

Cancer and the risk of COVID-19 diagnosis, hospitalisation, and death: a population-based multi-state cohort study including 4,618,377 adults in Catalonia, Spain

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Supplementary tables

Table S1. Descriptive characteristics of the population included, by state and transition

	Among general population				Among diagnosed with COVID-19		Among hospitalised with COVID-19
	General population	Diagnosed with COVID-19	Hospitalised with COVID-19	Death	Hospitalised with COVID-19	Death	Death
n	4,618,377	98,951	6,355	11,326	6,851	3,227	1,963
Age, in years [IQR]	48 [36.0, 63.0]	47 [37.0, 59.0]	71 [59.0, 80.0]	85 [76.0, 90.0]	60 [50.0, 73.0]	86 [79.0, 91.0]	80 [73.0, 86.0]
Age, categories (%)							
18 to 39 years	1,437,236 (31.1)	30,648 (31.0)	307 (4.8)	79 (0.7)	665 (9.7)	10 (0.3)	7 (0.4)
40 to 59 years	1,785,495 (38.7)	44,909 (45.4)	1,355 (21.3)	650 (5.7)	2,665 (38.9)	112 (3.5)	91 (4.6)
60 to 69 years	615,198 (13.3)	10,602 (10.7)	1,223 (19.2)	1,022 (9.0)	1,304 (19.0)	203 (6.3)	210 (10.7)
70 to 79 years	468,286 (10.1)	6,419 (6.5)	1,825 (28.7)	1,969 (17.4)	1,316 (19.2)	571 (17.7)	636 (32.4)
80 or older years	312,162 (6.8)	6,373 (6.4)	1,645 (25.9)	7,606 (67.2)	901 (13.2)	2,331 (72.2)	1,019 (51.9)
Sex, female (%)	2,361,230 (51.1)	57,507 (58.1)	2,705 (42.6)	5,679 (50.1)	3,067 (44.8)	1,734 (53.7)	769 (39.2)
MEDEA Deprivation Index (%)							
Quintile 1 (least deprived)	714,183 (15.5)	14,873 (15.0)	815 (12.8)	1,272 (11.2)	876 (12.8)	436 (13.5)	206 (10.5)
Quintile 2	703,921 (15.2)	15,349 (15.5)	936 (14.7)	1,112 (9.8)	1,043 (15.2)	281 (8.7)	192 (9.8)
Quintile 3	697,074 (15.1)	15,564 (15.7)	1,026 (16.1)	1,106 (9.8)	1,215 (17.7)	344 (10.7)	253 (12.9)

Quintile 4	692,844 (15.0)	15,774 (15.9)	1,107 (17.4)	1,014 (9.0)	1,205 (17.6)	222 (6.9)	228 (11.6)
Quintile 5 (most deprived)	687,062 (14.9)	15,134 (15.3)	1,097 (17.3)	896 (7.9)	1,184 (17.3)	204 (6.3)	195 (9.9)
Rural	832,256 (18.0)	14,670 (14.8)	650 (10.2)	2,271 (20.1)	753 (11.0)	658 (20.4)	206 (10.5)
Missing	291,037 (6.3)	7,587 (7.7)	724 (11.4)	3,655 (32.3)	575 (8.4)	1,082 (33.5)	683 (34.8)
Smoking status (%)							
Never smoker	1,834,657 (39.7)	42,353 (42.8)	2,548 (40.1)	3,967 (35.0)	3,026 (44.2)	1,220 (37.8)	669 (34.1)
Former smoker	772,875 (16.7)	19,340 (19.5)	2,089 (32.9)	3,436 (30.3)	1,901 (27.7)	1,020 (31.6)	730 (37.2)
Current smoker	712,739 (15.4)	13,820 (14.0)	302 (4.8)	839 (7.4)	334 (4.9)	132 (4.1)	68 (3.5)
Missing	1,298,106 (28.1)	23,438 (23.7)	1,416 (22.3)	3,084 (27.2)	1,590 (23.2)	855 (26.5)	496 (25.3)
Comorbidities (%)							
Autoimmune condition	259,234 (5.6)	6,322 (6.4)	632 (9.9)	1,292 (11.4)	586 (8.6)	346 (10.7)	244 (12.4)
Chronic kidney disease	201,258 (4.4)	4,167 (4.2)	1,137 (17.9)	3,708 (32.7)	675 (9.9)	1,076 (33.3)	616 (31.4)
Chronic obstructive pulmonary disease	119,532 (2.6)	2,476 (2.5)	596 (9.4)	1,457 (12.9)	344 (5.0)	342 (10.6)	271 (13.8)
Dementia	42,504 (0.9)	2,011 (2.0)	334 (5.3)	2,707 (23.9)	200 (2.9)	1,094 (33.9)	261 (13.3)
Heart disease	516,140 (11.2)	11,076 (11.2)	2,091 (32.9)	5,700 (50.3)	1,456 (21.3)	1,470 (45.6)	982 (50.0)
Hyperlipidaemia	505,102 (10.9)	11,015 (11.1)	1,215 (19.1)	1,581 (14.0)	1,189 (17.4)	480 (14.9)	389 (19.8)
Hypertension	687,358 (14.9)	14,149 (14.3)	1,947 (30.6)	3,831 (33.8)	1,725 (25.2)	1,115 (34.6)	694 (35.4)
Obesity	1,144,442 (24.8)	27,840 (28.1)	3,197 (50.3)	4,863 (42.9)	3,014 (44.0)	1,467 (45.5)	1,031 (52.5)
Type 2 diabetes	317,005 (6.9)	6,239 (6.3)	1,354 (21.3)	2,608 (23.0)	1,004 (14.7)	741 (23.0)	541 (27.6)
Without a prior diagnosis of cancer (%)	4,357,710 (94.4)	93,558 (94.5)	5,312 (83.6)	7,970 (70.4)	6,116 (89.3)	2,631 (81.5)	1,522 (77.5)
With a prior diagnosis of cancer, by years since cancer diagnosis (%)							

≥5 years*	167,053 (3.6)	3,464 (3.5)	670 (10.5)	1,714 (15.1)	464 (6.8)	379 (11.7)	293 (14.9)
1-5 years*	72,033 (1.6)	1,466 (1.5)	268 (4.2)	911 (8.0)	211 (3.1)	149 (4.6)	110 (5.6)
<1 year*	21,581 (0.5)	463 (0.5)	105 (1.7)	731 (6.5)	60 (0.9)	68 (2.1)	38 (1.9)
Cancer type [ICD-10-CM code] (%)							
Haematological	21,637 (0.5)	513 (0.5)	135 (2.1)	268 (2.4)	80 (1.2)	64 (2.0)	53 (2.7)
Leukaemia [C91-C95]	5,111 (0.1)	127 (0.1)	24 (0.4)	32 (0.3)	14 (0.2)	9 (0.3)	6 (0.3)
Non-Hodgkin lymphoma [C82-C96]	7,402 (0.2)	175 (0.2)	57 (0.9)	109 (1.0)	32 (0.5)	37 (1.1)	27 (1.4)
Hodgkin's lymphoma [C81]	2,249 (0.0)	48 (0.0)	24 (0.4)	66 (0.6)	7 (0.1)	7 (0.2)	9 (0.5)
Multiple myeloma [C90]	2,724 (0.1)	60 (0.1)	6 (0.1)	4 (0.0)	8 (0.1)	0 (0.0)	2 (0.1)
Other haematological [C96]	4,151 (0.1)	103 (0.1)	24 (0.4)	57 (0.5)	19 (0.3)	11 (0.3)	9 (0.5)
Solid	239,030 (5.2)	4,880 (4.9)	908 (14.3)	3,088 (27.3)	655 (9.6)	532 (16.5)	388 (19.8)
Breast [C50]	58,611 (1.3)	1,236 (1.2)	148 (2.3)	402 (3.5)	117 (1.7)	96 (3.0)	46 (2.3)
Prostate [C61]	37,141 (0.8)	682 (0.7)	186 (2.9)	440 (3.9)	122 (1.8)	103 (3.2)	87 (4.4)
Colorectal [C18-C21]	36,071 (0.8)	687 (0.7)	170 (2.7)	539 (4.8)	121 (1.8)	108 (3.3)	82 (4.2)
Bladder [C67]	20,592 (0.4)	421 (0.4)	132 (2.1)	350 (3.1)	61 (0.9)	64 (2.0)	56 (2.9)
Skin melanoma [C43]	7,569 (0.2)	140 (0.1)	42 (0.7)	314 (2.8)	20 (0.3)	19 (0.6)	18 (0.9)
Kidney [C64]	7,353 (0.2)	162 (0.2)	22 (0.3)	64 (0.6)	27 (0.4)	14 (0.4)	8 (0.4)
Lung [C33-C34]	7,911 (0.2)	159 (0.2)	28 (0.4)	92 (0.8)	27 (0.4)	17 (0.5)	15 (0.8)
Corpus uterus [C54-C55]	12,956 (0.3)	291 (0.3)	38 (0.6)	74 (0.7)	33 (0.5)	14 (0.4)	20 (1.0)
Thyroid [C73]	6,449 (0.1)	186 (0.2)	12 (0.2)	12 (0.1)	14 (0.2)	4 (0.1)	4 (0.2)

