

Descriptive Assessment of Race, Ethnicity, Comorbidities, and SARS-CoV-2 Infection-Fatality in North Carolina

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BACKGROUND SARS-CoV-2 infection has caused variable clinical outcomes including hospitalization and death. We analyzed state-level data from the North Carolina COVID-19 Surveillance System (NC COVID) to describe demographics of those infected with SARS-CoV-2 and to describe factors associated with infection-fatality in North Carolina.

METHODS This was a retrospective cohort study using surveillance data on positive SARS-CoV-2-infected individuals (N = 214,179) identified between March 1, 2020, and September 30, 2020. We present descriptive statistics and associations among demographics, medical comorbidities, and SARS-CoV-2 infection-fatality.

RESULTS Median age for residents with reported SARS-CoV-2 was 38 (IQR 23–54). Age was strongly correlated with SARS-CoV-2 infection-fatality. Greater infection-fatality was noted among those who identified as Black across all comorbidities. Coexisting chronic disease was associated with greater infection-fatality, with kidney disease demonstrating the strongest association.

LIMITATIONS A high percentage of missing data for race/ethnicity and comorbidities limits the interpretation of our findings. Data were not available for socioeconomic measures that could aid in better understanding inequities associated with SARS-CoV-2 infection-fatality.

CONCLUSIONS Among North Carolinians identified with SARS-CoV-2 via surveillance efforts, age, race, and comorbidities were associated with infection-fatality; these findings are similar to those of studies using different source populations in the United States. In addition to age and other nonmodifiable variables, systematic differences in social conditions and opportunity may increase the risk of SARS-CoV-2 infection-fatality among Black Americans compared to other races/ethnicities.

Coronavirus disease 2019 (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), had resulted in over 800,000 recorded deaths in the United States alone by the end of 2021 [1].

While many individuals with SARS-CoV-2 infection experience mild symptoms, some people experience acute, severe illness, which can result in death [2]. Recent data have demonstrated that the United States has higher COVID-19 mortality rates compared with other countries, and researchers speculate that this may be partially due to the high rates of comorbidities in the United States compared to other countries [3].

Studies on patients hospitalized with COVID-19 have repeatedly demonstrated an association between COVID-19 fatality and both age and gender [4–6]. Studies conducted among patients hospitalized with COVID-19 have also pointed to increased death in those with comorbidities; however, there has not been full agreement on which comorbidities are most important. For example, in a study including hospital-level data from 12 states [7], odds of death from COVID-19 were highest among individuals with coronary artery disease, whereas in a study of data from over 5900 patients in a single urban medical center in New York, odds of death from COVID-19 were highest among individuals with kidney disease and

second highest among individuals with dementia [8]. Characteristics associated with COVID-19 fatalities in hospitalized patients may be different from those associated with SARS-CoV-2 infection-fatalities identified through statewide surveillance data.

North Carolina, with a population of 10.5 million people, has a significant rural population and a growing older adult population (17% aged 65 years or older) with 13% of residents living in poverty [9, 10]. The state's most represented racial/ethnic categories include White non-Hispanic (63%), Black (22%), and Hispanic (10%) [10]. The North Carolina Department of Health and Human Services (NCDHHS) reports that over half (51%) of North Carolina's population is potentially at greater risk for poor outcomes related to SARS-CoV-2 infection due to age and/or having one or more underlying health conditions [11]. Although vaccinations are underway, understanding which factors are most associated with COVID-19-related death in North Carolina remains important for several reasons. First, some individuals who

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are at higher risk of death from COVID-19 are electing not to receive the vaccine. Second, as of this writing variants of SARS-CoV-2 continue to develop across the globe. Third, this information may aid in state-specific prevention, surveillance, and intervention strategies for future pandemics or other public health crises. Thus, using state-level surveillance data during the COVID-19 pandemic, we describe the demographics of those infected with SARS-CoV-2 and determine factors associated with infection-fatality in North Carolina residents.

Methods

Design and Setting

Our goal was to describe data, including the amount of missing data, collected as part of our state's SARS-CoV-2 surveillance system. As a descriptive study, we did not aim to generate or test hypotheses. This retrospective cohort study used surveillance data and included all reported SARS-CoV-2-infected North Carolina residents based on specimen collection dating from March 1 to September 30, 2020 (N = 214,179). SARS-CoV-2-infected individuals are defined as those having a positive reverse-transcriptase polymerase chain reaction (PCR) or antigen test result [12]. Data were provided in December 2020 and included deaths through November 2020. This descriptive assessment presents: 1) demographics and characteristics of North Carolina residents with reported SARS-CoV-2 infection; 2) SARS-CoV-2 infection-fatality rate from time of specimen collection using Kaplan-Meier curves stratified by race/ethnicity, age, sex, and the presence of comorbid health conditions; and 3) age-standardized infection-fatality rates within 30 days of specimen collection by race/ethnicity with and without comorbid conditions. This study was deemed exempt from further review by the University of North Carolina at Asheville Institutional Review Board.

