COVID-19 in patients with and without cancer: Examining differences in patient characteristics and outcomes

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Abstract

This study examines differences between patients with and without cancer in patient demographic and clinical characteristics and COVID-19 mortality and discusses the implications of these differences in relation to existing cancer disparities and COVID-19 vulnerabilities. Data was collected as a part of a retrospective study on a cohort of COVID-19 positive patients across Mount Sinai Health System from March 28, 2020 to April 26, 2020. Descriptive, comparative, and regression analyses were applied to examine differences between patients with and without cancer in demographic and clinical characteristics and COVID-19 mortality and whether cancer status predicts COVID-19 mortality controlling for these covariates using SAS 9.4. Results showed that, of 4641 patients who tested positive for COVID-19, 5.1% (N=236) had cancer. The median age of the total sample was 58 years (Q1-Q3: 41–71); 55.3% were male, 19.2% were current/former smokers, 6.1% were obese. The most commonly reported comorbidities were hypertension (22.6%) and diabetes (16.0%). Overall, the COVID-19 mortality rate was 8.3%. Examining differences between COVID-19 patients with and without cancer revealed significant differences (p<0.05) in COVID-19 mortality, hospitalization rates, age, gender, race, smoking status, obesity, and comorbidity indicators (e.g., diabetes) with cancer patients more

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Conflicts of Interest

The authors declare no potential conflicts of interest.

likely to be older, male, black, obese, smokers, and with existing comorbidities. Controlling for these clinical, demographic, and behavioral characteristics, results of logistic regression analyses showed significant effects of older age and male gender on COVID-19 mortality (p<0.05). While cancer patients with COVID-19 were more likely to experience worse COVID-19 outcomes, these associations might be related to common cancer and COVID-19 vulnerability factors such as older age and gender. The coexistence of these vulnerability age and gender factors in both cancer and COVID-19 populations emphasizes the need for better understanding of their implications for cancer and COVID-19 disparities, both diseases prevention efforts, policies, and clinical management.

Keywords

Infection; Virus; Pandemic; Cancer; Disparities; Survival

Introduction

Coronaviruses are a large family of viruses that include the 2019 SARS-CoV-2 that causes the COVID-19 disease [1–4]. As of November 19, 2020, over 53.7 million cases have been confirmed globally; 10,641,431 of which have been reported in the United States (US) [5]. Global death toll is 1.3 million deaths, of which the US has reported 242,542 deaths [5]. Although several studies have reported the epidemiological [6–8] and clinical [9,10] characteristics of infected patients, limited data on the impact of COVID-19 on cancer patients have been documented.

As more data on COVID-19 emerges, increasing evidence points to the possibility of disease inequalities as evident from higher incidence and mortality rates observed among racial/ethnic minorities and individuals from lower socio-economic and poorer geographic areas [11–13]. Observed risk factors of COVID-19 includes older age (>65 years), male gender, obesity, respiratory diseases, and active smoking status [13]. Historical accounts of other infectious diseases demonstrates that socioeconomic determinants of health (e.g., race, socioeconomic status) create behavioral risk factors (e.g., hygiene, smoking) and environmental conditions (e.g., neighborhoods with poor air and housing quality) that may increase the transmission of infectious diseases, thus, further contributing to unequal burdens of morbidity and mortality specially in individuals physically burdened with existing health conditions and chronic diseases (e.g., cancer, HIV, Asthma) [14–16].

While health disparities in COVID-19 patients continue to be examined by ongoing research efforts, health disparities in cancer patients are well documented based on patient age, gender, and race/ethnicity factors [17,18]. Cancer is a major public health problem worldwide and is the second leading cause of death in the US. In 2020, 1,806,590 new cancer cases and 606,520 cancer deaths are projected to occur in the US [17]. Although clinical reports suggest increased vulnerability to COVID-19 in cancer patients possibly due to COVID-19 related risk factors common in cancer patient populations (e.g., older age, male gender, and compromised immune system by chemotherapies and radiation therapies), more research in COVID-19 infected cancer patients is needed to confirm these associations

[18]. As the pandemic continues to evolve, it is necessary to identify cancer patients' risk factors (e.g., demographics, behavioral, and clinical characteristics) contributing to their increased vulnerability to COVID-19. In this study, we plan to examine differences between COVID-19 patients with and without cancer in demographics (e.g., age, gender, and race), clinical (e.g., comorbidities), and behavioral characteristics (e.g., smoking, obesity) as explore whether cancer diagnosis predict COVID-19 mortality controlling for potential demographics, behavioral, and clinical covariates.

