Ohio Journal of Public Health, Vol. 6, Issue 1 ISSN: 2578-6180

RESEARCH ARTICLE

The Role of Comorbid Conditions and Socioeconomic Factors in Mortality for Patients Hospitalized with COVID-19

Roberta E. Redfern[1]; Camelia Arsene[1,2]; Lance Dworkin[3]; Shipra Singh[1]; Amala Reddy Ambati[3]; Lukken Imel[3]; Alexandria A. Williamson[1]; Sadik Khuder[1,3]

[1]Department of Population Health, College of Health and Human Services, University of Toledo, Toledo, OH
[2]ProMedica Cancer Institute, ProMedica Health System, Toledo, OH
[3]Department of Medicine, University of Toledo College of Medicine and Life Sciences, Toledo, OH

Corresponding Author: Alexandria A. Williamson, 2801 W. Bancroft Street, Toledo, OH 43606, (330) 635-8068, williamson.alexx@gmail.com
Submitted September 23, 2022 Accepted July 29, 2023 Published September 13, 2023 https://doi.org/10.18061/ojph.v6i1.9247

ABSTRACT

Background: The emergence of COVID-19 as a global pandemic has provided yet another example of how racial and social factors can exacerbate health disparities and disproportionately affect minority populations. The goal of the current study was to understand how some of these factors impacted survival in patients hospitalized with COVID-19 in Northwest Ohio during the first year of the pandemic.

Methods: This study was a retrospective review of patient data from a single health care system. Electronic medical records were queried to obtain information on patients who were admitted to the hospital and had a laboratory-confirmed COVID-19 infection during their admission. Different predictors were included in the final Cox proportional hazard regression model.

Results: There were 3468 patients included in the analyses with an all-cause mortality rate of 18.5%. On average, White patients were older on admission with higher rates of mortality than patients who were Black or of "Other" races (19.8% versus 12.5% and 11.0%, respectively, $p < .001$). Mortality rates varied significantly by insurance status, with the highest mortality rates observed in the Medicare and "Other" categories (27.1% and 16.5%, respectively). Cox proportional hazard regression model also found race and insurance status to be associated with survival.

Conclusion: Considering race and preexisting conditions adjusted for age in a cohort of patients with COVID-19 reveals that insurance payor is significantly associated with mortality. Those who did not have commercial or public insurance had significantly increased risk of mortality compared to those with commercial insurance.

Keywords: All-cause mortality; Medicaid/Medicare; Social determinants of health; Socioeconomic status; Health disparities

INTRODUCTION

As of March 10, 2023, the United States (US) has confirmed over 676 million cases of COVID-19 caused by SARS-CoV-2 and over 6 million deaths.[1] The COVID-19 pandemic has caused not only physical suffering but other hardships as well. Since the start of the pandemic, millions of people have lost jobs, applied for unemployment assistance, delayed medical care, and had difficulty paying for routine household expenses.[2] Job loss caused by the COVID-19 pandemic has disrupted health coverage for millions of people. Preliminary administrative data for the federal Medicaid program showed enrollment increased by 17 million people (23.9%) between February 2020 and April 2022.[3]

Even though COVID-19 vaccinations are widely available, people in the US continue to be affected by the pandemic. The COVID-19 pandemic has exacerbated health disparities and affected minority populations disproportionately.[4] For example, the Centers for Disease Control and Prevention (CDC) reported overrepresentation of Black patients with COVID-19, as Black individuals make up 18% of the US population but account for 33% of COVID-19-related hospital admissions.[5] It has been suggested that the reason for the disproportionate impact of COVID-19 on Black populations is socioeconomic disparities and higher rates of comorbid conditions such as obesity, diabetes mellitus, cardiovascular disease, and hypertension.[4] According to the US Census Bureau's Household Pulse Survey, Black and Hispanic adults have fared worse than White adults in nearly all survey measures. For example, in April 2021, 64% of Black and 70% of Hispanic adults reported difficulty paying household expenses compared to 42% of White adults, while 14% of Black adults and 16% of Hispanic adults reported household food insecurity compared to 5% of White adults.[6] Furthermore, Black and Hispanic individuals were almost 3 times as likely as White individuals to be hospitalized and 2 times as likely to die due to COVID-19.[7,8] Race, ethnicity, and socioeconomic status are social constructs, often used as proxies for racism that, along with other factors such as occupational exposure to the SARS-CoV-2 virus and access to health care, influence health outcomes.[9]

People of color are also significantly more likely to be uninsured compared to White individuals, resulting in a group of people who are more likely to become ill but less likely to seek medical care.[10] While social determinants of health disparities existed before the pandemic, the differences in COVID-19 outcomes have further exposed these disparities.