Head and neck [C00-C14]	5,770 (0.1)	106 (0.1)	21 (0.3)	71 (0.6)	10 (0.1)	9 (0.3)	8 (0.4)
Cervix [C53]	3,313 (0.1)	81 (0.1)	6 (0.1)	72 (0.6)	7 (0.1)	5 (0.2)	4 (0.2)
Ovary [C56]	3,628 (0.1)	64 (0.1)	10 (0.2)	80 (0.7)	8 (0.1)	15 (0.5)	3 (0.2)
Stomach [C16]	3,889 (0.1)	82 (0.1)	6 (0.1)	39 (0.3)	9 (0.1)	11 (0.3)	5 (0.3)
Larynx [C32]	3,317 (0.1)	46 (0.0)	18 (0.3)	66 (0.6)	8 (0.1)	5 (0.2)	8 (0.4)
Brain and Central Nervous System [C70-C72, C75.1-C75.3]	2,051 (0.0)	37 (0.0)	8 (0.1)	97 (0.9)	6 (0.1)	2 (0.1)	3 (0.2)
Testis [C62]	3,979 (0.1)	108 (0.1)	4 (0.1)	25 (0.2)	8 (0.1)	2 (0.1)	2 (0.1)
Liver [C22]	1,622 (0.0)	43 (0.0)	11 (0.2)	98 (0.9)	7 (0.1)	9 (0.3)	1 (0.1)
Bone and cartilage [C40-C41]	763 (0.0)	15 (0.0)	6 (0.1)	41 (0.4)	2 (0.0)	8 (0.2)	2 (0.1)
Pancreas [C25]	479 (0.0)	19 (0.0)	3 (0.0)	23 (0.2)	4 (0.1)	2 (0.1)	2 (0.1)
Oesophagus [C15]	2,763 (0.1)	51 (0.1)	0 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	0 (0.0)
Gallbladder [C23-C24]	1,944 (0.0)	43 (0.0)	1 (0.0)	15 (0.1)	8 (0.1)	2 (0.1)	1 (0.1)
Other solid cancers	10,859 (0.2%)	221 (0.2%)	36 (0.6%)	173 (1.5%)	35 (0.5%)	22(0.7%)	13(0.7%)

Notes: * Years since cancer diagnosis to the index date (1 March 2020). The MEDEA deprivation index is calculated at the census tract level in urban areas. Other solid cancers include other solid cancers, cancers of unspecified site [C76, C80] and more than one cancer (i.e. patients that had more than one cancer recorded on the same date). Abbreviations: IQR, interquartile range; ICD-10-CM, International Classification for Diseases, 10th revision Clinical Modification

Table S2. Adjusted Hazard Ratios of COVID-19 outcomes in patients with cancer (overall and by years since cancer diagnosis) compared to patients without cancer, stratified by sex.

Transition		Sex	aHR (95% CI) in patients with cancer			
From	To		Overall	≥5 years*	1-5 years*	<1 year*
General population	Diagnosed with COVID-19	Female	1.05 (1.01 to 1.09)	1.08 (1.03 to 1.13)	1.00 (0.93 to 1.08)	0.91 (0.79 to 1.04)
		Male	1.08 (1.03 to 1.12)	1.05 (1.00 to 1.11)	1.05 (0.97 to 1.13)	1.33 (1.17 to 1.50)
	Hospitalised with COVID-19	Female	1.41 (1.26 to 1.58)	1.23 (1.08 to 1.42)	1.68 (1.38 to 2.04)	2.24 (1.64 to 3.06)
		Male	1.26 (1.15 to 1.38)	1.26 (1.13 to 1.40)	1.13 (0.96 to 1.32)	1.62 (1.27 to 2.07)
Diagnosed with COVID-19	Hospitalised with COVID-19	Female	1.16 (1.03 to 1.31)	1.10 (0.95 to 1.28)	1.39 (1.12 to 1.72)	0.88 (0.54 to 1.44)
		Male	1.05 (0.95 to 1.17)	1.03 (0.90 to 1.17)	1.09 (0.91 to 1.31)	1.07 (0.79 to 1.44)
	Death	Female	0.96 (0.83 to 1.10)	0.87 (0.74 to 1.03)	1.12 (0.86 to 1.46)	1.30 (0.86 to 1.97)
		Male	1.12 (0.99 to 1.27)	0.98 (0.85 to 1.14)	1.15 (0.93 to 1.43)	2.23 (1.65 to 3.01)
Hospitalised with COVID-19	Death	Female	1.09 (0.90 to 1.30)	0.97 (0.78 to 1.21)	1.26 (0.90 to 1.78)	1.73 (1.03 to 2.90)
		Male	1.12 (0.98 to 1.28)	1.08 (0.93 to 1.27)	1.12 (0.88 to 1.42)	1.47 (0.96 to 2.23)

Notes: * Years since cancer diagnosis to the index date (1 March 2020). Models are adjusted for age, the MEDEA deprivation index, smoking status, and comorbidities (autoimmune conditions, chronic kidney disease, chronic obstructive pulmonary disease, dementia, heart disease, hyperlipidaemia, hypertension, type 2 diabetes, and obesity). Abbreviations: aHR, adjusted Hazard Ratio; CI, Confidence Interval

Table S3. Adjusted Hazard Ratios of COVID-19 outcomes in patients with cancer (overall and by years since cancer diagnosis) compared to patients without cancer, stratified by age.

Transition		Age	aHR (95% CI) in patients with cancer			
From	To		Overall	≥5 years*	1-5 years*	<1 year*
General population	Diagnosed with COVID-19	<70 years	0.96 (0.93 to 1.00)	0.97 (0.92 to 1.02)	0.95 (0.89 to 1.01)	0.92 (0.81 to 1.04)
		≥70 years	1.12 (1.07 to 1.17)	1.11 (1.05 to 1.16)	1.09 (1.00 to 1.19)	1.39 (1.21 to 1.61)
	Hospitalised with COVID-19	<70 years	1.56 (1.37 to 1.77)	1.48 (1.26 to 1.74)	1.42 (1.14 to 1.77)	2.37 (1.74 to 3.25)
		≥70 years	1.21 (1.11 to 1.31)	1.16 (1.06 to 1.28)	1.24 (1.06 to 1.43)	1.55 (1.21 to 1.99)
Diagnosed with COVID-19	Hospitalised with COVID-19	<70 years	1.09 (0.97 to 1.24)	1.03 (0.87 to 1.21)	1.13 (0.92 to 1.40)	1.34 (0.94 to 1.89)
		≥70 years	1.07 (0.96 to 1.18)	1.05 (0.93 to 1.19)	1.22 (1.01 to 1.47)	0.75 (0.51 to 1.08)
	Death	<70 years	2.97 (2.25 to 3.92)	1.39 (0.86 to 2.24)	3.44 (2.31 to 5.13)	10.81 (6.83 to 17.12)
		≥70 years	0.97 (0.88 to 1.06)	0.92 (0.83 to 1.03)	1.02 (0.85 to 1.23)	1.29 (0.96 to 1.72)
Hospitalised with COVID-19	Death	<70 years	1.49 (1.10 to 2.01)	1.32 (0.90 to 1.92)	1.17 (0.65 to 2.10)	4.58 (2.47 to 8.50)
		≥70 years	1.07 (0.95 to 1.20)	1.01 (0.89 to 1.16)	1.16 (0.94 to 1.43)	1.30 (0.88 to 1.90)

Notes: * Years since cancer diagnosis to the index date (1 March 2020). Models are adjusted for sex, age, the MEDEA deprivation Index, smoking status, and comorbidities (autoimmune conditions, chronic kidney disease, chronic obstructive pulmonary disease, dementia, heart disease, hyperlipidaemia, hypertension, type 2 diabetes, and obesity). Abbreviations: aHR, adjusted Hazard Ratio; CI, Confidence Interval

Table S4. Adjusted Hazard Ratios of COVID-19 outcomes in patients with cancer (overall and by years since cancer diagnosis) compared to patients without cancer, stratified by solid or haematological cancer.