Methods

Sources of patient data

Data was collected as a part of a retrospective study on a cohort of patients examined for COVID-19 across the Mount Sinai Health System (MSHS). Testing was performed only on patients who had fever or signs/symptoms suggestive of respiratory illness and either a history of travel to affected areas (e.g., China, Japan, Italy, South Korea, Iran), or direct contact with a confirmed case of COVID-19 infection in the prior 2 weeks. All patients who tested positive for this disease across MSHS from March 28, 2020 to April 26, 2020 were included in this analysis. COVID-19 testing was performed in MSHS through respiratory specimens that were evaluated by real-time RT-PCR methods. The RT-PCR assay was conducted in accordance with the protocol established by the World Health Organization [19].

De-identified COVID-19 patient datasets are made available daily by the Scientific Computing department to the Mount Sinai research community at the Mount Sinai Data Warehouse (MSDW) [https://msdw.mountsinai.org/]. Data collected include information on patient demographics, comorbidities, body-mass index, smoking status, date of COVID-19 diagnosis, hospitalization, day of discharge, or date of death. As the MSDW provides de-identified data, the Ethics Committee of MSHS approved a waiver of documentation of informed consent. All human subjects research was conducted in accordance with the ethical standards of the Icahn School of Medicine at Mount Sinai (ISMMS) Institutional Review Board and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Statistical analyses

Data were summarized as median (interquartile range) for continuous variables and as frequency (%) for categorical variables. We examined bivariate associations between the demographic, behavioral, and clinical variables among COVID-19 positive patients overall stratified by cancer status (yes, no). We also used bivariate analyses to examine associations between cancer status and COVID-19 mortality, discharge, time to death or discharge and cancer using Chi-square ($\chi2$) or Fisher's exact tests for categorical variables and Wilcoxon Rank Sum Tests or Kruskal-Wallis Tests for continuous variables. In order to examine whether cancer status predicts COVID-19 mortality controlling for patient demographic, clinical, and behavioral covariates, we used a series of multivariate logistic regression analyses controlling for the covariates associated with COVID-19 mortality at a predefined

significance level α=0.10 were associated with mortality in the bivariate assessment. All statistical analyses were performed using SAS 9.4 and plots were generated using R 3.6.

Results

As of April 26, 2020, there were 4,641 cases of positive COVID-19 cases. Summarized in Table 1 is the distribution of demographic, behavioral and clinical factors overall and stratified by cancer status (see Supplementary Table S1 for the distribution of cancer sites) among COVID-19 patients. The median age was 58 years (IQR, 41–71), 55.3% were male, 48.6% were of African American descent or Hispanic/Latino ethnicity, 19.2% were current/former smokers, and 6.1% were obese. The majority had at least one underlying comorbidity (e.g., hypertension, diabetes, chronic obstructive pulmonary disease (COPD)). COVID-19 mortality rate reported during the observation period of this study is 8.3% (N=386). Among those who survived COVID-19, 45.3% were discharged, 9.0% were outpatients, and 37.4% remained hospitalized at the time of this analysis.

Results of bivariate assessments between demographic, clinical and behavioral factors and cancer status are shown in Table 1. Cancer patients in our study were more likely to be infected by (but not die from) COVID-19 if they are older than 65, smoker, and have comorbid disease including asthma, chronic obstructive pulmonary disease (COPD), hypertension, obesity, diabetes and HIV compared to non-cancer patients. (P<0.05). Mortality differences were noted for COVID-19 patients with other disease (Table 2 and Figure 1). For instance, COVID-19 patients with hypertension are more likely to die compared to patients who have no comorbid hypertension. We observed a statistically significant difference in the sum of comorbid diseases among cancer and non-cancer patients (p<0.001). Specifically, cancer patients were more likely to have at least 1 comorbid condition in comparison to non-cancer patients. Close to 50% of cancer patients stayed hospitalized compared to 36.9% of the non-cancer group; and more than one-tenth (12.3%) of those with cancer died during the study observation period as compared to 8.1% of patients with no cancer.

