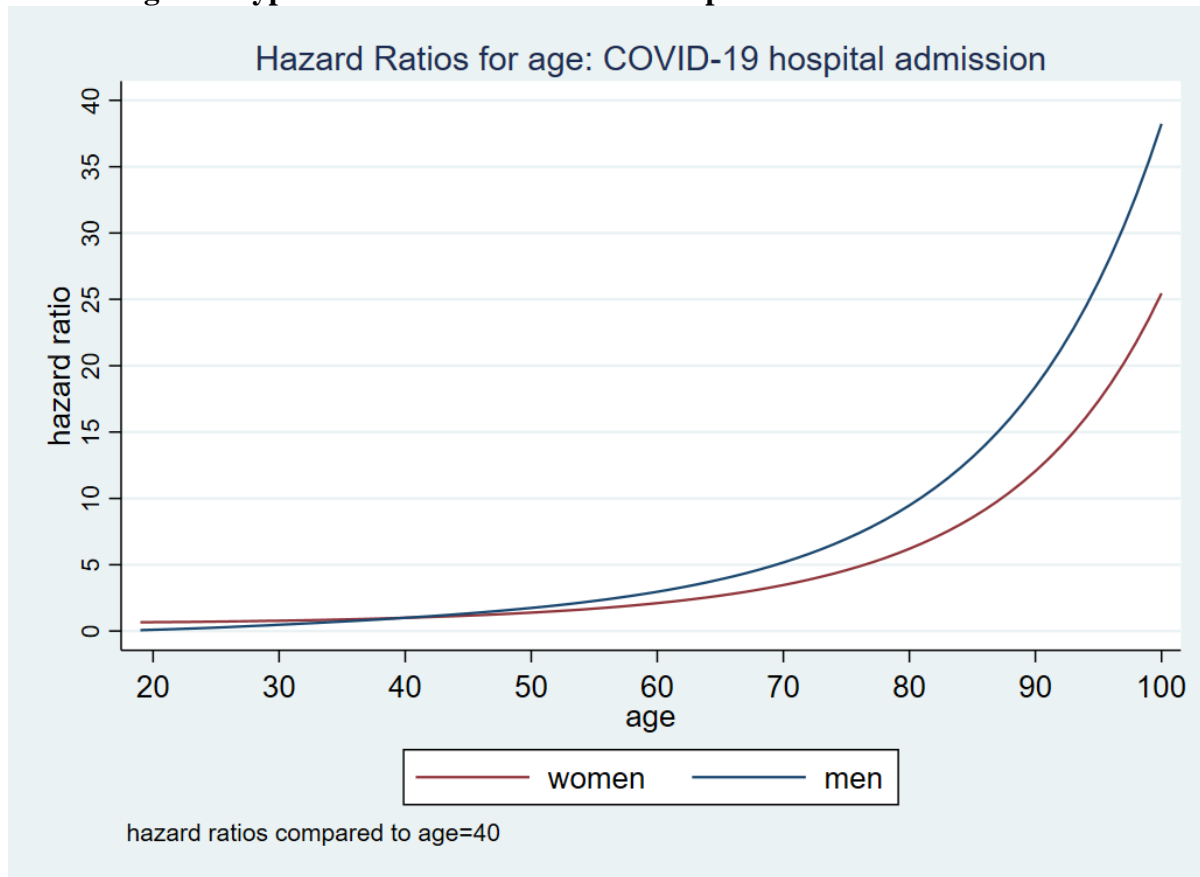
Hazard ratios by age for type 2 diabetes: COVID-19 hospital admission

Supplementary Figure C: Fully adjusted hazard ratios in women for variables for the full model including variables which were not retained in the final model

Adjusted hazard ratio (95% CI) of COVID-19 related death in women in the derivation cohort

Adjusted for variables shown, deprivation, fractional polynomial terms for BMI and age