Transition		Cancer type, number of events (overall)	aHR (95% CI) in patients with cancer			
From	To		Overall	≥5 years*	1-5 years*	<1 year*
General population	Diagnosed with COVID-19	Haematological, n=513	1.20 (1.10 to 1.31)	1.12 (1.00 to 1.25)	1.23 (1.05 to 1.45)	1.77 (1.38 to 2.28)
		Solid, n=4,880	1.07 (1.04 to 1.11)	1.09 (1.05 to 1.13)	1.03 (0.98 to 1.09)	1.07 (0.97 to 1.18)
	Hospitalised with COVID-19	Haematological, n=135	2.51 (2.12 to 2.98)	2.01 (1.57 to 2.56)	2.61 (1.92 to 3.53)	6.18 (4.31 to 8.86)
		Solid, n=908	1.24 (1.15 to 1.33)	1.21 (1.11 to 1.32)	1.21 (1.06 to 1.39)	1.49 (1.19 to 1.87)
Diagnosed with COVID-19	Hospitalised with COVID-19	Haematological, n=80	1.37 (1.10 to 1.71)	0.96 (0.68 to 1.36)	1.85 (1.31 to 2.60)	2.24 (1.34 to 3.76)
		Solid, n=655	1.05 (0.97 to 1.14)	1.05 (0.95 to 1.16)	1.12 (0.96 to 1.30)	0.85 (0.64 to 1.14)
	Death	Haematological, n=64	1.08 (0.84 to 1.39)	1.02 (0.72 to 1.43)	0.89 (0.57 to 1.38)	3.11 (1.67 to 5.81)
		Solid, n=532	1.03 (0.94 to 1.13)	0.91 (0.82 to 1.02)	1.20 (1.00 to 1.44)	1.69 (1.30 to 2.19)
Hospitalised with COVID-19	Death	Haematological, n=53	1.73 (1.31 to 2.28)	1.55 (1.04 to 2.31)	1.92 (1.24 to 2.99)	1.92 (0.96 to 3.86)
		Solid, n=388	1.07 (0.96 to 1.20)	1.03 (0.90 to 1.17)	1.07 (0.86 to 1.32)	1.56 (1.09 to 2.25)

Notes: * Years since cancer diagnosis to the index date (1 March 2020). Models for specific cancer types include patients without cancer and patients with the cancer type of interest. Models are adjusted for sex, age, the MEDEA deprivation Index, smoking status, and comorbidities (autoimmune conditions, chronic kidney disease, chronic obstructive pulmonary disease, dementia, heart disease, hyperlipidaemia, hypertension, type 2 diabetes, and obesity). Abbreviations: aHR, adjusted Hazard Ratio; CI, Confidence Interval

Table S5. Adjusted Hazard Ratios of COVID-19 outcomes in patients with cancer (overall and by years since cancer diagnosis) compared to patients without cancer, stratified by solid cancer type.

Transition		Solid cancer type, number of events (overall)	aHR (95% CI) in patients with cancer		
From	To		Overall	≥5 years*	<5 years*
General population	Diagnosed with COVID-19	Breast n=1,236	1.00 (0.95 to 1.06)	1.04 (0.97 to 1.12)	0.93 (0.85 to 1.03)
		Prostate, n=682	1.05 (0.97 to 1.14)	1.08 (0.99 to 1.19)	0.99 (0.86 to 1.13)
		Colorectal, n=687	1.07 (1.00 to 1.16)	1.09 (0.99 to 1.20)	1.05 (0.93 to 1.19)
		Bladder, n=421	1.22 (1.11 to 1.35)	1.25 (1.10 to 1.41)	1.19 (1.02 to 1.39)
		Lung, n= 140	1.02 (0.86 to 1.20)	0.99 (0.76 to 1.28)	1.03 (0.83 to 1.28)
	Hospitalised with COVID-19	Breast, n=148	1.30 (1.10 to 1.54)	1.10 (0.89 to 1.36)	1.87 (1.43 to 2.45)
		Prostate, n=186	0.99 (0.85 to 1.16)	1.09 (0.92 to 1.30)	0.75 (0.55 to 1.03)
		Colorectal, n=170	1.28 (1.10 to 1.49)	1.27 (1.04 to 1.53)	1.30 (1.01 to 1.67)
		Bladder, n=132	1.50 (1.26 to 1.79)	1.47 (1.18 to 1.83)	1.55 (1.17 to 2.06)
		Lung, n=42	1.53 (1.13 to 2.08)	1.35 (0.84 to 2.18)	1.69 (1.14 to 2.51)
Diagnosed with COVID-19	Hospitalised with COVID-19	Breast, n=117	1.06 (0.87 to 1.27)	1.04 (0.83 to 1.29)	1.12 (0.79 to 1.56)
		Prostate, n=122	0.91 (0.76 to 1.10)	0.93 (0.75 to 1.15)	0.88 (0.63 to 1.23)
		Colorectal, n=121	1.14 (0.95 to 1.37)	1.17 (0.93 to 1.48)	1.09 (0.81 to 1.47)
		Bladder, n=61	0.85 (0.66 to 1.09)	0.89 (0.65 to 1.21)	0.78 (0.51 to 1.20)
		Lung, n=20	1.03 (0.66 to 1.60)	1.54 (0.87 to 2.70)	0.60 (0.29 to 1.27)
	Death	Breast, n=96	1.08 (0.88 to 1.33)	0.99 (0.78 to 1.26)	1.41 (0.97 to 2.05)
		Prostate, n=103	0.84 (0.68 to 1.02)	0.76 (0.60 to 0.96)	1.17 (0.79 to 1.71)
		Colorectal, n=108	1.03 (0.85 to 1.26)	0.87 (0.68 to 1.11)	1.48 (1.09 to 2.01)

		Bladder, n=64	1.05 (0.82 to 1.35)	1.22 (0.91 to 1.65)	0.80 (0.51 to 1.25)
		Lung, n=19	1.68 (1.06 to 2.64)	0.96 (0.43 to 2.14)	2.57 (1.49 to 4.46)
Hospitalised with COVID-19	Death	Breast, n=46	0.88 (0.65 to 1.20)	0.73 (0.50 to 1.08)	1.28 (0.80 to 2.06)
		Prostate, n=87	1.02 (0.82 to 1.28)	1.01 (0.78 to 1.29)	1.11 (0.70 to 1.78)
		Colorectal, n=82	1.07 (0.85 to 1.34)	1.10 (0.85 to 1.43)	0.98 (0.64 to 1.49)
		Bladder, n=56	1.14 (0.87 to 1.50)	0.95 (0.67 to 1.33)	1.70 (1.11 to 2.60)
		Lung, n=18	1.04 (0.65 to 1.67)	1.46 (0.75 to 2.84)	0.81 (0.42 to 1.57)

Notes: * Years since cancer diagnosis to the index date (1 March 2020). Models for specific cancer types include patients without cancer and patients with the cancer type of interest; models for breast and prostate cancer include only females and males, respectively. Models are adjusted for sex, age, the MEDEA deprivation index, smoking status, and comorbidities (autoimmune conditions, chronic kidney disease, chronic obstructive pulmonary disease, dementia, heart disease, hyperlipidaemia, hypertension, type 2 diabetes, and obesity). Abbreviations: aHR, adjusted Hazard Ratio; CI, Confidence Interval

Table S6. Comparison of baseline characteristics among individuals with complete information on all covariates vs individuals with missing information on the MEDEA deprivation index and/or smoking status.