All variables under consideration were associated with mortality in general at the α=0.10 level except for race/ethnicity (p=0.68), asthma (p=0.35) and HIV (p=0.69; Table 2). Almost one-fifth (17.0%) of patients aged 65 years and older died as compared to 5.7% and 0.4% among 45–<65-year-olds and <45-year-olds, respectively (p<0.001). Approximately 9.2% of males died compared with 7.4% among females (p=0.030). Slightly higher proportions of Whites (8.9%), those of African diasporic ancestry (8.6%), those of Asian ancestry (9.5%) died compared to Hispanic/Latinx (7.8%) and Other/Unknown (7.5%) racial/ethnic groups (p=0.68). Approximately 11.8% of current/former smokers died compared to 8.0% of non-smokers and 6.7% of those with unknown smoking status (p<0.001). Additionally, more patients (22.8%) with COPD died compared to 8.0% of those without COPD (p<0.001). Compared to those without hypertension, more patients with hypertension died (15.2% vs 6.3%, p<0.001). Similarly, more deaths were observed among patients with diabetes (14.9% vs 7.1%, p<0.001) and patients with cancer (12.3% vs 8.1%, p=0.023).

Our unadjusted and adjusted logistic regression models are shown in Figure 1a and Figure 1b, respectively. Variables significantly associated with COVID-19 mortality in our bivariate analyses at the α=0.10 level were included in our adjusted model: cancer status, age group, sex, smoking status, diabetes, COPD, obesity, and hypertension. The results of adjusted logistic regression showed that age and sex are significant predictors of COVID-19 mortality. Specifically, the adjusted odds of dying for the middle-aged and oldest age groups were 14.95-fold (95% CI=6.05–36.97) and 49.19- fold (95% CI=20.14–120.14) higher than that observed among the youngest age group. Males had 1.46-fold (95% CI=1.17–1.83) higher adjusted odds of dying with COVID-19 in comparison to females. Additionally, the adjusted odds of dying with COVID-19 were 1.65-fold (95% CI=0.99–2.74) higher for patients with COPD as compared to the non-COPD group, 1.32-fold (95% CI=1.00–1.74) higher for patients with hypertension as compared to those without hypertension, 1.27-fold (95% CI=0.95–1.70) higher for patients with diabetes compared to those without diabetes, and 1.15-fold (95% CI=0.75–1.75) higher for patients who were obese compared to patients who were not obese. Race/ethnicity, smoking status and cancer status were not significantly associated with mortality in our model.

Discussion

In this paper, we examined differences between COVID-19 patients with and without cancer in clinical, demographic, and behavioral characteristics and COVID-19 mortality. In line with emerging global data on COVID-19 risk factors and vulnerabilities, the median age of our patient cohort was 58 years, and the majority were male which confirms the age and gender reported COVID-19 vulnerabilities. Our data also indicated that almost one-quarter of COVID-19 patients had hypertension, about one-fifth were smokers, 16% had diabetes, 5.7% had cancer, and 4% had asthma, thus, supporting the associations between existing comorbidities and increased risk of COVID-19. While we acknowledge that major inequalities in COVID-19 incidence (i.e., between individuals who tested positive for COVID-19 and those who tested negative for this disease) may exist, examining these inequalities is beyond the scope of this study. Our focus here is to understand how cancer patients with COVID-19 differ from other COVID-19 patients with no cancer history or diagnosis and whether these differences are conceptually related to factors associated with existing cancer disparities.