Data Source and Elements

Under a data use agreement with NCDHHS, deidentified individual-level data were acquired from the North Carolina COVID-19 Surveillance System (NC COVID) that included the dates of SARS-CoV-2 test specimen collection; resident age, sex, race, ethnicity, ZIP code, and county; death attributed to COVID-19 (yes/no); date of death; and presence of 6 comorbidities: cardiovascular disease (CVD, includes congenital heart disease), chronic lung disease (includes emphysema/chronic obstructive pulmonary disease, asthma/reactive airway disease, cystic fibrosis, history of smoking, and other chronic lung diseases), diabetes, kidney disease (includes nephrotic syndrome, chronic renal failure, and other kidney diseases), immunosuppressive conditions, and metabolic disorders (inborn error of metabolism and other metabolic disorders). Our team was also able to speak with 1 health department staff member and others involved in the COVID-19 data collection effort to provide some context as to how the processes changed over time. This was

helpful when considering the likely reasons for the large amount of missing data.

Statistical Analyses

Demographics and comorbidities were categorized and presented as counts and percentages of total infected individuals. As race and ethnicity measures were separately identified, we used the approach adopted by the Agency for Healthcare Research and Quality in defining a combined race/ethnicity categorization [13, 14]: 1) Hispanic (including individuals with recorded Hispanic ethnicity equal to yes, regardless of recorded race, including missing race); 2) Black, non-Hispanic (including individuals with recorded Black or African American race and Hispanic ethnicity equal to no or unknown); 3) White, non-Hispanic (including individuals with recorded White race and Hispanic ethnicity equal to no or unknown); 4) Other non-Hispanic (individuals with race noted to be American Indian/Alaskan Native, Asian, Native Hawaiian, or "Other," with Hispanic ethnicity marked as no or unknown); 5) missing race, non-Hispanic (including individuals where race was unknown and Hispanic ethnicity was equal to no or unknown). A more complete description of race and ethnicity categories for infected individuals is listed in Appendix 1.

APPENDIX 1

Race and Ethnicity of North Carolina Residents with Reported SARS-CoV-2 Infections with Specimen Collections Between March 1, 2020, and September 30, 2020

This appendix is available in its entirety in the online edition of the NCMJ.

The presence of each assessed comorbidity (CVD, chronic lung disease, diabetes, kidney disease, immunosuppressive conditions, and metabolic disorders) is shown as yes, no, or missing, as reported in the NC COVID system. Due to potential difficulties in clarifying the metabolic disorders category (for example, distinguishing different metabolic disorders from diabetes), analyses for metabolic disorders are shown in Appendix figures and tables only.

Kaplan-Meier curves illustrate the time from specimen collection of a SARS-CoV-2-positive test result to an infection-related fatality within specific strata. To ensure that the study outcome—death—occurred following SARS-CoV-2 specimen collection, infected individuals who had a date of death prior to (n = 22) or on the day of (n = 52) specimen collection were excluded from this analysis, the latter because time of test was unavailable. Individuals were censored for the time-to-event analysis on October 30, 2020 (30 days following the last included specimen collections) or at death due to a non-COVID-related cause (n = 101 individuals with death after specimen collection). The Kaplan-Meier curve graphs include the number of people at risk (the denomina-

tor) at 30-day intervals along their horizontal axis. Curves are truncated at 200 days post-specimen collection. We used a log rank test statistic for each of the Kaplan-Meier curves in order to statistically describe significant differences (at the $P < .05$ level) among any of the lines included in each graph.

As the majority of deaths occurred within the first 30 days following specimen collection, a dichotomous outcome variable of SARS-CoV-2 infection-fatality within 30 days of specimen collection was also created to calculate age-standardized infection-fatality. For this dichotomous outcome, in addition to excluding infected individuals with a date of death prior to or on the day of specimen collection, 67 individuals were excluded who had a non-SARS-CoV-2-associated death in the 30 days following specimen collection.

As age distributions within different race/ethnicity groups and in those with and without comorbidities were quite different, infection-fatalities were age-standardized (using 5-year age intervals through age 85+) to the full North Carolina SARS-CoV-2-infected population used in this study. Using the North Carolina SARS-CoV-2-infected population for age standardization allows one to make estimates and draw comparisons regarding how many deaths may have been observed had all North Carolina infected individuals been Black non-Hispanic residents versus if all had been Hispanic residents versus White non-Hispanic residents. Age-standardized infection-fatalities are shown as deaths per 1000 reported SARS-CoV-2-infected individuals. All analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC).

Results

There were 214,179 total SARS-CoV-2-infected North Carolina residents captured in the NC COVID system during this study time interval (Table 1). The largest racial/ethnic demographic was White non-Hispanic ($n = 77,876$, 36.4%), followed by Hispanic ($n = 49,105$, 22.9%), and then Black non-Hispanic ($n = 39,407$, 18.4%). The full race and ethnicity data from our cohort can be found in Appendix 1; notably, race was missing for 18.2% of infected individuals and Hispanic ethnicity was unknown for 30.0% of infected individuals.

The median age of all infected individuals was 38 (IQR 23–54) with 9.5% aged 70 or older and 13.4% aged 65 or older. Hispanic infected individuals had a lower median age (34, IQR 21–45) as compared to Black non-Hispanic (42, IQR 27–58), and White non-Hispanic infected individuals (43, IQR 24–61).