	With complete information on covariates	Without MEDEA or smoking status	Standardized Mean Difference
n	3,115,935	1,502,442	
Age, median [IQR]	49 [36.0, 64.0]	47 [36.0, 61.0]	0.063
Age, categories (%)			0.133
18 to 39	959,224 (30.8)	478,012 (31.8)	
40 to 59	1,161,860 (37.3)	623,635 (41.5)	
60 to 69	444,882 (14.3)	170,316 (11.3)	
70 to 79	340,542 (10.9)	127,744 (8.5)	
80 or older	209,427 (6.7)	102,735 (6.8)	
Sex, female (%)	1,639,430 (52.6)	721,800 (48.0)	0.092
MEDEA Deprivation Index (%)			0.696
Quintile 1 (least deprived)	499,651 (16.0)	214,532 (14.3)	
Quintile 2	501,888 (16.1)	202,033 (13.4)	
Quintile 3	501,880 (16.1)	195,194 (13.0)	
Quintile 4	501,959 (16.1)	190,885 (12.7)	
Quintile 5 (most deprived)	501,993 (16.1)	185,069 (12.3)	
Rural	608,564 (19.5)	223,692 (14.9)	
Missing	0 (0.0)	291,037 (19.4)	
Smoking status (%)			3.565
Never smoker	1,724,016 (55.3)	110,641 (7.4)	
Former smoker	725,290 (23.3)	47,585 (3.2)	
Current smoker	666,629 (21.4)	46,110 (3.1)	
Missing	0 (0.0)	1,298,106 (86.4)	
Comorbidities			
Autoimmune condition	191,028 (6.1)	68,206 (4.5)	0.071
Chronic kidney disease	145,800 (4.7)	55,458 (3.7)	0.049
Chronic obstructive pulmonary disease	89,240 (2.9)	30,292 (2.0)	0.055
Dementia	28,197 (0.9)	14,307 (1.0)	0.005
Heart disease	382,684 (12.3)	133,456 (8.9)	0.111
Hyperlipidaemia	386,108 (12.4)	118,994 (7.9)	0.148

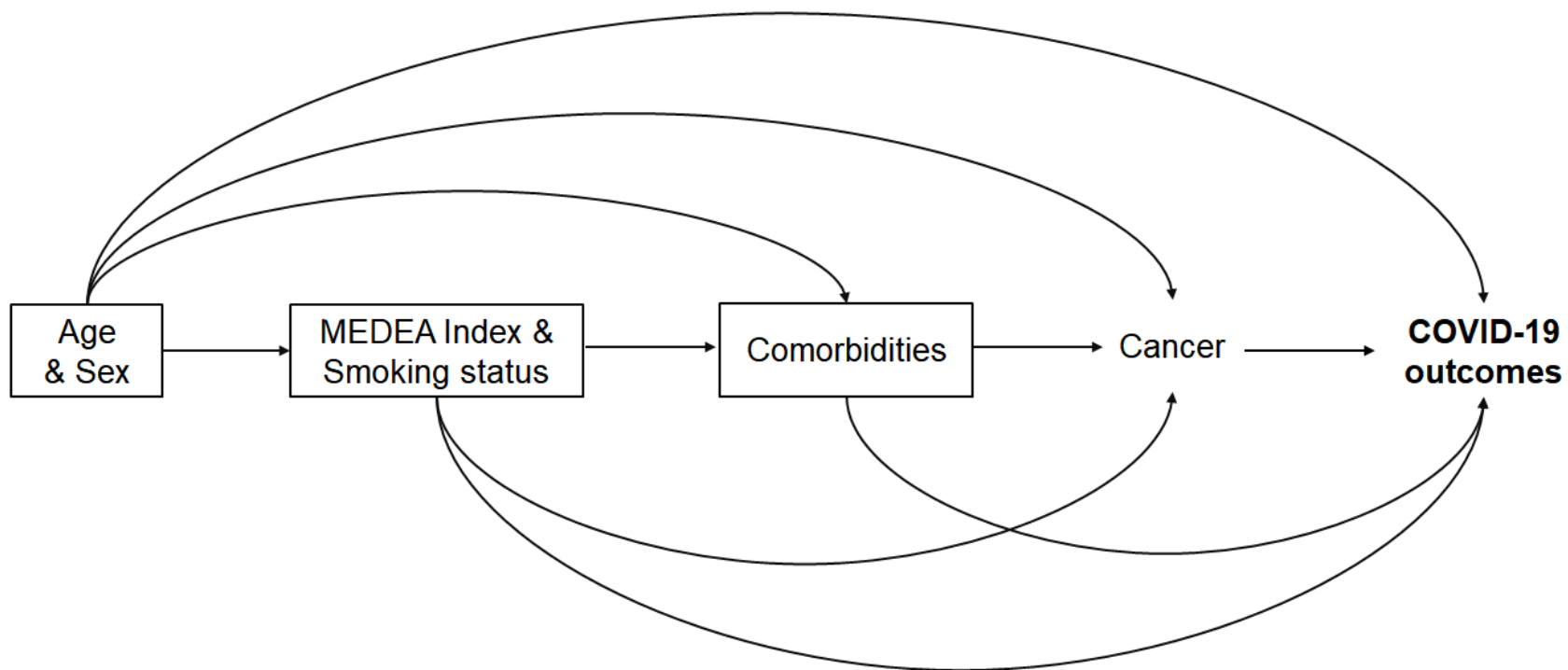
Hypertension	536,794 (17.2)	150,564 (10.0)	0.211
Obesity	873,059 (28.0)	271,383 (18.1)	0.238
Type 2 diabetes	239,653 (7.7)	77,352 (5.1)	0.104
Cancer status			0.064
Without a prior diagnosis of cancer	2,925,498 (93.9)	1,432,212 (95.3)	
With a prior diagnosis of cancer, by years since cancer diagnosis			
>5 years	121,949 (3.9)	45,104 (3.0)	
1-5 years	53,026 (1.7)	19,007 (1.3)	
< 1 year	15,462 (0.5)	6,119 (0.4)	
Age at cancer diagnosis, median [IQR]	61 [50.5, 70.0]	61 [49.7, 70.9]	0.007
Cancer type [ICD-10-CM code] (%)			
Haematological	15,640 (0.5)	5,997 (0.4)	0.015
Leukaemia [C91-C95]	3,717 (0.1)	1,394 (0.1)	0.008
Non-Hodgkin lymphoma [C82-C96]	5,317 (0.2)	2,085 (0.1)	0.008
Hodgkin's lymphoma [C81]	1,643 (0.1)	606 (0.0)	0.006
Multiple myeloma [C90]	1,940 (0.1)	784 (0.1)	0.004
Other haematological [C96]	3,023 (0.1)	1,128 (0.1)	0.007
Solid	174,797 (5.6)	64,233 (4.3)	0.062
Breast [C50]	41,834 (1.3)	16,777 (1.1)	0.021
Prostate [C61]	28,396 (0.9)	8,745 (0.6)	0.038
Colorectal [C18-C21]	26,299 (0.8)	9,772 (0.7)	0.022
Bladder [C67]	15,570 (0.5)	5,022 (0.3)	0.026
Melanoma [C43]	5,804 (0.2)	1,765 (0.1)	0.018
Kidney [C64]	5,248 (0.2)	2,105 (0.1)	0.007
Lung [C33-C34]	5,749 (0.2)	2,162 (0.1)	0.010
Corpus uterus [C54-C55]	9,296 (0.3)	3,660 (0.2)	0.011
Thyroid [C73]	4,756 (0.2)	1,693 (0.1)	0.011
Head and neck [C00-C14]	4,136 (0.1)	1,634 (0.1)	0.007
Cervix [C53]	2,387 (0.1)	926 (0.1)	0.006
Ovary [C56]	2,623 (0.1)	1,005 (0.1)	0.006
Stomach [C16]	2,734 (0.1)	1,155 (0.1)	0.004
Larynx [C32]	2,564 (0.1)	753 (0.1)	0.013

Brain and Central Nervous System [C70-C72, C75.1-C75.3]	1,462 (0.0)	589 (0.0)	0.004
Testis [C62]	2,859 (0.1)	1,120 (0.1)	0.006
Liver [C22]	1,144 (0.0)	478 (0.0)	0.003
Bone and cartilage [C40-C41]	581 (0.0)	182 (0.0)	0.005
Pancreas [C25]	341 (0.0)	138 (0.0)	0.002
Oesophagus [C15]	1,891 (0.1)	872 (0.1)	0.001
Gallbladder [C23-C24]	1,441 (0.0)	503 (0.0)	0.006
Other solid cancers	7,682 (0.2)	1,104 (0.02)	0.004

Notes: The MEDEA deprivation index is calculated at the census tract level in urban areas. Other solid cancers include other solid cancers, cancers of unspecified site [C76, C80] and more than one cancer (i.e. patients that had more than one cancer recorded on the same date). Abbreviations: IQR, interquartile range; ICD-10-CM, International Classification for Diseases, 10th revision Clinical Modification, MEDEA: MEDEA deprivation index.