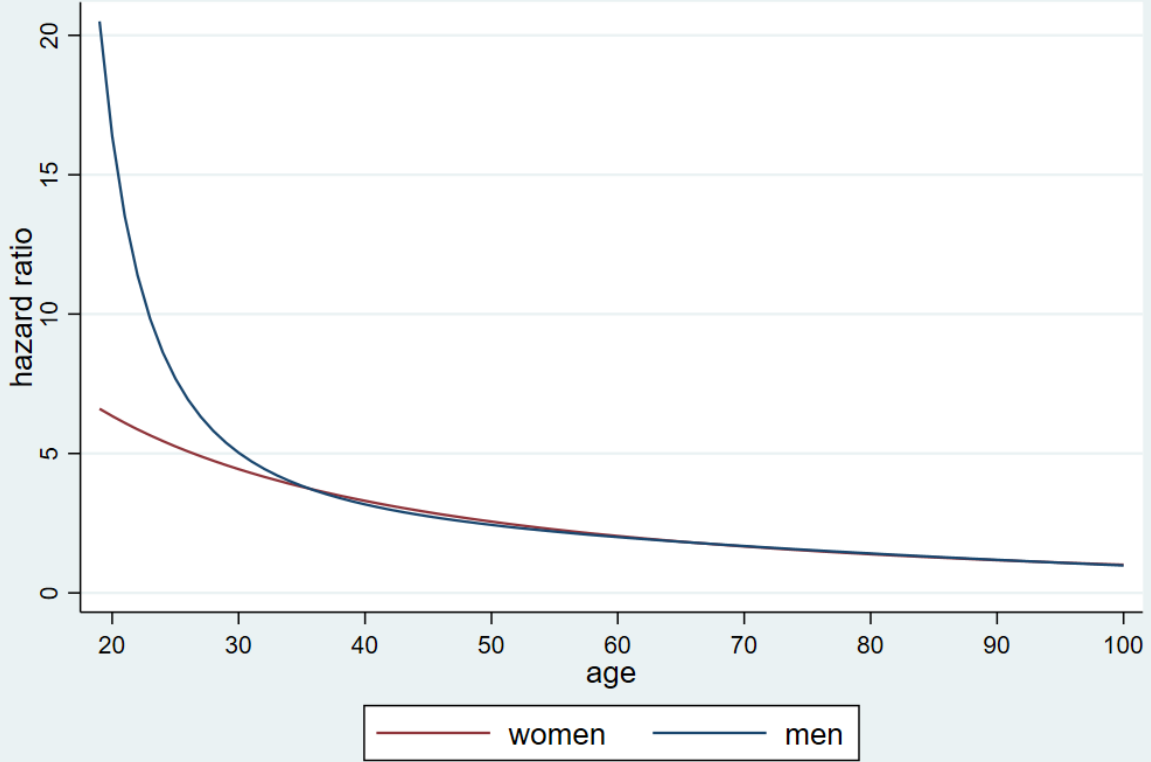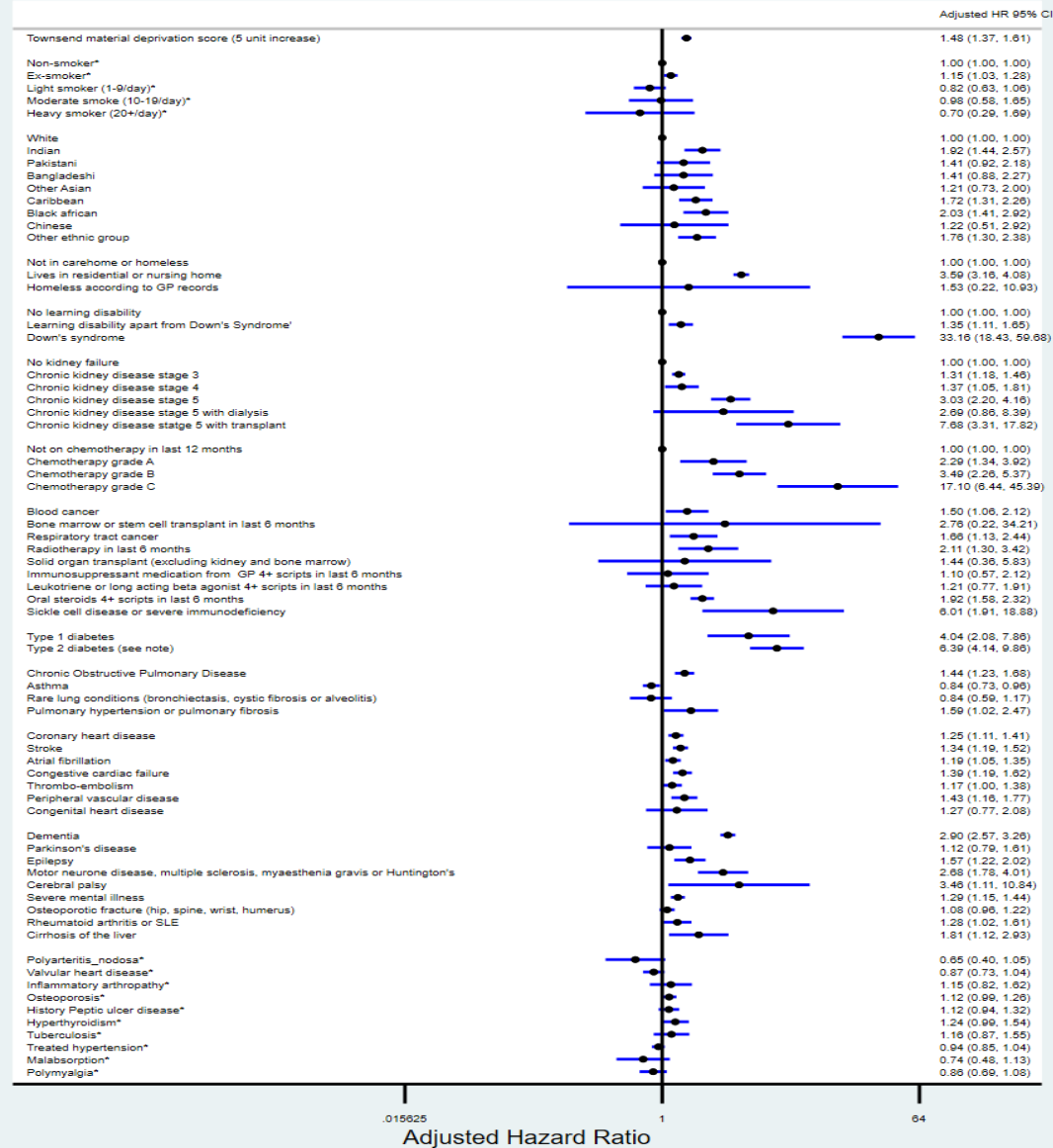|	Adjusted HR 95% CI
Townsend material deprivation score (5 unit increase)	1.48 (1.37, 1.61)
Non-smoker*	1.00 (1.00, 1.00)
Ex-smoker*	1.15 (1.03, 1.28)
Light smoker (1-9/day)*	0.82 (0.63, 1.06)
Moderate smoke (10-19/day)*	0.98 (0.58, 1.65)
Heavy smoker (20+/day)*	0.70 (0.29, 1.69)
White	1.00 (1.00, 1.00)
Indian	1.92 (1.44, 2.57)
Pakistani	1.41 (0.92, 2.18)
Bangladeshi	1.41 (0.88, 2.27)
Other Asian	1.21 (0.73, 2.00)
Caribbean	1.72 (1.31, 2.26)
Black african	2.03 (1.41, 2.92)
Chinese	1.22 (0.51, 2.92)
Other ethnic group	1.76 (1.30, 2.38)
Not in carehome or homeless	1.00 (1.00, 1.00)
Lives in residential or nursing home	3.59 (3.16, 4.08)
Homeless according to GP records	1.53 (0.22, 10.93)
No learning disability	1.00 (1.00, 1.00)
Learning disability apart from Down's Syndrome'	1.35 (1.11, 1.65)
Down's syndrome	33.16 (18.43, 59.68)
No kidney failure	1.00 (1.00, 1.00)
Chronic kidney disease stage 3	1.31 (1.18, 1.46)
Chronic kidney disease stage 4	1.37 (1.05, 1.81)
Chronic kidney disease stage 5	3.03 (2.20, 4.16)
Chronic kidney disease stage 5 with dialysis	2.69 (0.86, 8.39)
Chronic kidney disease statge 5 with transplant	7.68 (3.31, 17.82)
Not on chemotherapy in last 12 months	1.00 (1.00, 1.00)
Chemotherapy grade A	2.29 (1.34, 3.92)
Chemotherapy grade B	3.49 (2.26, 5.37)
Chemotherapy grade C	17.10 (6.44, 45.39)
Blood cancer	1.50 (1.06, 2.12)
Bone marrow or stem cell transplant in last 6 months	2.76 (0.22, 34.21)
Respiratory tract cancer	1.66 (1.13, 2.44)
Radiotherapy in last 6 months	2.11 (1.30, 3.42)
Solid organ transplant (excluding kidney and bone marrow)	1.44 (0.36, 5.83)