Cardiovascular disease was the most common comorbidity (marked as present/yes in 9.6%), followed by diabetes (8.2%) and chronic lung disease (7.0%). A high level of missing data was observed for all comorbidities ranging from 47% missing for immunosuppressive conditions to 55% missing for metabolic disorders (metabolic disorder data is in Appendix 2A). Black non-Hispanic infected indi-

APPENDIX 2 Metabolic Disorder in North Carolina Residents with Reported SARS-CoV-2 Infection with Specimen Collection Between March 1, 2020, and September 30, 2020

This appendix is available in its entirety in the online edition of the NCMJ.

viduals tended to have an overall higher prevalence of these comorbidities as compared to White non-Hispanic infected individuals at all age groups.

Kaplan-Meier curves for SARS-CoV-2-associated deaths demonstrated differences in infection-fatality over time for different race/ethnicity groups (Figure 1). Black non-Hispanic infected individuals and White non-Hispanic infected individuals showed the most infection-fatality, followed by “other race” non-Hispanic infected individuals. Infection-fatality was lowest among Hispanic individuals and for those with race data missing ($P < .001$). The most pronounced association was observed for age, with older age groups having higher infection-fatality. Slightly increased infection-fatality over time was observed for males.

Increased SARS-CoV-2 infection-fatality was found for those having any of the comorbidities assessed, with those noted to have kidney disease showing the highest infection-fatality (Figure 2).

Age-standardized SARS-CoV-2 infection-fatalities 30 days from specimen collection were highest overall for Black non-Hispanic individuals at 23.2 (95% CI, 21.7–24.6) deaths per 1000 SARS-CoV-2-positive individuals (Figure 3 and Appendix 3). The second-highest rates were observed in White non-Hispanic individuals at 16.4 (95% CI, 15.6–17.1) deaths per 1000 SARS-CoV-2-positive individuals, followed by Hispanic individuals (14.2 per 1000; 95% CI, 11.8–16.7), “other race,” non-Hispanic individuals (13.1 per 1000; 95% CI, 11.1–15.1), and “missing race,” non-Hispanic individuals (6.5 per 1000; 95% CI, 5.5–7.6). For all race/ethnicity groups, kidney disease showed the highest age-standardized infection-fatality ranging from 101.4 deaths (95% CI, 71.6–131.2) per 1000 Black non-Hispanic SARS-CoV-2 positive individuals to 36.4 deaths (95% CI, 17.7–55.0) per 1000 for “other” non-Hispanic individuals. The presence of any of

APPENDIX 3 Age-Standardized SARS-CoV-2 Infection-Fatality Within 30 Days of Specimen Collection for Positive Test, Age-Standardized to the Population of North Carolina Residents with a Reported SARS-CoV-2 Infection with Specimen Collection Dates Between March 1, 2020, and September 30, 2020

This appendix is available in its entirety in the online edition of the NCMJ.

TABLE 1.
Demographics and Comorbidities, Separated by Race/Ethnicity, of North Carolina Residents with Reported SARS-CoV-2 Infection, with Specimen Collection Dates Between March 1, 2020, and September 30, 2020

	Total 214,179		Black, NH 39,407 (18.4%)		Hispanic 49,105 (22.9%)		White, NH 77,876 (36.4%)		Other, NH 15,417 (7.2%)		Missing, NH 32,374 (15.1%)	
	n	%	n	%	n	%	n	%	n	%	n	%
Median age, (IQR)	38	(23-54)	42	(27-58)	34	(21-45)	43	(24-61)	35	(22-52)	35	(22-51)
Age groups	—		—		—		—		—		—	
0-29	77,430	36.2%	11,841	30.0%	20,453	41.7%	25,796	33.1%	6154	39.9%	13,186	40.7%
30-54	83,240	38.9%	15,632	39.7%	23,600	48.1%	25,333	32.5%	5903	38.3%	12,772	39.5%
55-69	33,222	15.5%	7710	19.6%	4128	8.4%	14,896	19.1%	2188	14.2%	4300	13.3%
70+	20,278	9.5%	4224	10.7%	924	1.9%	11,849	15.2%	1171	7.6%	2110	6.5%
Missing	9	0%	0	0%	0	0%	2	0%	1	0%	6	0%
Sex	—		—		—		—		—		—	
Female	111,693	52.1%	22,592	57.3%	23,990	48.9%	41,207	52.9%	8423	54.6%	15,481	47.8%
Male	101,129	47.2%	16,598	42.1%	24,808	50.5%	36,304	46.6%	6937	45.0%	16,482	50.9%
Missing	1357	0.6%	217	0.6%	307	0.6%	365	0.5%	57	0.4%	411	1.3%
Cardiovascular disease	—		—		—		—		—		—	
Yes	20,522	9.6%	6279	15.9%	2119	4.3%	10,004	12.8%	1211	7.9%	909	2.8%
No	83,545	39.0%	15,151	38.4%	23,815	48.5%	33,922	43.6%	5218	33.8%	5439	16.8%
Missing	110,112	51.4%	17,977	45.6%	23,171	47.2%	33,950	43.6%	8988	58.3%	26,026	80.4%
Chronic lung disease	—		—		—		—		—		—	
Yes	14,989	7.0%	3897	9.9%	2019	4.1%	7419	9.5%	935	6.1%	719	2.2%
No	86,978	40.6%	16,675	42.3%	23,925	48.7%	35,440	45.5%	5354	34.7%	5584	17.2%
Missing	112,212	52.4%	18,835	47.8%	23,161	47.2%	35,017	45.0%	9128	59.2%	26,071	80.5%
Diabetes	—		—		—		—		—		—	
Yes	17,545	8.2%	5300	13.4%	3456	7.0%	6813	8.7%	1126	7.3%	850	2.6%
No	86,596	40.4%	16,161	41.0%	23,250	47.3%	36,283	46.6%	5353	34.7%	5549	17.1%
Missing	110,038	51.4%	17,946	45.5%	22,399	45.6%	34,780	44.7%	8938	58.0%	25,975	80.2%
Kidney disease	—		—		—		—		—		—	
Yes	4110	1.9%	1494	3.8%	344	0.7%	1872	2.4%	236	1.5%	164	0.5%
No	94,539	44.1%	18,385	46.7%	25,121	51.2%	39,333	50.5%	5819	37.7%	5881	18.2%
Missing	115,530	53.9%	19,528	49.6%	23,640	48.1%	36,671	47.1%	9362	60.7%	26,329	81.3%
Immunosuppression	—		—		—		—		—		—	
Yes	8103	3.8%	2098	5.3%	1003	2.0%	3915	5.0%	521	3.4%	566	1.7%
No	105,854	49.4%	19,893	50.5%	28,292	57.6%	43,539	55.9%	6791	44.0%	7339	22.7%
Missing	100,222	46.8%	17,416	44.2%	19,810	40.3%	30,422	39.1%	8105	52.6%	24,469	75.6%