This study examined to what extent demographic factors, health status, and health insurance type predicted the survival of patients who were hospitalized for any reason and tested positive for COVID-19 during the early phases of the pandemic in a single health care system serving mainly Northwest Ohio.

METHODS

This retrospective cohort study was based on data from patients served by a single health care system serving mainly Northwest Ohio.

Participants

Eligible participants included all patients who were hospitalized between March 2020 and January 2021 and underwent SARS-CoV-2 polymerase chain reaction (PCR) testing during their admission with a positive result. Patients were included regardless of reason for admission; elective surgeries and other admissions with incidental findings of COVID-19 infection were included.

Procedures

The institutional electronic medical records were queried to gather data, as was the institution's prospectively maintained COVID-19 registry. Patient baseline characteristics were collected including sex, age, race, ethnicity, BMI, zip code of residence, insurance status, admission and discharge date, and discharge disposition. Date of admission and discharge were used to calculate hospital length of stay. Multiple admissions per patient were observed during the period of interest and were categorized as all-cause readmissions. Insurance status was further categorized as Commercial (covered by employer or self-purchased), Medicaid, Medicare, or Other (self-pay, military/veteran insurance, and third-party liability payors). The prospectively maintained COVID-19 database included information regarding ventilator use during admission and comorbidities including previous diagnosis of atrial fibrillation, acute myocardial infarction, anemia, asthma, chronic kidney disease, chronic obstructive pulmonary disorder, congestive heart failure, type 2 diabetes, dementia, depression, hyperlipidemia, hypertension, ischemic heart disease, malnutrition, obesity, osteoarthritis, and stroke. Medical records were manually reviewed to collect missing data when not available in the initial data query. In cases where BMI at admission was greater than or equal to 30 kg/m^2 and no diagnosis of obesity was recorded, patient obesity status was updated. Comorbid conditions were used with age to calculate a limited Charlson Comorbidity Index (CCI) score. Since not all conditions included in that index were available, the limited CCI included age, acute myocardial infarction, cancer, cerebrovascular disease, congestive heart failure, chronic kidney disease, chronic obstructive pulmonary disease, dementia, and type 2 diabetes.

Measures

Patient vital status was the main outcome of interest; all-cause mortality was used for patient status and was not limited to mortality suspected to be related to COVID-19 infection. Status was ascertained by the electronic medical records and discharge disposition. Medical records were examined manually to determine the last date of contact or known date of vital status. Patient status was considered "unknown" and censored from analysis unless an electronic local obituary could be located, matching patient name, date of birth, and city of residence. The percentage of patients with "unknown" status was approximately 5%.

Statistical Analysis

Patient characteristics were presented as descriptive statistics and continuous variables were compared using [Student] t test. Chi-square tests were used to compare categorical variables. Survival curves were drawn using Kaplan–Meier estimates. A Cox proportional hazards regression model adjusting for patient characteristics, limited CCI, comorbidities not included in the CCI score, race, and insurance payor type was created to investigate predictors of mortality.

The model initially included all variables that were not collinear, and Akaike information criterion (AIC) in stepwise regression was used to create a model that included the best-fitting variables. The

final model included limited CCI score, race, sex, hyperlipidemia, obesity, ventilator use, and insurance payor. The variables were analyzed against the Black race and commercial insurance categories as references. Age has been excluded from the final model in order to avoid the effect of collinearity because the limited CCI includes age.

SAS (Version 9.2, SAS Institute Inc., Cary, NC, USA) and R (Version 4.1.0, The R Foundation for Statistical Computing, Vienna, Austria) were used for data analysis. In all tests, a 2-tailed p value less than .05 was considered statistically significant.

Institutional review board approval was obtained prior to data collection and written informed consent was waived due to the retrospective nature of the study.