Immunosuppressant medication from GP 4+ scripts in last 6 months	1.10 (0.57, 2.12)
Leukotriene or long acting beta agonist 4+ scripts in last 6 months	1.21 (0.77, 1.91)
Oral steroids 4+ scripts in last 6 months	1.92 (1.58, 2.32)
Sickle cell disease or severe immunodeficiency	6.01 (1.91, 18.88)
Type 1 diabetes	4.04 (2.08, 7.86)
Type 2 diabetes (see note)	6.39 (4.14, 9.86)
Chronic Obstructive Pulmonary Disease	1.44 (1.23, 1.68)
Asthma	0.84 (0.73, 0.96)
Rare lung conditions (bronchiectasis, cystic fibrosis or alveolitis)	0.84 (0.59, 1.17)
Pulmonary hypertension or pulmonary fibrosis	1.59 (1.02, 2.47)
Coronary heart disease	1.25 (1.11, 1.41)
Stroke	1.34 (1.19, 1.52)
Atrial fibrillation	1.19 (1.05, 1.35)
Congestive cardiac failure	1.39 (1.19, 1.62)
Thrombo-embolism	1.17 (1.00, 1.38)
Peripheral vascular disease	1.43 (1.16, 1.77)
Congenital heart disease	1.27 (0.77, 2.08)
Dementia	2.90 (2.57, 3.26)
Parkinson's disease	1.12 (0.79, 1.61)
Epilepsy	1.57 (1.22, 2.02)
Motor neurone disease, multiple sclerosis, myaesthenia gravis or Huntington's	2.68 (1.78, 4.01)
Cerebral palsy	3.46 (1.11, 10.84)
Severe mental illness	1.29 (1.15, 1.44)
Osteoporotic fracture (hip, spine, wrist, humerus)	1.08 (0.96, 1.22)
Rheumatoid arthritis or SLE	1.28 (1.02, 1.61)
Cirrhosis of the liver	1.81 (1.12, 2.93)
Polyarteritis_nodosa*	0.65 (0.40, 1.05)
Valvular heart disease*	0.87 (0.73, 1.04)
Inflammatory arthropathy*	1.15 (0.82, 1.62)
Osteoporosis*	1.12 (0.99, 1.26)
History Peptic ulcer disease*	1.12 (0.94, 1.32)
Hyperthyroidism*	1.24 (0.99, 1.54)
Tuberculosis*	1.16 (0.87, 1.55)
Treated hypertension*	0.94 (0.85, 1.04)
Malabsorption*	0.74 (0.48, 1.13)
Polymyalgia*	0.86 (0.69, 1.08)