Over the past decades, research provided evidence for cancer related disparities in several patient sub-populations (e.g., age and racial minorities, patients with low SES, patients residing in rural areas) [20]. Confirming emerging data from multiple cancer registries (e.g., the COVID-19 and Cancer Consortium [21], the American Association for Cancer Research (AACR)-COVID-19 Consortium, and the American Society of Clinical Oncology (ASCO) COVID-19 Consortium), we have found significant differences between COVID-19 patients with and without cancer in mortality and demographic, clinical and behavioral characteristics associated with cancer disparities. Cancer patients were more likely to be male, racial/ethnic minorities, active or former smokers, obese, and with comorbid diseases. However, regression analyses showed that only older age, male gender, obesity, COPD, diabetes, and hypertension significantly predicted COVID-19 mortality. Although cancer

status did not predict mortality, these results reflect common characteristics that render cancer patients more vulnerable to COVID-19 mortality and worse cancer outcomes.

Previous studies in other pandemics (e.g., Ebola, tuberculosis) have identified significant links between socioeconomic determinants of health including poverty, race, ethnicity, social marginalization, and physical environment to infectious diseases [22–26]. Quinn et al., [27] created empirical measures for exposure to pandemics, susceptibility, and access to care, and used these measures in Influenza pandemic (H1N1) data collection in 2009 in the US. Their findings demonstrate a significant potential for existing socioeconomic disadvantages to contribute to a greater burden of morbidity and mortality from H1N1, thereby exacerbating health disparities. Participants with higher levels of exposure due to lack of access to resources that would enable social distancing reported having had influenza and were also more likely to have less access to clinical care once disease developed [27,28]. Further evidence by Quinn et al. suggests that absence of workplace policies (paid sick days) contributes to a population attributable risk of 5 million additional H1N1 cases in the general population and 1.2 million additional cases among Hispanics [27,28]. In New York City, individuals living in more affluent neighborhoods (e.g. Lower Manhattan; average income of $118,166) were able to practice social distancing sooner, and thus, experienced lower rates of COVID-19, compared to those living in economically disadvantaged neighborhoods (e.g. Queens-Jackson Heights, average per capita income of $26,708) [29].

COVID-19 has introduced new challenges for cancer patients, their family caregivers, and their clinical providers across the cancer care continuum. Cancer patients presenting at clinics and hospitals for treatment and follow-up clinical care might have increased exposure to COVID-19 infected patients and clinical personnel leading to increased risk of COVID-19, morbidity, and mortality. Increasing evidence from epidemiological studies and anecdotal reports indicate that COVID-19 negatively influence cancer patients' clinical management, treatment and health outcomes. To reduce the risk of exposure, difficult clinical decisions must be made by physicians following new guidelines about whom, how and when they provide cancer treatment and follow-up care [30,31]. However, delays in cancer management may lead to missed therapeutic window, and increased risks of cancer progression to metastasis and poor treatment outcomes. For patients experiencing metastatic or recurrent cancer, considerations should include how such delays may lead to immediate need for hospital-based palliative care [31]. For patients receiving chemotherapy, immunotherapy or those who have undergone recent surgery for tumor removal, the risks are even higher because of the compromised immune system. Reinforcement of strict social distancing policies, although efficient in reducing risk of exposure, are likely to increase patient clinical care needs (managing comorbidities), financial needs (loss of job/medical insurance), psychosocial needs (social isolation), thus leading to worse quality of life in a population already burdened by cancer [32–34].

Amid the pandemic, several hospitals and clinics in the US have adopted a Telehealth care delivery approach; however, such shifts in care delivery approaches may pose significant challenges especially for patients with limited access to the internet or with less computer skills [35]. For patients participating in cancer clinical trials, forced "physical distancing" policies or quarantine complicates hospital attendance for continuity in clinical care. If

these patients experience complications or need urgent care, clinical management might be delayed (e.g., travel-ban or COVID-19 hospital policies), thus leading to potentially significant deterioration in patient health [36,37].