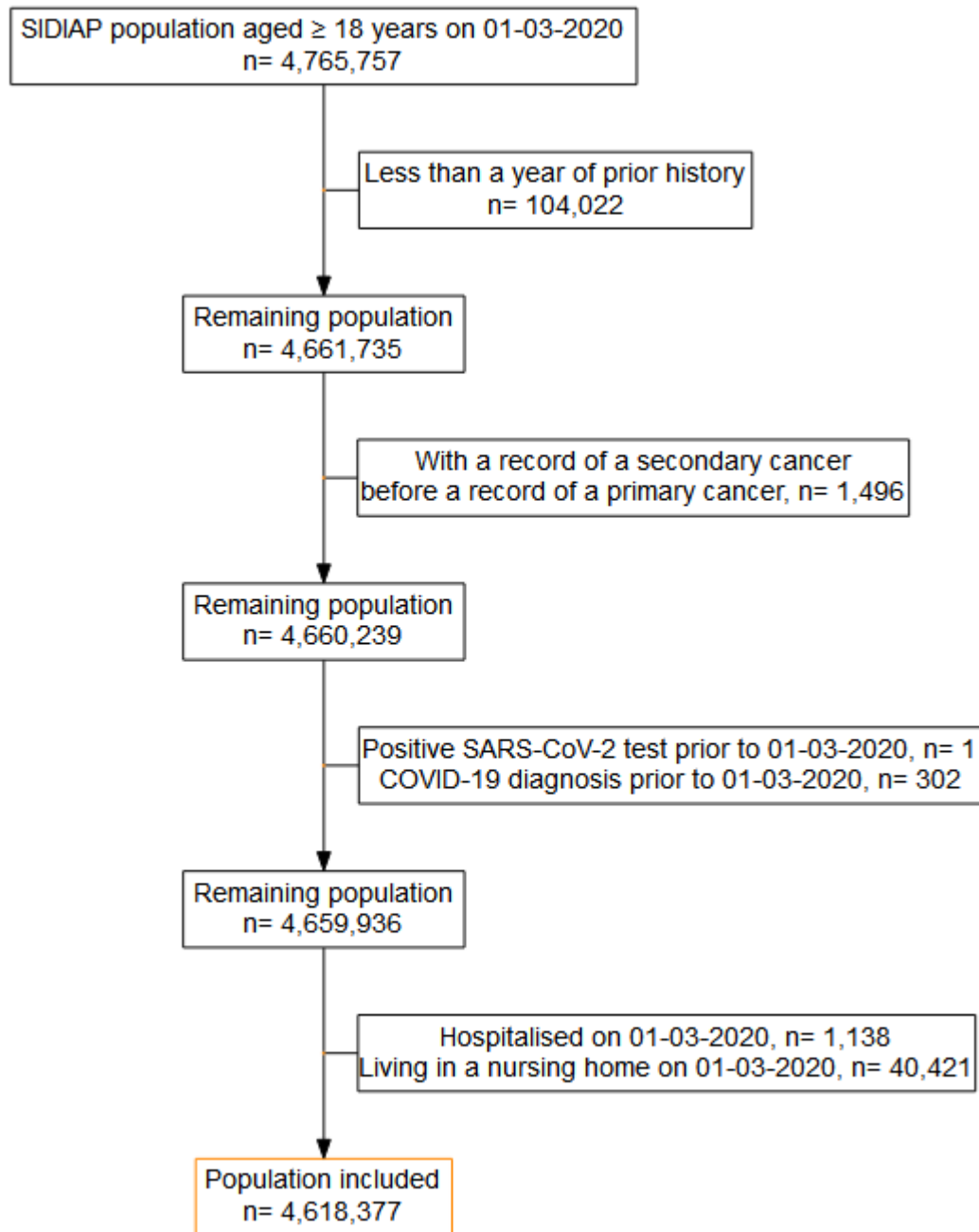
Supplementary figures

Figure S1. Directed Acyclic Graph used to adjust the Cox proportional hazard models to assess the relationship between cancer and COVID-19 outcomes



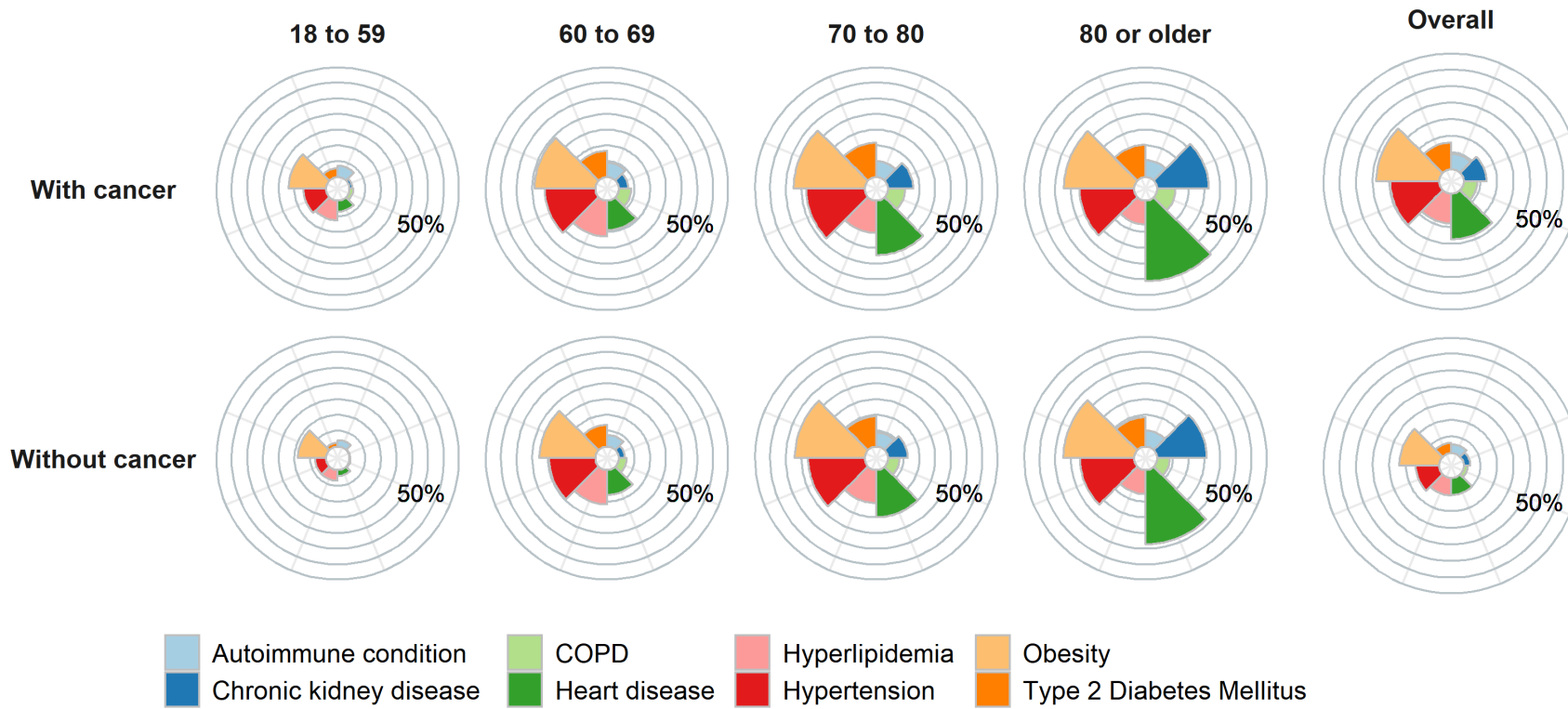
Notes: MEDEA is an index of deprivation calculated at the census tract level in urban areas. The comorbidities considered are autoimmune conditions, chronic kidney disease, chronic obstructive pulmonary disease, dementia, heart disease, hyperlipidaemia, hypertension, obesity, and type 2 diabetes.