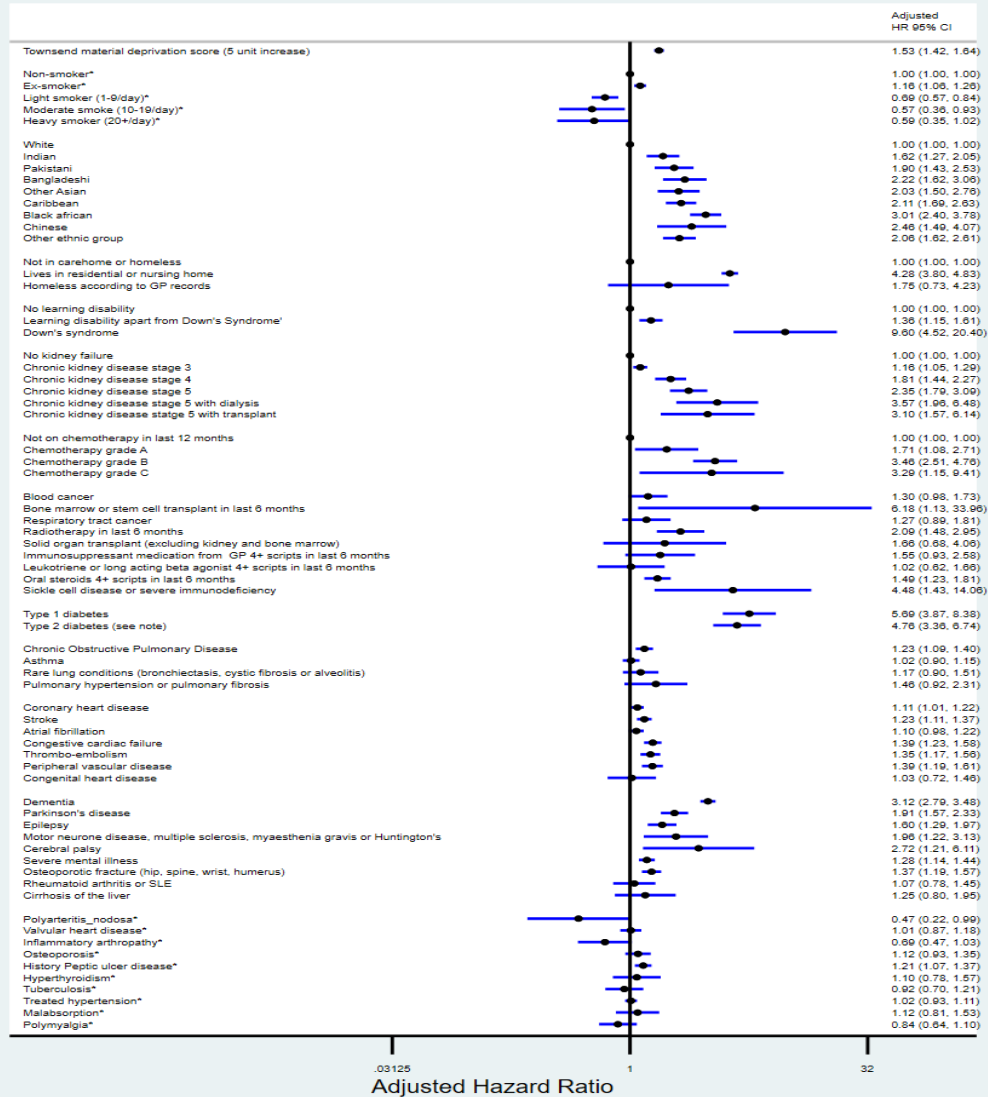Adjusted Hazard Ratio (.015625 — 1 — 64)