In summary, the present work emphasizes the importance and implications of factors associated with disparities among cancer patients with COVID-19. We recognize however that our study has several limitations. First, this is a single institute study covering one month only. Second, because clinical information, particularly regarding time of cancer diagnosis, chemotherapy or other treatment (e.g., going for a transplant) and COVID-19 symptom severity was unavailable in this de-identified data set, it was difficult to assess differences by symptom severity, cancer treatment, or time since diagnosis. Third, the data was unbalanced, with the majority of patient being non-cancer patients. Our future studies will allow for appropriate matched cohorts analyses based on essential clinical (e.g., comorbidities, compromised immune system) and demographic (e.g., age, gender, race) factors as numbers of cancer patients with COVID-19 are increasing. Additionally, the small number of patients within the cancer site groups do not allow for meaningful cancer group comparisons in all data collected for this study. Our study, however, emphasize the importance of further examining vulnerabilities of cancer patients conferred by COVID-19 as these associations can potentially exacerbate existing cancer disparities. Additional investigative efforts into other prognostic factors are needed to advance our knowledge of the extent of the clinical burden by COVID-19 in cancer.

Practice Implications

Comprehensive national examination of the impact of COVID-19 on populations already affected by inequities and disparities would inform health equity surveillance systems that could be used to guide new policies and health care strategies. Routine data collection of determinants of health within electronic medical records are necessary to optimize the quality of analysis concerning health inequities [38–40]. In turn, an improved surveillance system will ensure appropriate prevention strategies, timely detection and management of this COVID-19 in underserved populations including cancer patients [38–40].

Conclusion

There is limited knowledge on the impact of COVID-19 on the clinical outcomes of infected patients with cancer and the added burden of this pandemic to existing cancer disparities. Our study findings emphasize the need for further research to explore the magnitude and long-term impact of COVID-19 on cancer patients' outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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(a)

	OR	(95% CI)
Age		
65+ yrs. vs <45 yrs.	55.10	(22.69–133.81)
45– <65yrs. vs <45yrs.	16.19	(6.56–39.97)
Sex		
Male vs Female	1.26	(1.02–1.56)
Smoking Status		
Current/former smoker vs Non–Smoker	1.55	(1.2–1.99)
Unknown vs Non–Smoker	0.85	(0.66–1.1)
COPD		
Yes vs No	3.37	(2.09–5.43)
HTN		
Yes vs No	2.64	(2.12–3.27)
Diabetes		
Yes vs No	2.29	(1.81–2.9)
Obesity		
Yes vs No	1.43	(0.98–2.1)
Cancer		
Yes vs No	1.58	(1.05–2.36)

−0.5 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5
log(Unadjusted OR)

(b)

	OR	(95% CI)
Age		
65+ yrs. vs <45 yrs.	49.19	(20.14–120.14)
45– <65yrs. vs <45yrs.	14.95	(6.05–36.97)
Sex		
Male vs Female	1.46	(1.17–1.83)
Smoking Status		
Current/former smoker vs Non–Smoker	0.93	(0.71–1.23)
Unknown vs Non–Smoker	1.11	(0.84–1.48)
COPD		
Yes vs No	1.65	(0.99–2.74)
HTN		
Yes vs No	1.32	(1.00–1.74)
Diabetes		
Yes vs No	1.27	(0.95–1.7)
Obesity		
Yes vs No	1.15	(0.75–1.75)
Cancer		
Yes vs No	0.85	(0.56–1.29)

−0.5 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5
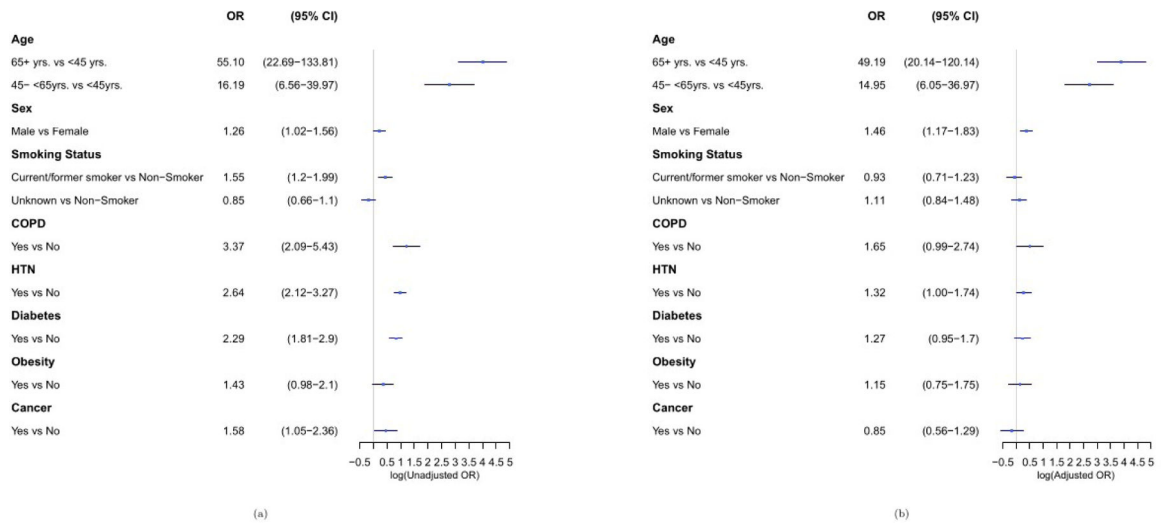log(Adjusted OR)