Figure S2. Flowchart with the inclusion and exclusion criteria of the study population



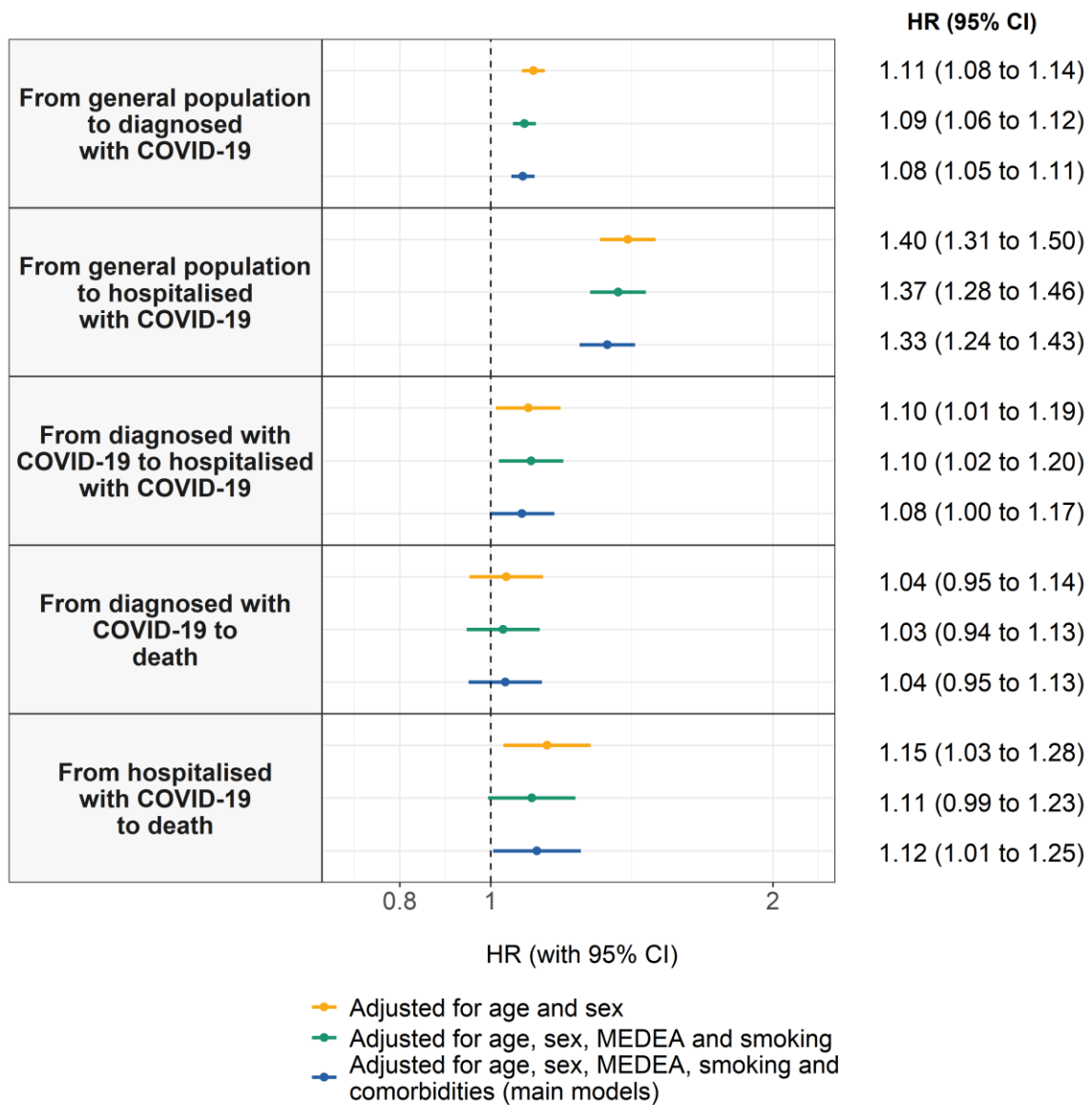
Abbreviations: SIDIAP: Information System for Research in Primary Care; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2

Figure S3. Prevalence of comorbidities among the general population, by age and cancer status



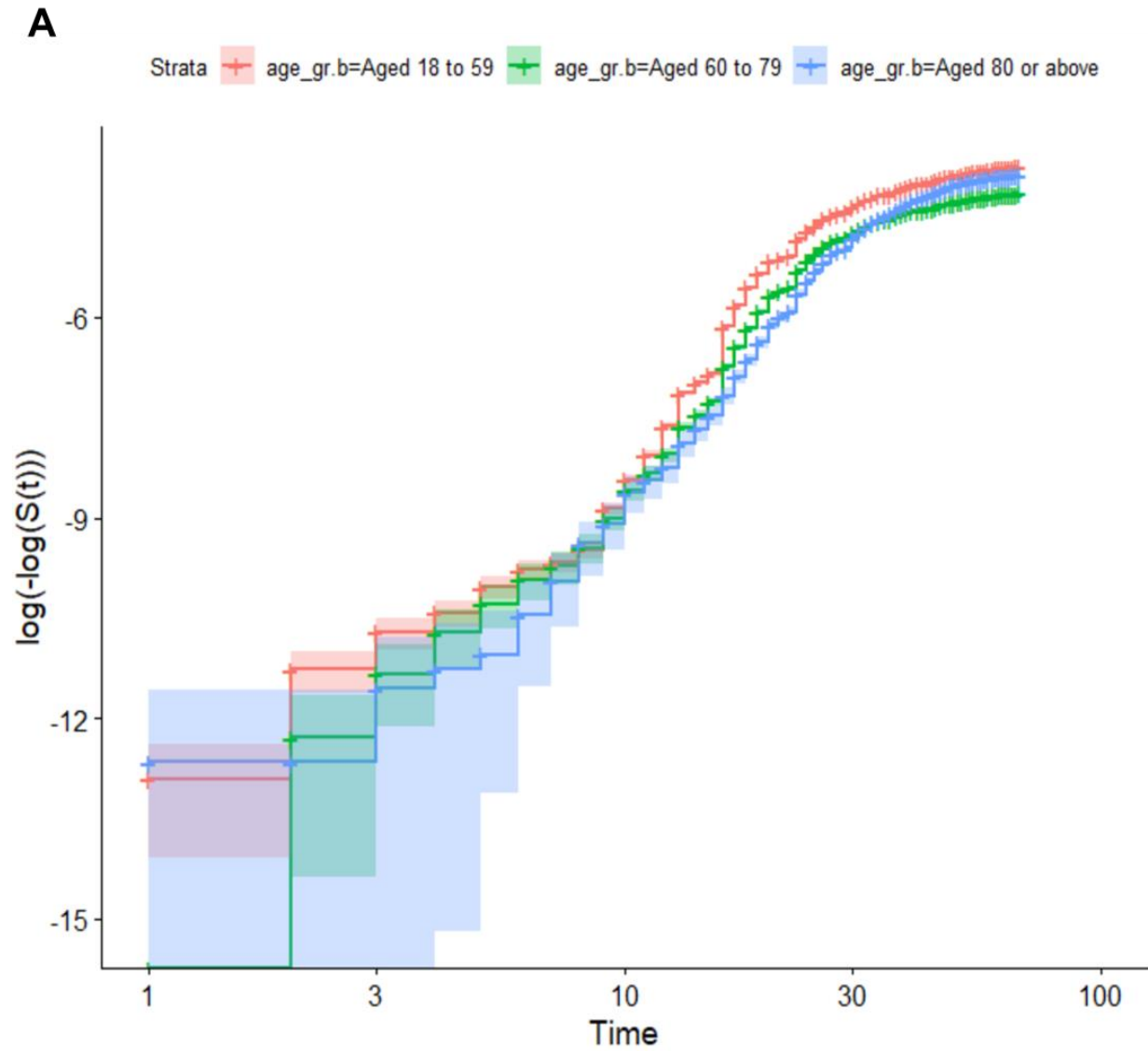
Abbreviations: COPD, Chronic Obstructive Pulmonary Disease

Figure S4. Hazard Ratios of COVID-19 outcomes in patients with cancer compared to patients without cancer, using different adjustment strategies.



Notes: The comorbidities included are autoimmune conditions, chronic kidney disease, chronic obstructive pulmonary disease, dementia, heart disease, hyperlipidaemia, hypertension, type 2 diabetes, and obesity. Abbreviations: HR, Hazard Ratio; CI, Confidence Interval, MEDEA: MEDEA deprivation index.