Hispanic ethnicity missing counted as non-Hispanic; Other includes American Indian/Alaskan Native, Asian, Native Hawaiian, and any separately noted "Other" race (which includes more than one race). For more detailed information, please see Supplement 1.
 IQR=interquartile range; NH=non-Hispanic

the comorbidities was associated with a higher age-standardized infection-fatality rate as compared to not having the condition or having information missing for the condition. Black non-Hispanic infected individuals had the highest age-standardized infection-fatality rate for each of the assessed comorbidities.

Discussion

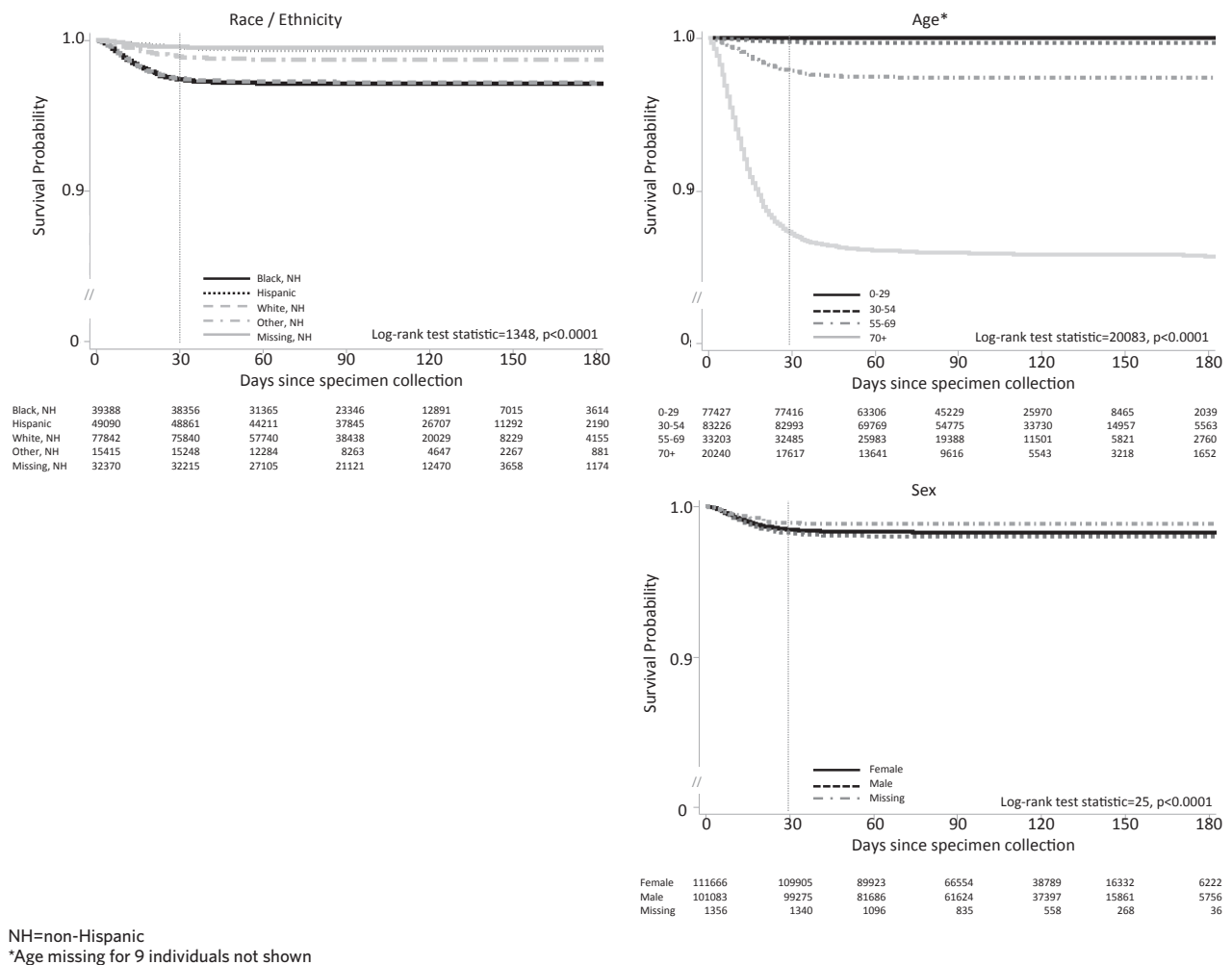
This study describes demographics, the presence of comorbidities, and infection-fatality among North Carolina residents identified as infected with SARS-CoV-2 via the state's surveillance efforts. Numerous other studies that have analyzed COVID-19 death in hospitalized patients [4-6, 15-17] demonstrate that age, and less so sex, was associated with increased SARS-CoV-2 infection-fatality.