Model includes fractional polynomial terms for age (3 3) & bmi (.5 .5 ln(bmi)) and interaction terms between age terms and type 2 diabetes. HR for type 2 diabetes reported at mean age

*denotes variables not included in the final model

Supplementary Figure D: Fully adjusted hazard ratios in men for variables for the full model including variables which were not retained in the final model

Adjusted hazard ratio (95% CI) of COVID-19 related death in men in the derivation cohort

Adjusted for variables shown, deprivation, fractional polynomial terms for BMI and age
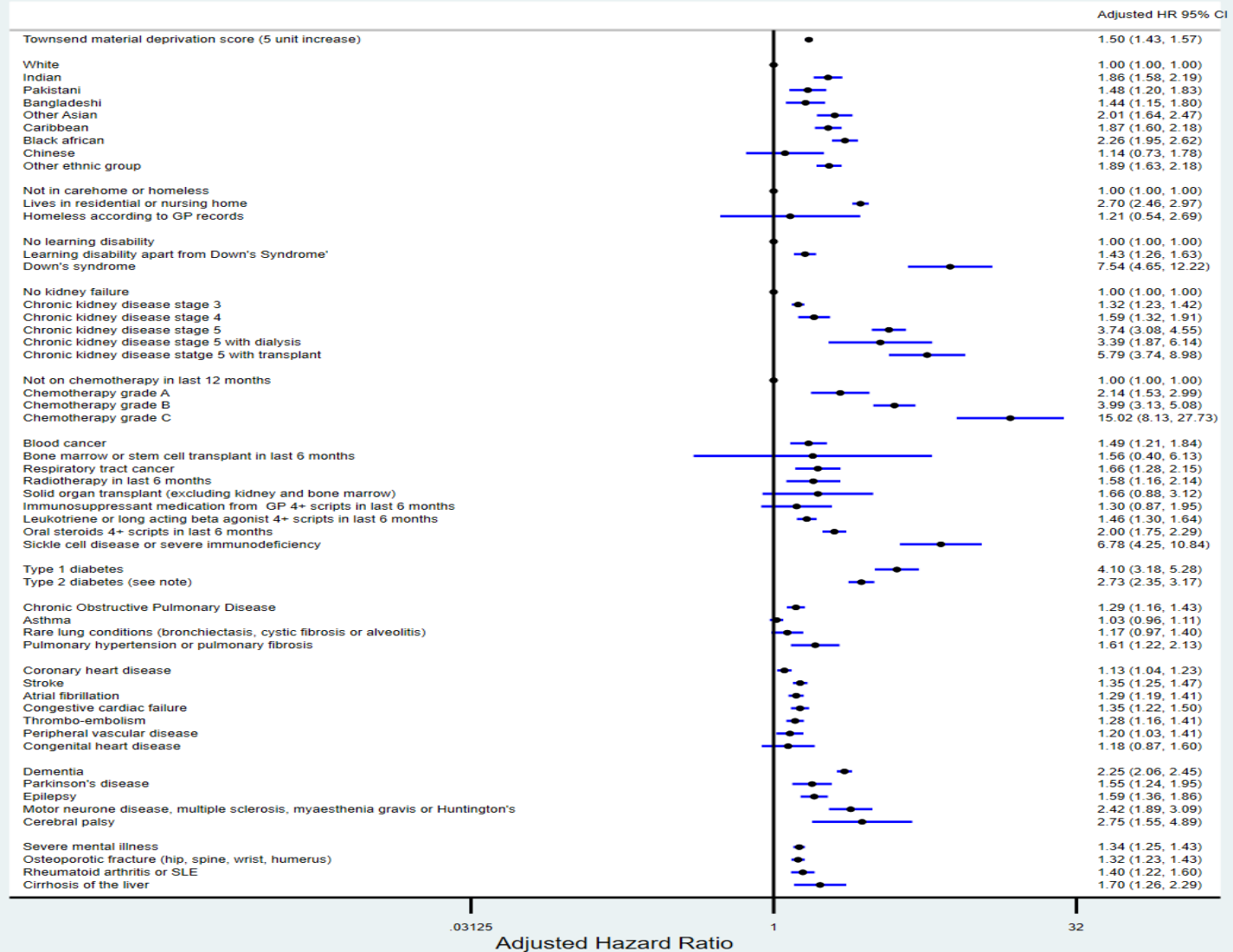
	Adjusted HR 95% CI
Townsend material deprivation score (5 unit increase)	1.53 (1.42, 1.64)
Non-smoker*	1.00 (1.00, 1.00)
Ex-smoker*	1.16 (1.06, 1.26)
Light smoker (1-9/day)*	0.69 (0.57, 0.84)
Moderate smoke (10-19/day)*	0.57 (0.36, 0.93)
Heavy smoker (20+/day)*	0.59 (0.35, 1.02)
White	1.00 (1.00, 1.00)
Indian	1.62 (1.27, 2.05)
Pakistani	1.90 (1.43, 2.53)
Bangladeshi	2.22 (1.62, 3.06)
Other Asian	2.03 (1.50, 2.76)
Caribbean	2.11 (1.69, 2.63)
Black african	3.01 (2.40, 3.78)
Chinese	2.46 (1.49, 4.07)
Other ethnic group	2.06 (1.62, 2.61)
Not in carehome or homeless	1.00 (1.00, 1.00)
Lives in residential or nursing home	4.28 (3.80, 4.83)
Homeless according to GP records	1.75 (0.73, 4.23)
No learning disability	1.00 (1.00, 1.00)
Learning disability apart from Down's Syndrome'	1.36 (1.15, 1.61)
Down's syndrome	9.60 (4.52, 20.40)
No kidney failure	1.00 (1.00, 1.00)
Chronic kidney disease stage 3	1.16 (1.05, 1.29)
Chronic kidney disease stage 4	1.81 (1.44, 2.27)
Chronic kidney disease stage 5	2.35 (1.79, 3.09)
Chronic kidney disease stage 5 with dialysis	3.57 (1.96, 6.48)
Chronic kidney disease statge 5 with transplant	3.10 (1.57, 6.14)
Not on chemotherapy in last 12 months	1.00 (1.00, 1.00)
Chemotherapy grade A	1.71 (1.08, 2.71)
Chemotherapy grade B	3.46 (2.51, 4.76)
Chemotherapy grade C	3.29 (1.15, 9.41)
Blood cancer	1.30 (0.98, 1.73)
Bone marrow or stem cell transplant in last 6 months	6.18 (1.13, 33.96)
Respiratory tract cancer	1.27 (0.89, 1.81)
Radiotherapy in last 6 months	2.09 (1.48, 2.95)
Solid organ transplant (excluding kidney and bone marrow)	1.66 (0.68, 4.06)
Immunosuppressant medication from GP 4+ scripts in last 6 months	1.55 (0.93, 2.58)
Leukotriene or long acting beta agonist 4+ scripts in last 6 months	1.02 (0.62, 1.66)
Oral steroids 4+ scripts in last 6 months	1.49 (1.23, 1.81)
Sickle cell disease or severe immunodeficiency	4.48 (1.43, 14.06)
Type 1 diabetes	5.69 (3.87, 8.38)
Type 2 diabetes (see note)	4.76 (3.36, 6.74)
Chronic Obstructive Pulmonary Disease	1.23 (1.09, 1.40)
Asthma	1.02 (0.90, 1.15)
Rare lung conditions (bronchiectasis, cystic fibrosis or alveolitis)	1.17 (0.90, 1.51)
Pulmonary hypertension or pulmonary fibrosis	1.46 (0.92, 2.31)
Coronary heart disease	1.11 (1.01, 1.22)
Stroke	1.23 (1.11, 1.37)
Atrial fibrillation	1.10 (0.98, 1.22)
Congestive cardiac failure	1.39 (1.23, 1.58)
Thrombo-embolism	1.35 (1.17, 1.56)
Peripheral vascular disease	1.39 (1.19, 1.61)
Congenital heart disease	1.03 (0.72, 1.46)
Dementia	3.12 (2.79, 3.48)
Parkinson's disease	1.91 (1.57, 2.33)
Epilepsy	1.60 (1.29, 1.97)
Motor neurone disease, multiple sclerosis, myaesthenia gravis or Huntington's	1.96 (1.22, 3.13)
Cerebral palsy	2.72 (1.21, 6.11)
Severe mental illness	1.28 (1.14, 1.44)
Osteoporotic fracture (hip, spine, wrist, humerus)	1.37 (1.19, 1.57)
Rheumatoid arthritis or SLE	1.07 (0.78, 1.45)
Cirrhosis of the liver	1.25 (0.80, 1.95)
Polyarteritis_nodosa*	0.47 (0.22, 0.99)
Valvular heart disease*	1.01 (0.87, 1.18)
Inflammatory arthropathy*	0.69 (0.47, 1.03)
Osteoporosis*	1.12 (0.93, 1.35)
History Peptic ulcer disease*	1.21 (1.07, 1.37)
Hyperthyroidism*	1.10 (0.78, 1.57)
Tuberculosis*	0.92 (0.70, 1.21)
Treated hypertension*	1.02 (0.93, 1.11)
Malabsorption*	1.12 (0.81, 1.53)
Polymyalgia*	0.84 (0.64, 1.10)

