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Supplementary appendix

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**Geriatric risk factors for serious COVID-19 outcomes among older adults with cancer:
A cohort study from the COVID-19 and Cancer Consortium**

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Methods: Definition and derivation of the geriatric risk index.

In this section, we provide the definition and derivation of the geriatric risk index. First, we defined a modified Charlson comorbidity index (CCI) according to:

Variable	Score
Coronary artery disease	1
Congestive heart failure	1
Peripheral vascular disease	1
Cerebrovascular accident or stroke	1
Chronic obstructive pulmonary disorder or emphysema	1
Dementia	1
Diabetes mellitus	1
Diabetes mellitus and/or end stage renal disease, peripheral vascular disease, coronary artery disease	2
Chronic renal insufficiency	2
End stage renal disease, with or without dialysis	2
Liver disease not otherwise specified	1
Cirrhosis	3
Rheumatologic or autoimmune disease	1
HIV/AIDS and CD4 count <200 mm ³	6

Next, we calculated the geriatric risk index based on age, modified CCI, and Eastern Cooperative Oncology Group (ECOG) performance status: age (≤ 75 years, 0 points; 76–80 years, 1 point; >80 years, 2 points); modified CCI (0, 0 points; 1 or 2, 1 point; >2 , 2 points); and ECOG performance status (0, 0 points; 1, 1 point; >2 , 2 points). Patients were categorized as standard risk (0 or 1 point), intermediate risk (2 or 3 points), or high risk (4–6 points).

To include patients with partially missing data and to maximize use of the available data, all patients had a geriatric risk index point total calculated. Patients with unknown ECOG performance status were initially categorized separately based on the available data and denoted as belonging to “at least” that category, recognizing that their level of risk may be underestimated. If ECOG performance was unknown and:

- Age ≤ 75 years and modified CCI = 0, then geriatric risk index = “at least standard risk”
- Age 76–80 years and modified CCI = 0, then geriatric risk index = “at least standard risk”
- Age >80 years and modified CCI = 0, then geriatric risk index = “at least intermediate risk”
- Age ≤ 75 years and modified CCI = 1 or 2, then geriatric risk index = “at least standard risk”
- Age 76–80 years and modified CCI = 1 or 2, then geriatric risk index = “at least intermediate risk”
- Age >80 years and modified CCI = 1 or 2, then geriatric risk index = “at least intermediate risk”
- Age ≤ 75 years and modified CCI >2 , then geriatric risk index = “at least intermediate risk”
- Age 76–80 years and modified CCI >2 , then geriatric risk index = “at least intermediate risk”
- Age >80 years and modified CCI >2 , then geriatric risk index = “high risk”

For simplicity of clinical application and given similarity to the adjacent groups, these “at least” categories were consolidated (i.e., “at least standard risk” was consolidated with “standard risk” and “at least intermediate risk” was consolidated with “intermediate risk”).

Table S1: Distribution of variables used to define the geriatric risk index among older adults with cancer and COVID-19.

	Standard risk (n = 2365)	Intermediate risk (n = 2217)	High risk (n = 1089)
Median age, years	67 (63–72)	73 (67–79)	83 (78–87)
60–69	1516 (64%)	750 (34%)	70 (6%)
70–79	822 (35%)	949 (43%)	268 (25%)
≥80	27 (1%)	518 (23%)	751 (69%)
Median Charlson comorbidity index	0 (0–1)	1 (1–3)	3 (1–4)
0	1581 (67%)	426 (19%)	52 (5%)
1 or 2	784 (33%)	1135 (51%)	373 (34%)
≥3	0 (0%)	646 (29%)	664 (61%)
Missing/unknown	0 (0%)	9 (<1%)	0 (0%)
Eastern Cooperative Oncology Group performance status			
0	1113 (47%)	344 (16%)	29 (3%)
1	371 (16%)	871 (39%)	278 (26%)
≥2	0 (0%)	356 (16%)	657 (60%)
Unknown	881 (37%)	644 (29%)	125 (11%)
Missing	0 (0%)	2 (<1%)	0 (0%)

Data are n (%) or median (interquartile range).

Table S2: Type of malignancy among older adults with cancer and COVID-19, stratified by geriatric risk index.

	Standard risk (n = 2365)	Intermediate risk (n = 2217)	High risk (n = 1089)
Solid tumor			
Breast	480 (20%)	359 (16%)	179 (16%)
Prostate	442 (19%)	400 (18%)	230 (21%)
Gastrointestinal	267 (11%)	384 (17%)	172 (16%)
Other genitourinary	181 (8%)	195 (9%)	117 (11%)
Thoracic	200 (8%)	289 (13%)	143 (13%)
Gynecological	169 (7%)	152 (7%)	56 (5%)
Endocrine	100 (4%)	73 (3%)	25 (2%)
Skin cancer	76 (3%)	87 (4%)	43 (4%)
Head and neck	78 (3%)	87 (4%)	32 (3%)
Sarcoma	53 (2%)	31 (1%)	11 (1%)
Nervous system	25 (1%)	29 (1%)	7 (1%)
Not otherwise specified	18 (1%)	15 (1%)	14 (1%)
Hematological neoplasm			
Lymphoid neoplasms	321 (14%)	246 (11%)	127 (12%)
Multiple myeloma	123 (5%)	124 (6%)	63 (6%)
Myeloid neoplasm	89 (4%)	111 (5%)	68 (6%)
Not otherwise specified	4 (<1%)	4 (<1%)	3 (<1%)

Data are n (%). Categories are not mutually exclusive.