Results from the current study demonstrate several key

findings related to race and ethnicity. First, as has been demonstrated in a county-level surveillance assessment in Fulton County, Georgia, this study found higher age-standardized SARS-CoV-2 infection-fatality in Black non-Hispanic infected individuals as compared to White non-Hispanic and Hispanic infected individuals, both overall and with the noted presence of comorbidities [18]. Additionally, data from this study indicate that the presence of comorbidities differed by race and ethnicity, with Black non-Hispanic and Hispanic infected individuals having higher proportions of comorbidities across all age groups. These findings were noted in other studies as well [8, 19], highlighting longstanding health inequities; Black non-Hispanic infected individuals were more likely to have comorbidities and showed higher infection-fatality risk with comorbidities [20].

Lower SARS-CoV-2 infection-fatality was found in this

FIGURE 1.
Kaplan-Meier Curves Showing SARS-CoV-2 Infection-Fatality by Strata – Race/Ethnicity, Age, and Sex



study for Hispanic infected individuals as compared to White non-Hispanic infected individuals. This may be attributed to differences in testing strategies among specific groups that focused on outbreaks at workplaces or residential settings as the pandemic progressed in North Carolina. Lower infection-fatality among infected Hispanic individuals was also observed in a study where authors used county-level SARS-CoV-2 data from Fulton County, Georgia [18]. While our study found lower SARS-CoV-2 infection-fatality among infected Hispanic individuals, other studies assessing COVID-19 mortality have overwhelmingly found higher mortality due to COVID-19 in Hispanic populations [21-23]. The findings present in other studies may be driven in part by the higher infection rates per population due to social and structural vulnerabilities, including the need to continue working in occupations with higher risks of SARS-CoV-2 exposure throughout the pandemic [24].

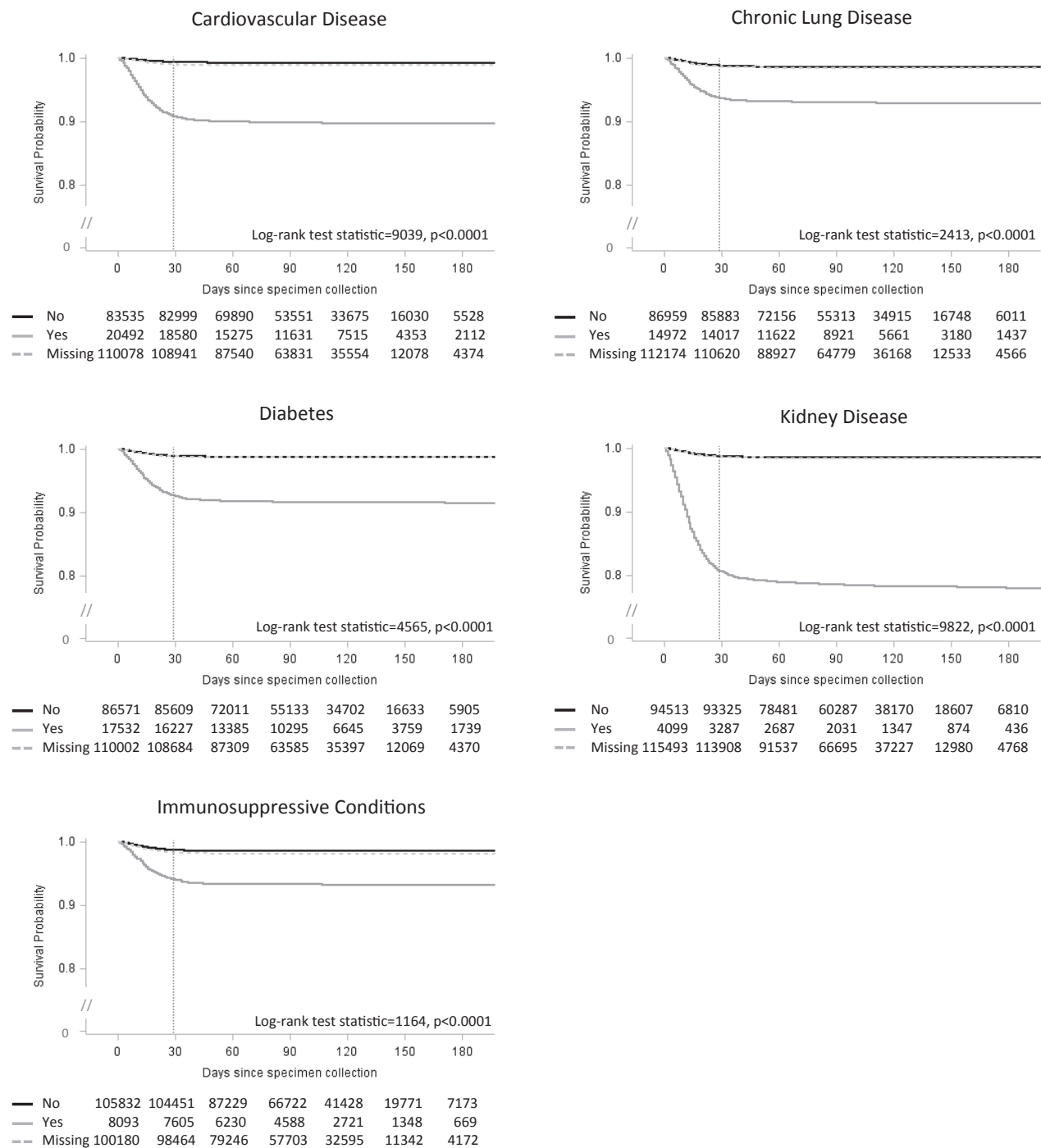
When comparing the race/ethnicity of SARS-CoV-2 infections to the racial makeup of the state population, our sample of the Hispanic population has a disproportionately high