Adjusted Hazard Ratio (.03125 — 1 — 32)

Model includes fractional polynomial terms for age (1 3) & bmi (-.5 -.5 ln(age)) and interaction terms between age terms and type 2 diabetes. HR for type 2 diabetes reported at mean age

*denotes variables not included in the final model

Supplementary Figure E: Fully adjusted hazard ratios for a combined outcome of either COVID-19 related death or hospital admission in women.

Adjusted hazard ratio (95% CI) of COVID-19 death or hospital admission in women in the derivation cohort

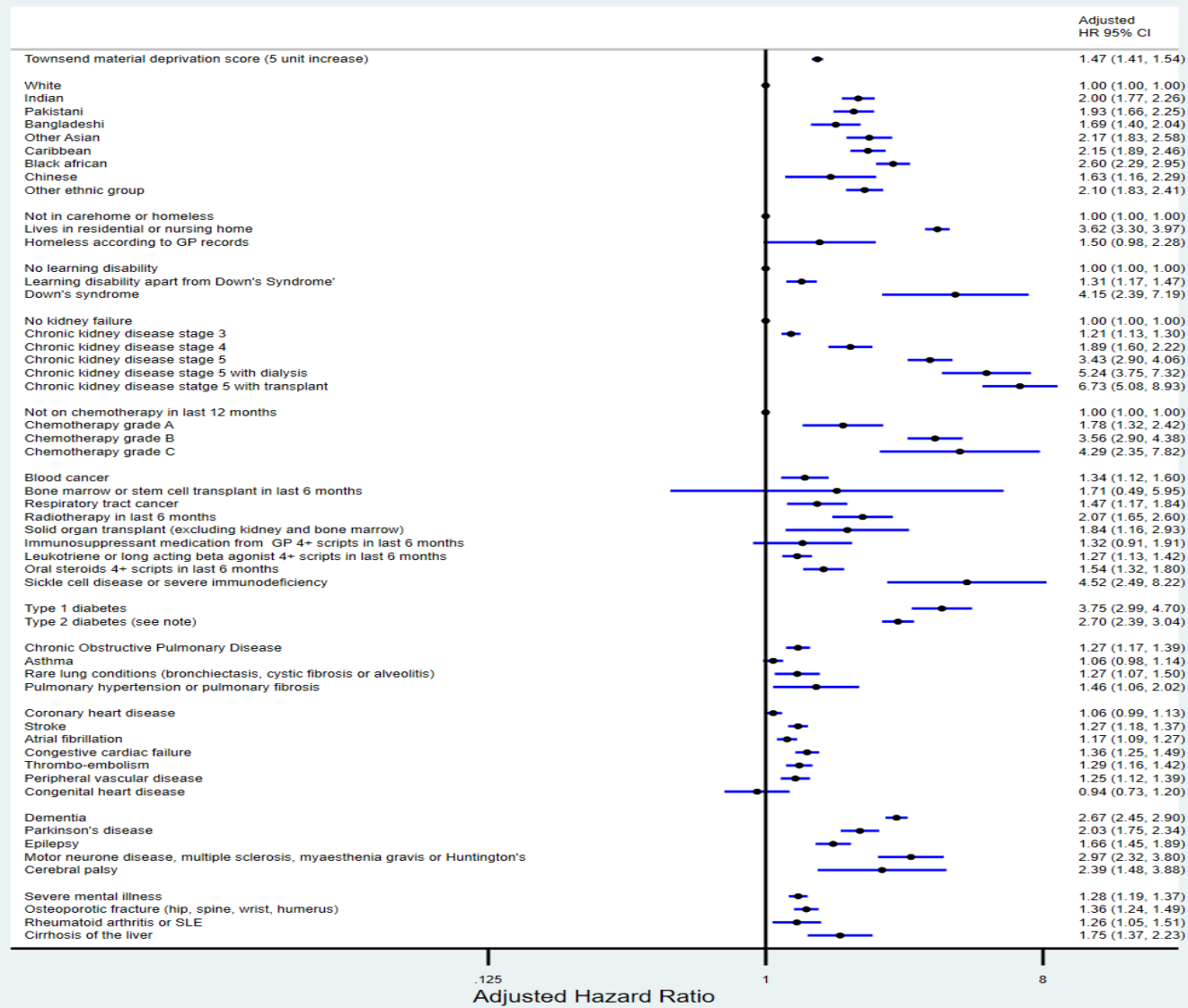Adjusted for variables shown, deprivation, fractional polynomial terms for BMI and age