Table S3: Association of geriatric risk index (“at least” categories not consolidated) with COVID-19 severity and 30-day all-cause mortality among older adults with cancer.

Geriatric risk index	COVID-19 severity	30-day mortality
Standard risk	Reference	Reference
At least standard risk	1.56 (1.32 to 1.85)	1.58 (1.14 to 2.20)
Intermediate risk	3.14 (2.72 to 3.62)	4.19 (3.23 to 5.42)
At least intermediate risk	3.47 (2.88 to 4.17)	5.14 (3.80 to 6.94)
High risk	9.30 (7.88 to 11.0)	13.2 (10.1 to 17.1)

Data are odds ratio (95% confidence interval).

Table S4: Adjusted associations of demographic and clinical factors with COVID-19 severity and 30-day all-cause mortality among older adults with cancer.

	COVID-19 severity*	30-day mortality†
Age, per decade	1.55 (1.44 to 1.66)	2.08 (1.87 to 2.32)
Sex, male vs. female	1.45 (1.30 to 1.62)	1.76 (1.48 to 2.09)
Race and ethnicity		
Non-Hispanic Black vs. non-Hispanic White	1.31 (1.14 to 1.52)	1.39 (1.12 to 1.73)
Hispanic vs. non-Hispanic White	1.45 (1.20 to 1.74)	1.58 (1.18 to 2.10)
Other vs. non-Hispanic White	1.28 (1.06 to 1.55)	1.16 (0.85 to 1.57)
Smoking status, ever vs. never	1.28 (1.15 to 1.43)	1.33 (1.11 to 1.59)
Obesity, yes vs. no	1.12 (1.00 to 1.26)	1.04 (0.86 to 1.25)
Dementia, yes vs. no	1.65 (1.25 to 2.17)	1.35 (0.97 to 1.89)
Charlson comorbidity index		
1 or 2 vs. 0	1.77 (1.55 to 2.00)	1.85 (1.49 to 2.30)
≥3 vs. 0	2.48 (2.13 to 2.88)	2.24 (1.76 to 2.84)
Eastern Cooperative Oncology Group performance status		
1 vs. 0	1.59 (1.37 to 1.85)	1.97 (1.49 to 2.59)
≥2 vs. 0	4.60 (3.84 to 5.50)	6.42 (4.86 to 8.48)
Unknown vs. 0	2.08 (1.79 to 2.41)	3.08 (2.34 to 4.05)
Type of malignancy		
Hematological neoplasm vs. solid cancer	2.06 (1.75 to 2.42)	1.87 (1.46 to 2.40)
Multiple‡ vs. solid cancer	1.45 (1.24 to 1.69)	1.37 (1.09 to 1.73)
Cancer status		
Active and responding vs. remission or no evidence of disease	1.09 (0.89 to 1.35)	1.19 (0.84 to 1.68)
Active and stable vs. remission or no evidence of disease	1.10 (0.93 to 1.31)	1.36 (1.03 to 1.78)
Active and progressing vs. remission or no evidence of disease	3.48 (2.86 to 4.23)	5.15 (3.93 to 6.74)
Unknown vs. remission or no evidence of disease	2.10 (1.67 to 2.63)	3.26 (2.37 to 4.47)
Recent cytotoxic chemotherapy vs. no recent cytotoxic chemotherapy§	1.38 (1.16 to 1.64)	1.49 (1.16 to 1.91)
Recent targeted therapy vs. no recent targeted therapy§	1.17 (0.97 to 1.42)	0.96 (0.72 to 1.29)
Recent endocrine therapy vs. no recent endocrine therapy§	0.85 (0.69 to 1.03)	0.74 (0.54 to 1.02)
Recent immunotherapy vs. no recent immunotherapy§	1.19 (0.92 to 1.54)	1.10 (0.76 to 1.60)
Recent locoregional therapy vs. no recent locoregional therapy§	1.10 (0.90 to 1.35)	1.22 (0.90 to 1.66)
Other recent anti-cancer therapy vs. no other recent anti-cancer therapy§	1.10 (0.70 to 1.73)	1.12 (0.55 to 2.25)
No anti-cancer therapy, ever vs. >3 months before COVID-19 diagnosis	0.95 (0.75 to 1.20)	0.88 (0.62 to 1.24)
Country of residence, outside US vs. US	0.98 (0.74 to 1.29)	0.72 (0.47 to 1.11)
Month of COVID-19 diagnosis		
May–Aug 2020 vs. Jan–Apr 2020	0.47 (0.41 to 0.53)	0.35 (0.29 to 0.43)
Sep–Dec 2020 vs. Jan–Apr 2020	0.30 (0.25 to 0.35)	0.25 (0.19 to 0.33)
Jan–Apr 2021 vs. Jan–Apr 2020	0.52 (0.44 to 0.62)	0.36 (0.27 to 0.48)
May–Jun 2021 vs. Jan–Apr 2020	1.64 (0.87 to 3.08)	0.33 (0.08 to 1.25)

Data are odds ratio (95% confidence interval).