Figure S5. Log-log plots for risk of having an outpatient COVID-19 diagnosis, for age categories (A) and for cancer status by years since cancer diagnosis (B)



B

+

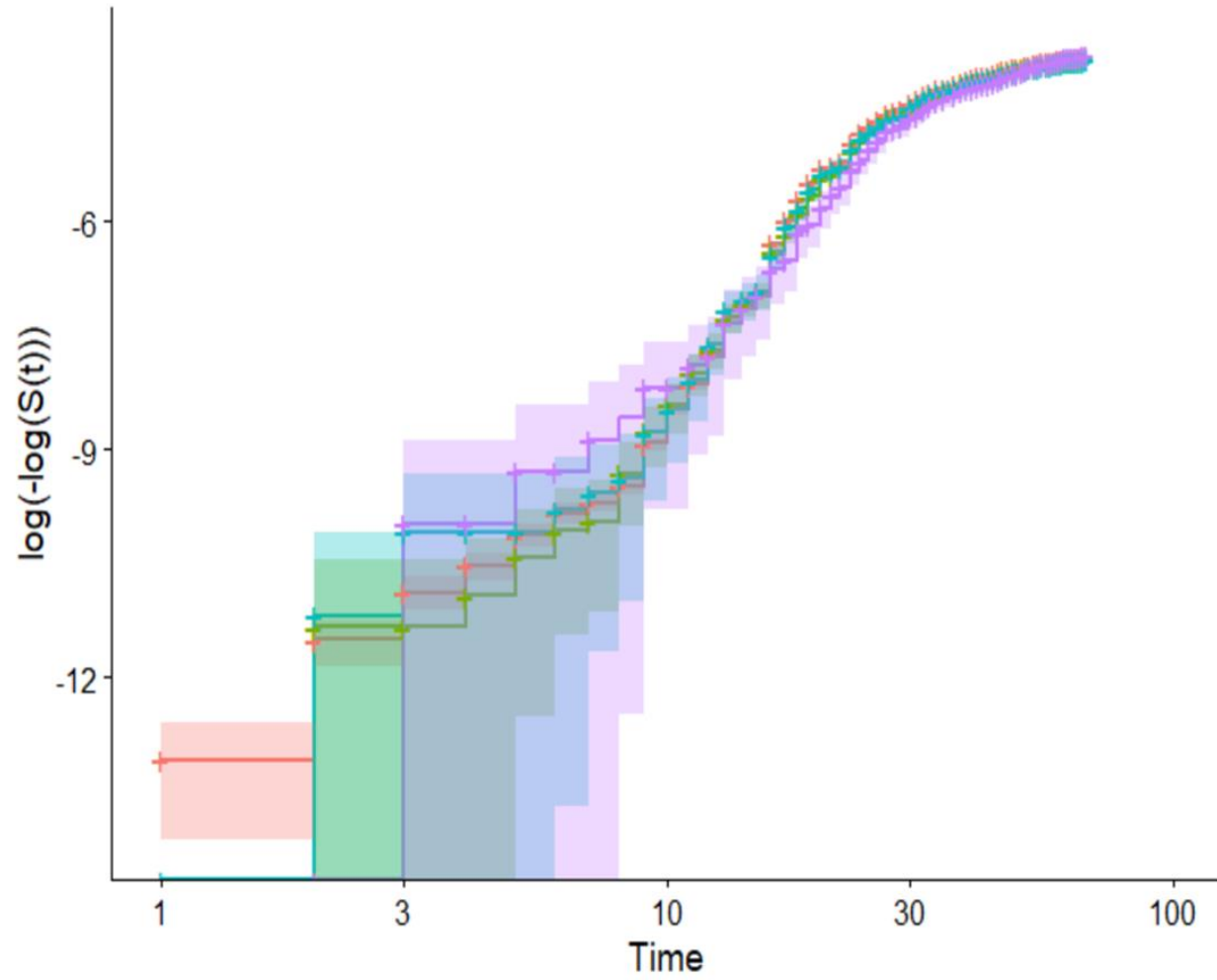
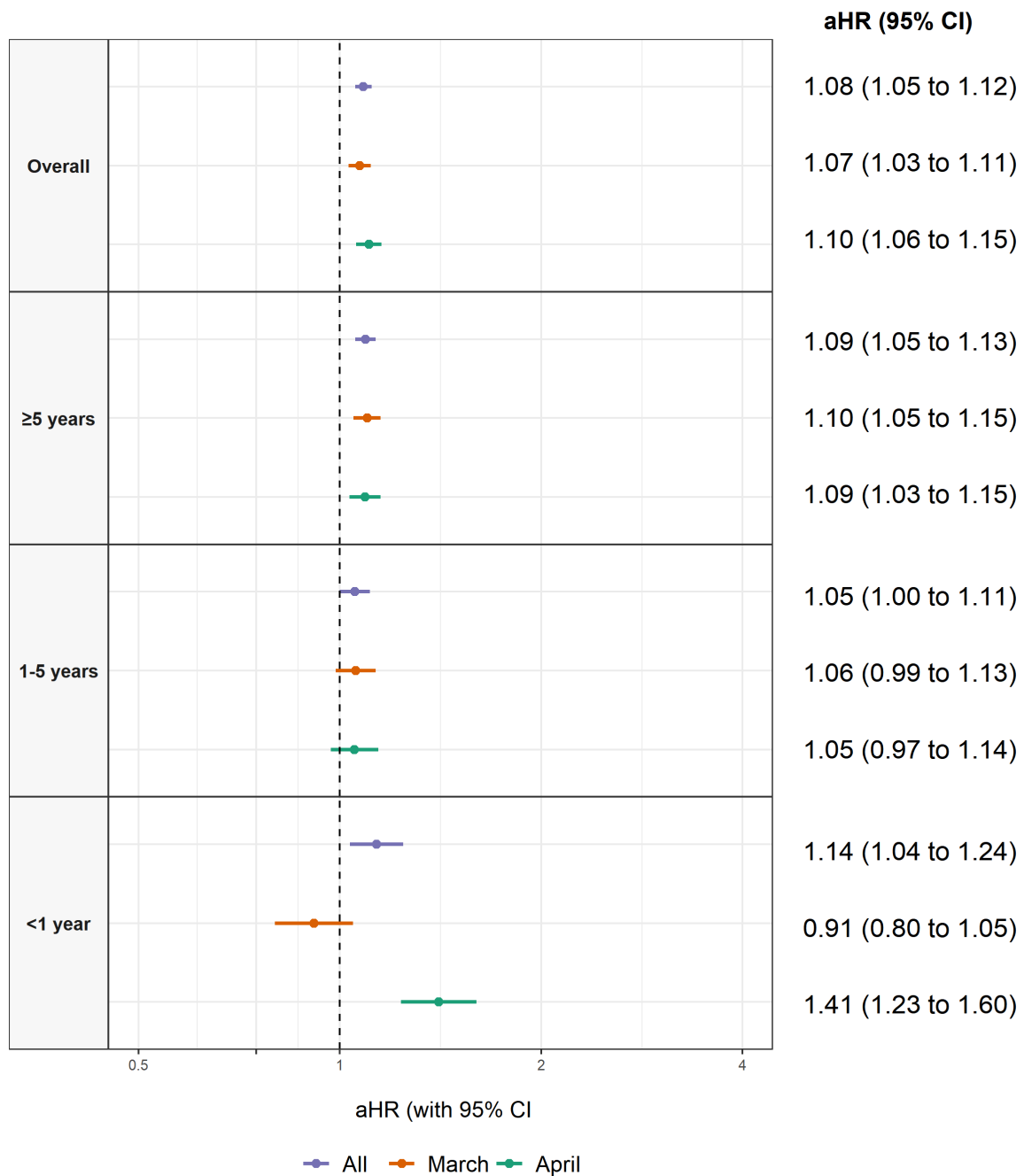
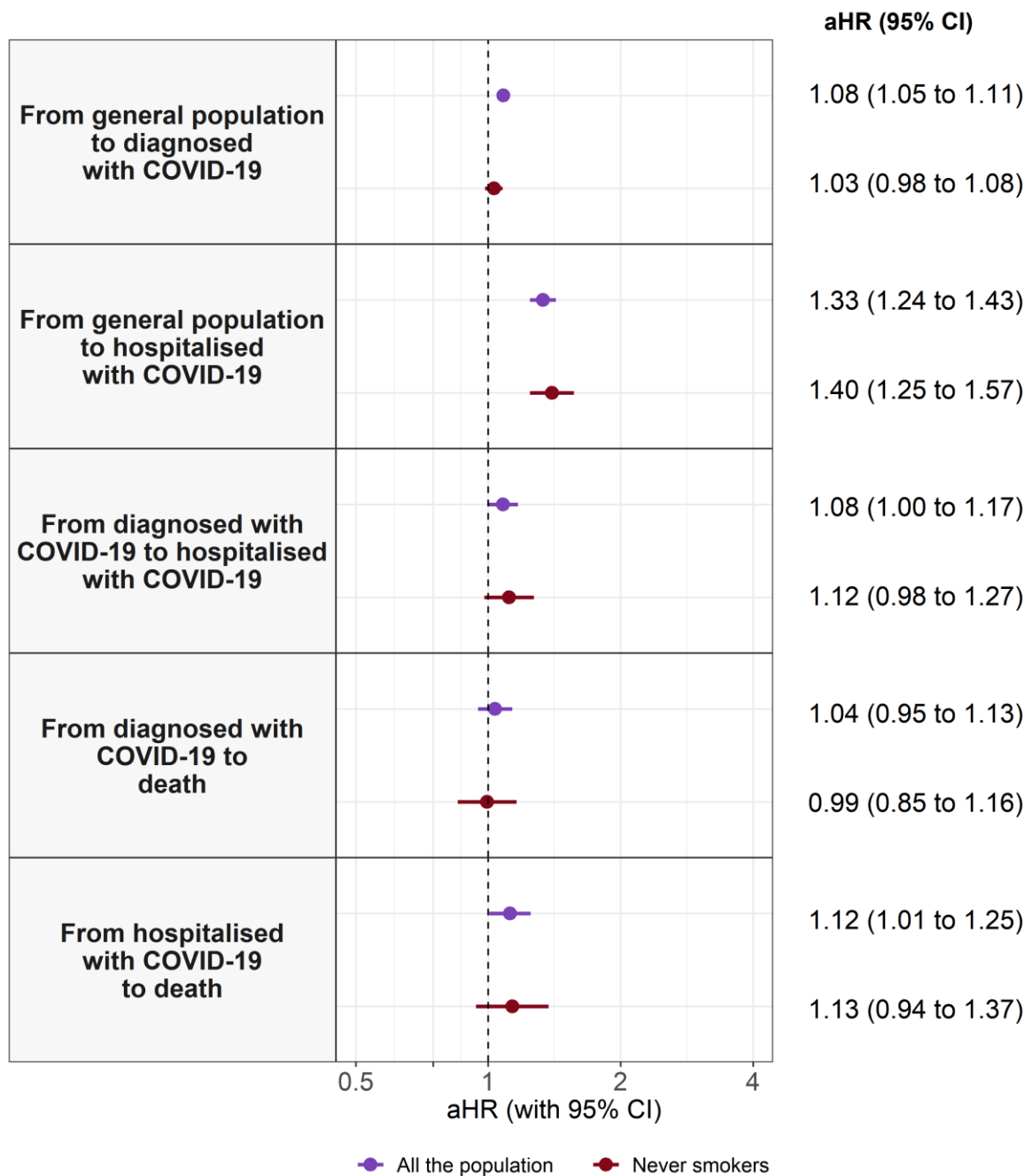
 c_status=cancer-free + c_status=>5years + c_status=1-5 years + c_status=< 1 year