Figure 1:
Results of unadjusted (a) and adjusted (b) logistic regression analyses examining the contribution of cancer, as well as demographics, behavioral factors, and comorbidities to the odds of mortality among COVID-19 positive patients. Variables were included in this analysis if they were associated with mortality at the $\alpha = 0.10$ level in bivariate assessments.

Table 1:

Distribution of demographics, smoking status, comorbidities, and outcomes among COVID-19 positive patients overall and stratified by Cancer (Yes/No), n=4641.

Variable	Sub-categories	Overall (n=4641)	Cancer=No (n=4405)	Cancer=Yes (n=236)	p-value
Age		58 (41–71)	57 (40–70)	69 (61–78)	<0.001
Age Categories	<45 yrs.	1347 (29.0%)	1329 (30.2%)	18 (7.6%)	<0.001
	45- <65 yrs.	1585 (34.2%)	1524 (34.6%)	61 (25.9)	
	65+ yrs.	1709 (36.8%)	1552 (35.2%)	157 (66.5%)	
Sex [1]	Female	2046 (44.1%)	1946 (44.2%)	100 (42.4%)	0.41
	Male	2569 (55.35%)	2433 (55.2%)	136 (57.6%)	
Race/Ethnicity	African ancestry	1180 (25.4%)	1114 (25.3%)	66 (28.0%)	0.002
	White	1187 (25.6%)	1125 (25.5%)	62 (26.3%)	
	Hispanic/Latinx	1075 (23.2%)	1006 (22.8%)	69 (29.2%)	
	Asian	189 (4.1%)	177 (4.0%)	12 (5.1%)	
	Other/Unknown	1010 (21.8%)	983 (22.3%)	27 (11.4%)	
Smoking Status	Non-Smoker	2325 (50.1%)	2190 (49.7%)	135 (57.2%)	<0.001
	Current/former smoker	891 (19.2%)	797 (18.1%)	94 (39.8%)	
	Unknown	1425 (30.7%)	1418 (32.2%)	7 (3.0%)	
Asthma	No	4454 (96.0%)	4236 (96.2%)	218 (92.4%)	0.004
	Yes	187 (4.0%)	169 (3.8%)	18 (7.6%)	
COPD	No	4540 (97.8%)	4318 (98.0%)	222 (94.1%)	<0.001
	Yes	101 (2.2%)	87 (2.0%)	14 (5.9%)	
HTN	No	3594 (77.4%)	3476 (78.9%)	118 (50.0%)	<0.001
	Yes	1047 (22.6%)	929 (21.1%)	118(50.0%)	
Obesity	No	4358 (93.9%)	4146 (94.1%)	212 (89.8%)	0.007
	Yes	283 (6.1%)	259 (5.9%)	24 (10.2%)	
Diabetes	No	3896 (83.9%)	3733 (84.7%)	163 (69.1%)	<0.001
	Yes	745 (16.0%)	672 (15.3%)	73 (30.9%)	
HIV	No	4570 (98.5%)	4345 (98.6%)	225 (95.3%)	<0.001