* Six-level ordinal scale based on a patient's most severe reported disease status. Odds ratios greater than 1 indicate higher COVID-19 severity. Adjusted for all variables listed.

† Odds ratios greater than 1 indicate higher odds of 30-day all-cause mortality. Adjusted for all variables listed.

‡ Includes two or more solid tumors or hematological neoplasms.

§ Within 3 months prior to COVID-19 diagnosis.

Figure S1: Adjusted associations of demographic and clinical factors with COVID-19 severity and 30-day all-cause mortality among older adults with cancer.

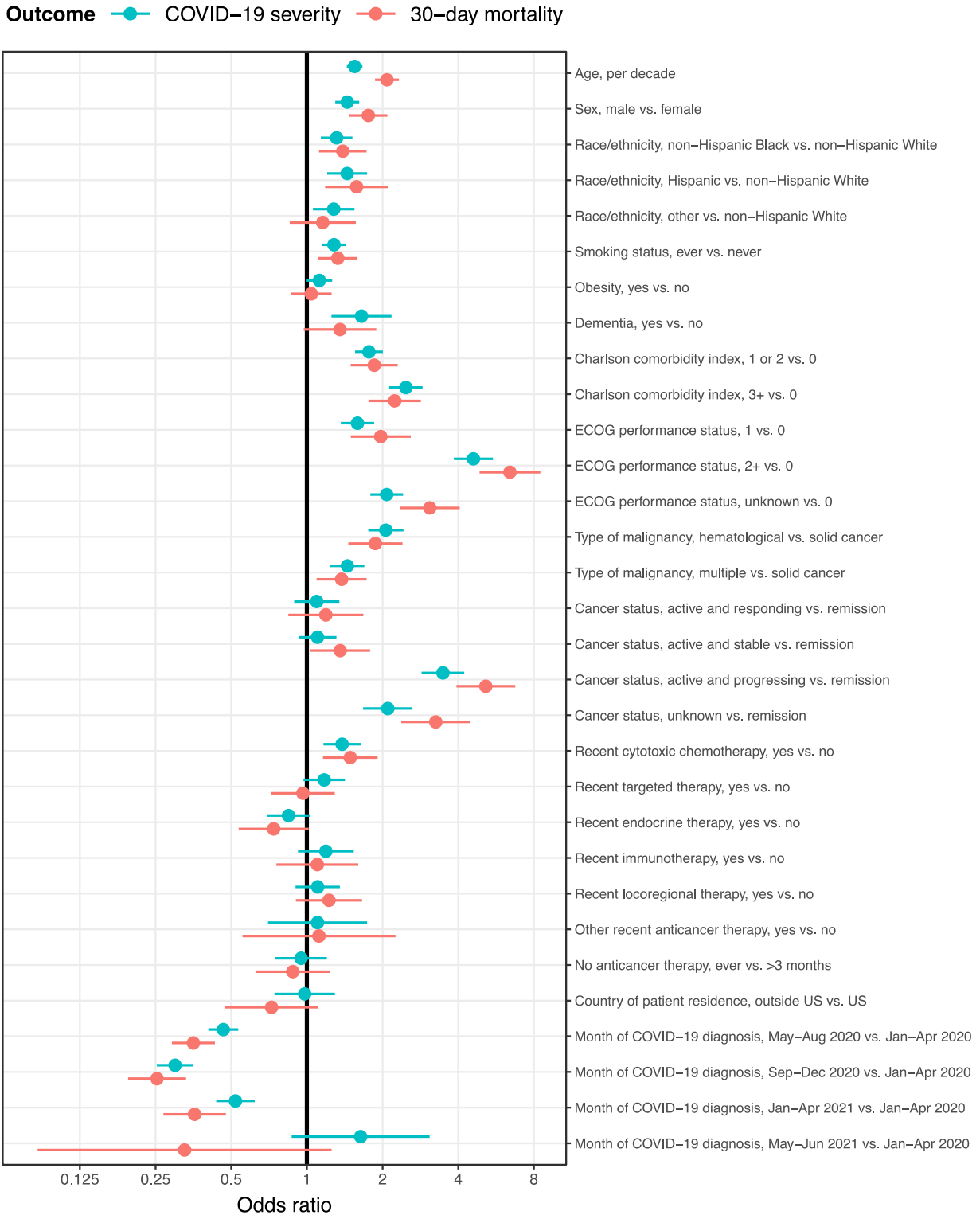


Figure S2: Proportion of the model's chi-square statistic for each variable included in multivariable models for COVID-19 severity and 30-day all-cause mortality.