number of individuals with reported SARS-CoV-2 infections, followed by the Black non-Hispanic population, as compared to the White non-Hispanic population. Additionally, data from our study indicate differences in age distributions of those infected with SARS-CoV-2 by race and ethnicity. Specifically, Black non-Hispanic and Hispanic infected individuals in this sample tended to be younger than infected individuals who were White non-Hispanic. These results add to the findings by Turner and colleagues that in North Carolina, not only are Black non-Hispanic and Hispanic individuals disproportionately affected by SARS-CoV-2 infection, but younger Black non-Hispanic and Hispanic individuals are disproportionately affected [25].

Age was highly correlated with SARS-CoV-2 infection-fatality in North Carolina, findings that are consistent with prior studies on COVID-19-associated death in hospitalized populations and infection-fatality identified using surveillance data [4-6, 15, 18].

All chronic diseases analyzed were associated with increased SARS-CoV-2 infection-fatality in this North

FIGURE 2.
Kaplan-Meier Curves Showing SARS-CoV-2 Infection-Fatality in Those With and Without Reported Comorbidities



Carolina-based sample. These results coincide with prior analyses of associations of chronic diseases and COVID-19 death in both hospitalized populations [8, 26] and in a county-level surveillance assessment in Fulton County, Georgia [18]. We found that those with kidney disease had the highest infection-fatality. Similarly, a meta-analysis examining 11 chronic conditions among 25 studies found the highest average risk ratio for death from COVID-19 among

individuals with kidney disease [27]. However, in another review of 41 studies, kidney disease was the third most strongly correlated with death from COVID-19, following cardiovascular and cerebrovascular disease [28]. Others have likewise demonstrated greater COVID-19 fatality as the number of coexisting comorbidities increased [17]. In our North Carolina sample, individuals with kidney disease were more likely to have multiple other comorbidities compared

to individuals with other forms of chronic disease (data not shown). This may partly explain the larger association with infection-fatality.

Our results further demonstrate that older individuals, especially those with comorbidities, may be at greatest risk of death if infected with SARS-CoV-2. This finding may add further support to the preferential vaccination rollout efforts to protect such individuals when supplies and resources are limited. As North Carolina continues to make efforts to protect and care for people during the pandemic, older adults and those with chronic kidney disease may be of particular interest as an at-risk population based on our retrospective analysis.

Results from this study are limited by missing and incomplete data, in part due to time and resource restrictions as infections quickly increased across North Carolina and individual public health department staff members' need to engage in this work within their own contexts and resource constraints. Thus, contacting infected individuals and connecting them with resources and support may have been prioritized above the collection of ancillary data. Infection-fatality estimates by race/ethnicity may be influenced by the sizable proportion for whom race/ethnicity was not identified in this data set. Infection-fatality estimates for those with an identified race/ethnicity may be over or underestimates, based upon the composition among those with missing race/ethnicity. Additionally, differences in reported infected individuals by race/ethnicity were likely influ-