Variable	Sub-categories	Overall (n=4641)	Cancer=No (n=4405)	Cancer=Yes (n=236)	p-value
Deceased	Yes	71 (1.5%)	60 (1.4%)	11 (4.6%)	
	No	4255 (91.7%)	4048 (91.9%)	207 (87.7%)	0.023
Discharge & Deceased Combined	Yes	386 (8.3%)	357 (8.1%)	29 (12.3%)	
	Died	386 (8.3%)	357 (8.1%)	29 (12.3%)	
	Outpatient	417 (9.0%)	397 (9.0%)	20 (8.5%)	
	Not Discharged	1737 (37.4%)	1625 (36.9%)	112 (47.5%)	<0.001
	Discharged	2101 (45.3%)	2026 (46.0%)	75 (31.8%)	
Comorbidity SUM		0 (0–1)	0 (0–1)	1 (0–2)	<0.001

Data were summarized as median (Q1–Q3) for continuous variables and as frequency (row%) for categorical variables.

[1]Missing info for SEX for 26 (0.17%) in Overall and 26 (100%) for Deceased=No.

Table 2:

Distribution of demographics, behavioral factors, and comorbidities by deceased status (n=4641).

Variable	Sub-categories	Overall (n=4641)	Cancer=No (n=4405)	Cancer=Yes (n=236)	p-value
Age		58 (41–71)	57 (40–70)	69 (61–78)	<0.001
Age Categories	<45 yrs.	1347 (29.0%)	1329 (30.2%)	18 (7.6%)	<0.001
	45- <65 yrs.	1585 (34.2%)	1524 (34.6%)	61 (25.9)	
	65+ yrs.	1709 (36.8%)	1552 (35.2%)	157 (66.5%)	
Sex [1]	Female	2046 (44.1%)	1946 (44.2%)	100 (42.4%)	0.41
	Male	2569 (55.35%)	2433 (55.2%)	136 (57.6%)	
Race/Ethnicity	African ancestry	1180 (25.4%)	1114 (25.3%)	66 (28.0%)	0.002
	White	1187 (25.6%)	1125 (25.5%)	62 (26.3%)	
	Hispanic/Latinx	1075 (23.2%)	1006 (22.8%)	69 (29.2%)	
	Asian	189 (4.1%)	177 (4.0%)	12 (5.1%)	
	Other/Unknown	1010 (21.8%)	983 (22.3%)	27 (11.4%)	
Smoking Status	Non-Smoker	2325 (50.1%)	2190 (49.7%)	135 (57.2%)	<0.001
	Current/former smoker	891 (19.2%)	797 (18.1%)	94 (39.8%)	
	Unknown	1425 (30.7%)	1418 (32.2%)	7 (3.0%)	
Asthma	No	4454 (96.0%)	4236 (96.2%)	218 (92.4%)	0.004
	Yes	187 (4.0%)	169 (3.8%)	18 (7.6%)	
COPD	No	4540 (97.8%)	4318 (98.0%)	222 (94.1%)	<0.001
	Yes	101 (2.2%)	87 (2.0%)	14 (5.9%)	
HTN	No	3594 (77.4%)	3476 (78.9%)	118 (50.0%)	<0.001
	Yes	1047 (22.6%)	929 (21.1%)	118(50.0%)	
Obesity	No	4358 (93.9%)	4146 (94.1%)	212 (89.8%)	0.007
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Variable	Sub-categories	Overall (n=4641)	Cancer=No (n=4405)	Cancer=Yes (n=236)	p-value
Deceased	No	4255 (91.7%)	4048 (91.9%)	207 (87.7%)	0.023
	Yes	386 (8.3%)	357 (8.1%)	29 (12.3%)	
Discharge & Deceased Combined	Died	386 (8.3%)	357 (8.1%)	29 (12.3%)	<0.001
	Outpatient	417 (9.0%)	397 (9.0%)	20 (8.5%)	
	Not Discharged	1737 (37.4%)	1625 (36.9%)	112 (47.5%)	
	Discharged	2101 (45.3%)	2026 (46.0%)	75 (31.8%)	
comorbidity SUM		0 (0–1)	0 (0–1)	1 (0–2)	<0.001

Data were summarized as median (Q1–Q3) for continuous variables and as frequency (row%) for categorical variables.

[1]Missing info for SEX for 26 (0.17%) in Overall and 26 (100%) for Deceased=No.