	Adjusted HR 95% CI
Townsend material deprivation score (5 unit increase)	1.50 (1.43, 1.57)
White	1.00 (1.00, 1.00)
Indian	1.86 (1.58, 2.19)
Pakistani	1.48 (1.20, 1.83)
Bangladeshi	1.44 (1.15, 1.80)
Other Asian	2.01 (1.64, 2.47)
Caribbean	1.87 (1.60, 2.18)
Black african	2.26 (1.95, 2.62)
Chinese	1.14 (0.73, 1.78)
Other ethnic group	1.89 (1.63, 2.18)
Not in carehome or homeless	1.00 (1.00, 1.00)
Lives in residential or nursing home	2.70 (2.46, 2.97)
Homeless according to GP records	1.21 (0.54, 2.69)
No learning disability	1.00 (1.00, 1.00)
Learning disability apart from Down's Syndrome'	1.43 (1.26, 1.63)
Down's syndrome	7.54 (4.65, 12.22)
No kidney failure	1.00 (1.00, 1.00)
Chronic kidney disease stage 3	1.32 (1.23, 1.42)
Chronic kidney disease stage 4	1.59 (1.32, 1.91)
Chronic kidney disease stage 5	3.74 (3.08, 4.55)
Chronic kidney disease stage 5 with dialysis	3.39 (1.87, 6.14)
Chronic kidney disease statge 5 with transplant	5.79 (3.74, 8.98)
Not on chemotherapy in last 12 months	1.00 (1.00, 1.00)
Chemotherapy grade A	2.14 (1.53, 2.99)
Chemotherapy grade B	3.99 (3.13, 5.08)
Chemotherapy grade C	15.02 (8.13, 27.73)
Blood cancer	1.49 (1.21, 1.84)
Bone marrow or stem cell transplant in last 6 months	1.56 (0.40, 6.13)
Respiratory tract cancer	1.66 (1.28, 2.15)
Radiotherapy in last 6 months	1.58 (1.16, 2.14)
Solid organ transplant (excluding kidney and bone marrow)	1.66 (0.88, 3.12)
Immunosuppressant medication from GP 4+ scripts in last 6 months	1.30 (0.87, 1.95)
Leukotriene or long acting beta agonist 4+ scripts in last 6 months	1.46 (1.30, 1.64)
Oral steroids 4+ scripts in last 6 months	2.00 (1.75, 2.29)
Sickle cell disease or severe immunodeficiency	6.78 (4.25, 10.84)
Type 1 diabetes	4.10 (3.18, 5.28)
Type 2 diabetes (see note)	2.73 (2.35, 3.17)
Chronic Obstructive Pulmonary Disease	1.29 (1.16, 1.43)
Asthma	1.03 (0.96, 1.11)
Rare lung conditions (bronchiectasis, cystic fibrosis or alveolitis)	1.17 (0.97, 1.40)
Pulmonary hypertension or pulmonary fibrosis	1.61 (1.22, 2.13)
Coronary heart disease	1.13 (1.04, 1.23)
Stroke	1.35 (1.25, 1.47)
Atrial fibrillation	1.29 (1.19, 1.41)
Congestive cardiac failure	1.35 (1.22, 1.50)
Thrombo-embolism	1.28 (1.16, 1.41)
Peripheral vascular disease	1.20 (1.03, 1.41)
Congenital heart disease	1.18 (0.87, 1.60)
Dementia	2.25 (2.06, 2.45)
Parkinson's disease	1.55 (1.24, 1.95)
Epilepsy	1.59 (1.36, 1.86)
Motor neurone disease, multiple sclerosis, myaesthenia gravis or Huntington's	2.42 (1.89, 3.09)
Cerebral palsy	2.75 (1.55, 4.89)
Severe mental illness	1.34 (1.25, 1.43)
Osteoporotic fracture (hip, spine, wrist, humerus)	1.32 (1.23, 1.43)
Rheumatoid arthritis or SLE	1.40 (1.22, 1.60)
Cirrhosis of the liver	1.70 (1.26, 2.29)