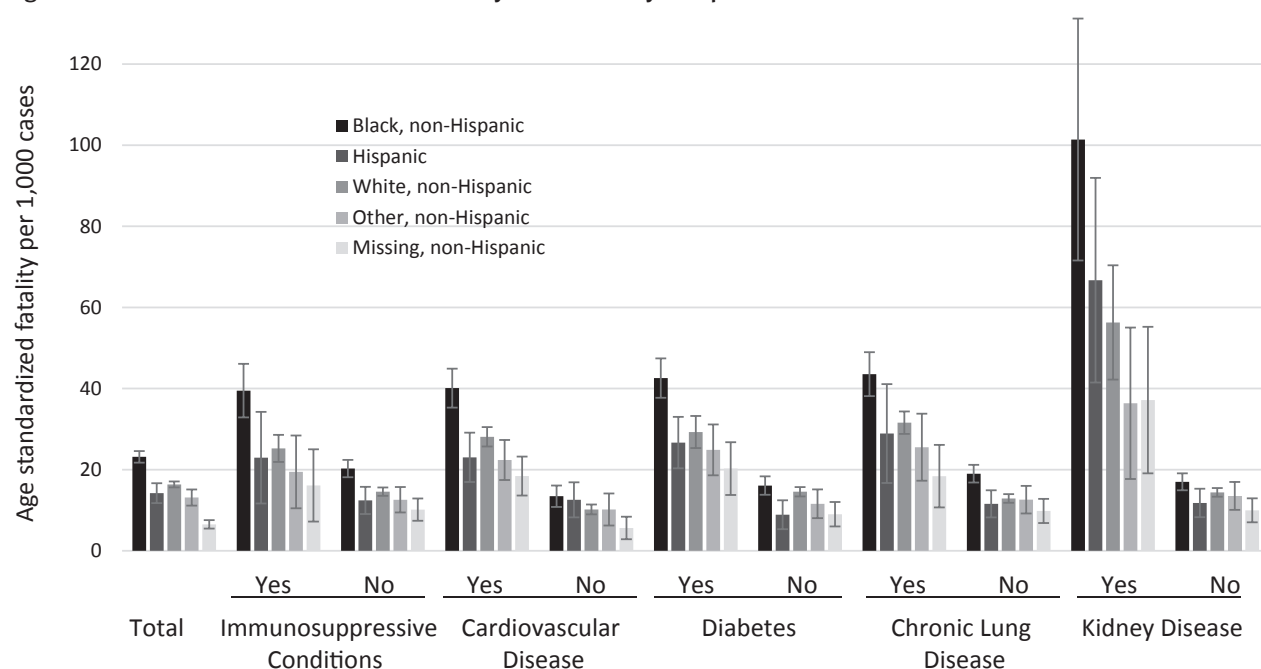
enced by various testing campaigns related to facility outbreaks (such as meatpacking factories, prisons, and nursing homes). This may have led to certain groups having more identified and reported asymptomatic infections in healthy workers.

Despite these limitations, a strength of the current study is its focus on state-level, surveillance-based data in North Carolina for factors associated with SARS-CoV-2 infection-fatality. Many previous studies have assessed comorbidity in hospitalized patients, excluding both healthier patients who do not present to the hospital and the sickest patients who may choose not to seek hospital-based end-of-life care. In addition, care was taken not to draw conclusions that may be misleading or inappropriate. As such, this study represents rich, descriptive, correlational data that will be useful for practitioners and policymakers in North Carolina as they consider the next steps in the COVID-19 response as well as future pandemic planning. In addition to providing information on factors associated with SARS-CoV-2 infection-fatality, this study showed how academic and state partners can work together to use surveillance data during a pandemic.

Conclusions

Among a surveillance system-based sample of North Carolinians with SARS-CoV-2 infection, race/ethnicity, age, and comorbidities (most notably kidney disease) were associated with infection-fatality in a similar manner to studies assessing COVID-19 fatality in hospitalized patient popu-

FIGURE 3.
Age-Standardized^a SARS-CoV-2 Infection-Fatality Within 30 Days of Specimen Collection with 95% Confidence Intervals



^aAge-standardized to the population of North Carolina residents with a reported SARS-CoV-2 infection with specimen collection between March 1, and September 30, 2020.

lations in the United States. These findings suggest that in addition to age and other nonmodifiable variables, systematic differences in social conditions and opportunity may increase the risk of SARS-CoV-2 infection-fatality among Black Americans compared to other races/ethnicities. Results from this study also contribute to the growing body of evidence supporting prevention and treatment for non-White individuals for chronic and infectious diseases. **NCMJ**

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APPENDIX 1.**Race and Ethnicity of North Carolina Residents with Reported SARS-CoV-2 Infections with Specimen Collections Between March 1, 2020, and September 30, 2020**

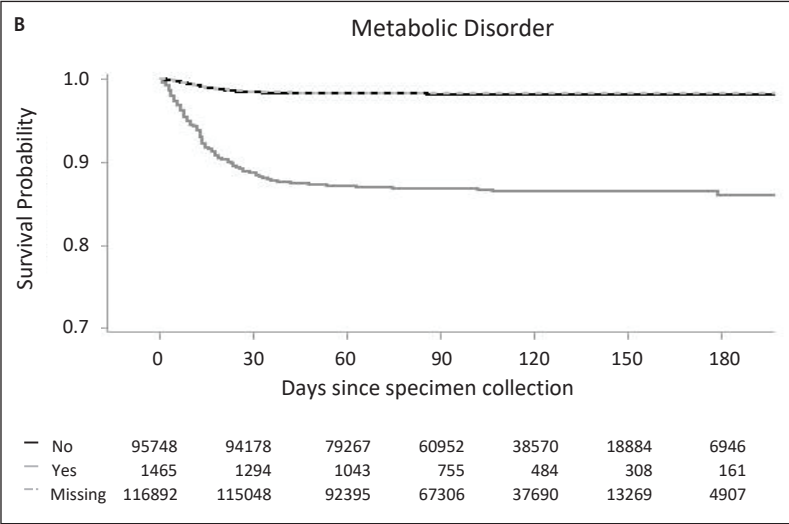
Race	Ethnicity			Total
	Hispanic	Not Hispanic	Missing	
American Indian/Alaskan Native	185	1592	961	2738
Asian	53	2401	923	3377
Black/African American	930	30,275	9132	40,337
Native Hawaiian/ Pacific Islander	86	179	47	312
White	23,679	60,448	17,428	101,555
Other	17,476	4358	4956	26,790
Missing	6696	1479	30,895	39,070
Total	49,105	100,732	64,342	214,179