Figure S6. Adjusted Hazard Ratios for having an outpatient COVID-19 diagnosis in patients with cancer (overall and by years since the cancer diagnosis) compared to patients without cancer, stratified by month



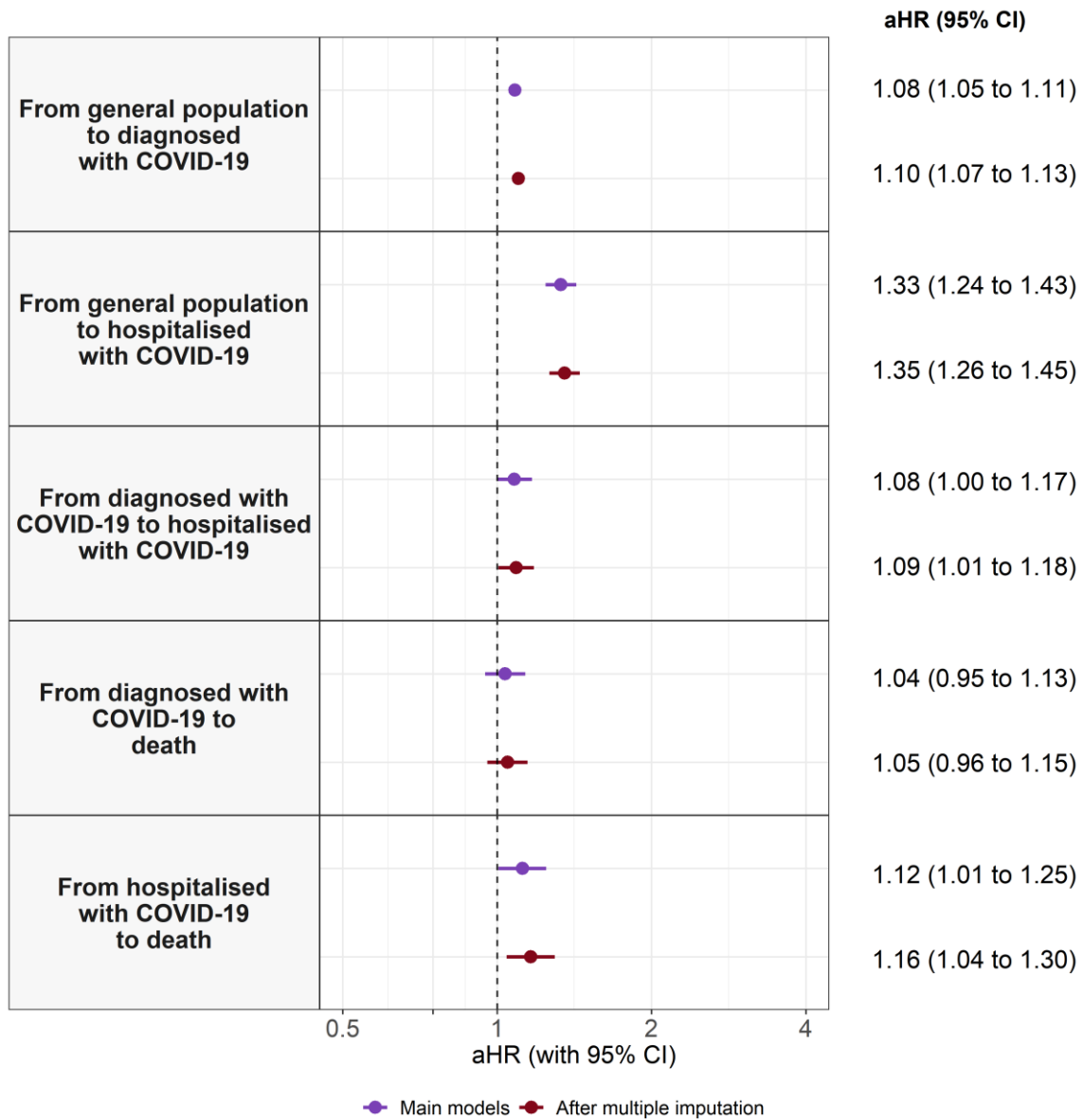
Notes: Models are adjusted for sex, age, the MEDEA deprivation Index, and comorbidities (autoimmune conditions, chronic kidney disease, chronic obstructive pulmonary disease, dementia, heart disease, hyperlipidaemia, hypertension, type 2 diabetes, and obesity). Abbreviations: aHR, adjusted Hazard Ratio; CI, Confidence Interval

Figure S7. Adjusted Hazard Ratios of COVID-19 outcomes in patients with cancer compared to patients without cancer, by population included (all and restricting participants to never smokers)



Notes: Models are adjusted for sex, age, the MEDEA deprivation Index, and comorbidities (autoimmune conditions, chronic kidney disease, chronic obstructive pulmonary disease, dementia, heart disease, hyperlipidaemia, hypertension, type 2 diabetes, and obesity). Models including all the population are also adjusted for smoking status. Abbreviations: aHR, adjusted Hazard Ratio; CI, Confidence Interval

Figure S8. Adjusted Hazard Ratios of COVID-19 outcomes in patients with cancer compared to patients without cancer, after multiple imputation of missing data on the MEDEA deprivation index and/or smoking status



Notes: Models are adjusted for sex, age, the MEDEA deprivation Index, smoking status, and comorbidities (autoimmune conditions, chronic kidney disease, chronic obstructive pulmonary disease, dementia, heart disease, hyperlipidaemia, hypertension, type 2 diabetes, and obesity). Abbreviations: aHR, adjusted Hazard Ratio; CI, Confidence Interval