.03125   1   32

Adjusted Hazard Ratio

Standard Cox model with fpterms for age (1 1) and bmi (-1 0) and interaction terms between age terms & type 2 diabetes. HR for type 2 diabetes reported at mean age

QResearch database version 44; study period 24.01.2020 to 30.04.2020

Supplementary Figure F: Fully adjusted hazard ratios for a combined outcome of COVID-19 related death or hospital admission in men

Adjusted hazard ratio (95% CI) of COVID-19 death or hospital admission in men in the derivation cohort

Adjusted for variables shown, deprivation, fractional polynomial terms for BMI and age

	Adjusted HR 95% CI
Townsend material deprivation score (5 unit increase)	1.47 (1.41, 1.54)
White	1.00 (1.00, 1.00)
Indian	2.00 (1.77, 2.26)
Pakistani	1.93 (1.66, 2.25)
Bangladeshi	1.69 (1.40, 2.04)
Other Asian	2.17 (1.83, 2.58)
Caribbean	2.15 (1.89, 2.46)
Black african	2.60 (2.29, 2.95)
Chinese	1.63 (1.16, 2.29)
Other ethnic group	2.10 (1.83, 2.41)
Not in carehome or homeless	1.00 (1.00, 1.00)
Lives in residential or nursing home	3.62 (3.30, 3.97)
Homeless according to GP records	1.50 (0.98, 2.28)
No learning disability	1.00 (1.00, 1.00)
Learning disability apart from Down's Syndrome'	1.31 (1.17, 1.47)
Down's syndrome	4.15 (2.39, 7.19)
No kidney failure	1.00 (1.00, 1.00)
Chronic kidney disease stage 3	1.21 (1.13, 1.30)
Chronic kidney disease stage 4	1.89 (1.60, 2.22)
Chronic kidney disease stage 5	3.43 (2.90, 4.06)
Chronic kidney disease stage 5 with dialysis	5.24 (3.75, 7.32)
Chronic kidney disease statge 5 with transplant	6.73 (5.08, 8.93)
Not on chemotherapy in last 12 months	1.00 (1.00, 1.00)
Chemotherapy grade A	1.78 (1.32, 2.42)
Chemotherapy grade B	3.56 (2.90, 4.38)
Chemotherapy grade C	4.29 (2.35, 7.82)
Blood cancer	1.34 (1.12, 1.60)
Bone marrow or stem cell transplant in last 6 months	1.71 (0.49, 5.95)
Respiratory tract cancer	1.47 (1.17, 1.84)
Radiotherapy in last 6 months	2.07 (1.65, 2.60)
Solid organ transplant (excluding kidney and bone marrow)	1.84 (1.16, 2.93)
Immunosuppressant medication from GP 4+ scripts in last 6 months	1.32 (0.91, 1.91)
Leukotriene or long acting beta agonist 4+ scripts in last 6 months	1.27 (1.13, 1.42)
Oral steroids 4+ scripts in last 6 months	1.54 (1.32, 1.80)
Sickle cell disease or severe immunodeficiency	4.52 (2.49, 8.22)
Type 1 diabetes	3.75 (2.99, 4.70)
Type 2 diabetes (see note)	2.70 (2.39, 3.04)
Chronic Obstructive Pulmonary Disease	1.27 (1.17, 1.39)
Asthma	1.06 (0.98, 1.14)
Rare lung conditions (bronchiectasis, cystic fibrosis or alveolitis)	1.27 (1.07, 1.50)
Pulmonary hypertension or pulmonary fibrosis	1.46 (1.06, 2.02)
Coronary heart disease	1.06 (0.99, 1.13)
Stroke	1.27 (1.18, 1.37)
Atrial fibrillation	1.17 (1.09, 1.27)
Congestive cardiac failure	1.36 (1.25, 1.49)
Thrombo-embolism	1.29 (1.16, 1.42)
Peripheral vascular disease	1.25 (1.12, 1.39)
Congenital heart disease	0.94 (0.73, 1.20)
Dementia	2.67 (2.45, 2.90)
Parkinson's disease	2.03 (1.75, 2.34)
Epilepsy	1.66 (1.45, 1.89)
Motor neurone disease, multiple sclerosis, myaesthenia gravis or Huntington's	2.97 (2.32, 3.80)
Cerebral palsy	2.39 (1.48, 3.88)
Severe mental illness	1.28 (1.19, 1.37)
Osteoporotic fracture (hip, spine, wrist, humerus)	1.36 (1.24, 1.49)
Rheumatoid arthritis or SLE	1.26 (1.05, 1.51)
Cirrhosis of the liver	1.75 (1.37, 2.23)

.125   1   8

Adjusted Hazard Ratio

Standard Cox model withfpterms for age (-2 2) and bmi (-.5 -.5) and interaction terms between age terms & type 2 diabetes. HR for type 2 diabetes reported at mean age

QResearch database version 44 study period 24.01.2020 to 30.04.2020

Supplementary Figure G: Example risk calculation in 55 year old black African man with type 2 diabetes, body mass index of 27.7, and no other risk factors

Supplementary Figure H: Example risk calculation in 30 year old white woman with Down's syndrome and body mass index of 40