APPENDIX 2.
Metabolic Disorder in North Carolina Residents with Reported SARS-CoV-2 Infection, with Specimen Collection Between March 1, 2020, and September 30, 2020

- A) Reported presence of metabolic disorder for SARS-CoV-2-infected individuals.
B) Kaplan-Meier curves showing SARS-CoV-2 infection-fatality.
C) Age-standardized* SARS-CoV-2 infection-fatality within 30 days of specimen collection for positive test.

A

	n	%
	214,179	
Metabolic disorder	—	—
Yes	1,468	0.7%
No	95,774	44.7%
Missing	116,937	54.6%



C

—	Black, non-Hispanic			Hispanic			White, non-Hispanic			Other, non-Hispanic			Missing, non-Hispanic		
	# Total	# Died	fatality per 1000 ^a	# Total	# Died	fatality per 1000 ^a	# Total	# Died	fatality per 1000 ^a	# Total	# Died	fatality per 1000 ^a	# Total	# Died	fatality per 1000 ^a
Comorbidities															
Metabolic Disorder															
Yes	314	41	59.6	151	9	39.7	841	105	34.1	81	4	24.8	73	7	33.9
No	19,003	444	22.8	25,135	110	13.1	39,785	878	16.4	5877	75	15.0	5922	54	11.3
Missing	20,055	539	22.8	23,803	116	14.7	37,172	992	15.7	9453	90	11.7	26,364	90	5.0

^aAge-standardized to the population of North Carolina residents with a reported SARS-CoV-2 infection with specimen collection between March 1 and September 30, 2020

APPENDIX 3.**Age-Standardized SARS-CoV-2 Infection-Fatality Within 30 Days of Specimen Collection for Positive Test, Age-Standardized to the Population of North Carolina Residents with a Reported SARS-CoV-2 Infection with Specimen Collection Dates Between March 1, 2020, and September 30, 2020**

—	Black, non-Hispanic			Hispanic			White, non-Hispanic			Other, non-Hispanic			Missing, non-Hispanic		
	# Total	# Died	fatality per 1000 ^a	# Total	# Died	fatality per 1000 ^a	# Total	# Died	fatality per 1000 ^a	# Total	# Died	fatality per 1000 ^a	# Total	# Died	fatality per 1000 ^a
Comorbidities															
Total	39,372	1024	23.2	49,089	235	14.2	77,798	1975	16.4	15,411	169	13.1	32,359	151	6.5
Cardiovascular Disease															
Yes	6261	582	40.1	2116	70	23.0	9967	1097	28.1	1208	84	22.4	908	60	18.4
No	15,149	122	13.4	23,810	78	12.6	33,908	283	10.2	5216	29	10.2	5437	16	5.6
Missing	17,962	320	18.1	23,163	87	13.1	33,923	595	12.6	8987	56	9.1	26,014	75	4.4
Chronic Lung Disease															
Yes	3892	271	43.6	2018	28	28.9	7400	592	31.6	934	39	25.5	718	23	18.4
No	16,666	303	19.0	23,919	100	11.6	35,416	565	12.9	5351	54	12.6	5582	42	9.8
Missing	18,814	450	20.7	23,152	107	13.6	34,982	818	14.3	9126	76	10.8	26,059	86	4.9
Diabetes															
Yes	5289	490	42.6	3454	107	26.7	6797	600	29.3	1123	65	24.9	849	39	20.3
No	16,155	202	16.1	23,244	55	8.9	36,253	615	14.6	5351	42	11.6	5547	35	9.0
Missing	17,928	332	18.1	22,391	73	12.6	34,748	760	13.7	8937	62	9.5	25,963	77	4.4
Kidney Disease															
Yes	1481	331	101.4	342	33	66.7	1859	386	56.3	235	25	36.4	163	22	37.2
No	18,379	279	17.0	25,115	95	11.8	39,305	703	14.4	5816	61	13.5	5879	44	10.0
Missing	19,512	414	19.3	23,632	107	14.3	36,634	886	14.9	9360	83	11.3	26,317	85	4.8
Immunosuppressive Conditions															
Yes	2092	163	39.5	1003	23	23.0	3904	264	25.2	521	19	19.5	565	15	16.1
No	19,884	363	20.3	28,286	112	12.4	43,510	775	14.6	6787	64	12.6	7337	53	10.1
Missing	17,396	498	22.9	19,800	100	15.5	30,384	936	16.8	8103	86	12.6	24,457	83	4.8