RESULTS

A total of 3468 patients were admitted to 1 of 12 hospitals in the health care system during the study period. Baseline patient characteristics are shown in Table 1. The average age of those in the cohort was 65 years and the sex distribution was even with 50.9% of the cohort being male. The majority of the patient population was White and not Hispanic/Latino. Most of the cohort had public insurance (Medicaid or Medicare).

The distribution of payor status was investigated by age group and race in a stratified chi-square test (Table 2). In the youngest category of patients, the "Other" race category had the highest proportion of both commercial and other insurance status, while Black patients had the highest percentage of Medicaid insurance. In the 35-49 years age group, the White population had the highest proportion of commercial insurance, while the Black population had the highest proportion of both Medicaid and Medicare. Similarly, in the 50-64 years age group, the White population had the highest rate of commercial insurance, while the "Other" race category had the highest percent of commercial insurance in the 65-79 years age group. Unsurprisingly, nearly all individuals in the 80+ years age group, regardless of race, had Medicare.

The prevalence of comorbid conditions on admission was also investigated by insurance payor status, all of which varied significantly by payor. Most comorbidities were more common in those with Medicare insurance; of the 17 comorbidities investigated, only asthma, depression, hyperlipidemia, hypertension, and obesity were more common in another insurance payor type. Depression and obesity were least prevalent in those with "Other" insurance, while hypertension and hyperlipidemia were least prevalent in those with Medicaid (Table 3).

On chi-square analysis, those with Medicare (27.1%) and "Other" insurance (16.5%) experienced higher rates of mortality than those with commercial or Medicaid insurance ($p < .001$) (Figure 1). The log rank test result for the Kaplan-Meier survival curve had a p value of less than .0001 (Appendix). White patients had higher rates of all-cause mortality (19.8%) than Black patients (12.5%) or those whose race was categorized as "Other" (11.0%, $p < .001$) (Figure 1). The log rank test result for the Kaplan-Meier survival curve had a p value of less than .0001 (Appendix).

All-cause mortality occurred more frequently in males ($p = .002$) and those over 65 years of age ($p < .001$) (Figure 1).

In the final Cox proportional hazard regression model limited CCI, White race, ventilator use, Medicare insurance, and "Other" insurance were significantly associated with survival (Table 4). The unadjusted models are presented in the Appendix. The need for a ventilator was the strongest predictor of all-cause mortality, HR 4.25 (95% CI 3.61-5.0, $p < .001$). Compared to commercial insur-

Table 1. Patient Demographic Information and Clinical Characteristics

Patient Characteristic	Mean ± Standard Deviation
Age (years)	65.0 ± 17.1
Black	58.7 ± 17.6
White	66.6 ± 16.6
Other	59.6 ±18.5
BMI (kg/m^2)	32.7 ± 9.2
Length of stay (days)	8.3 ± 8.1
Limited Charlson Comorbidity Index (CCI)	4.74 ± 2.59
Sex	Frequency (%)
Female	1702 (49.1)
Male	1766 (50.9)
Race	
Black	489 (14.1)
White	2879 (83.0)
Other	100 (2.9)
Ethnicity	
Hispanic/Latino	282 (8.1)
Not Hispanic/Latino	3160 (91.1)
Unknown	26 (0.75)
Insurance payor status	
Commercial	965 (27.9)
Medicaid	362 (10.5)
Medicare	2022 (58.5)
Other	119 (3.1)

Table 2. Descriptive statistics (chi-square test) Investigating Distribution of Insurance Payor by Race, Stratified by Age Group

Age Group/Race	Commercial (%)	Medicaid (%)	Medicare (%)	Other (%)	*P* Value
18-34 years					
Black	33.9	59.7	4.8	1.6	
White	57.7	35.5	3.7	3.2	.003[a]
Other	68.8	18.8	0.0	12.5	
35-49 years					
Black	41.8	40.7	13.2	4.4	
White	63.5	26.0	7.4	3.2	.020[a]
Other	46.2	38.5	7.7	7.7	
50-64 years					
Black	42.4	26.7	25.0	5.8	
White	62.0	11.8	21.6	4.7	< .001[a]
Other	47.4	21.1	26.3	5.3	
65-79 years					
Black	9.2	5.7	81.6	3.6	
White	6.8	1.0	90.0	2.3	< .001[a]
Other	17.9	10.7	60.7	10.7	
80+ years					
Black	0.0	1.5	98.6	0.0	
White	1.3	0.0	97.6	1.1	.040[a]
Other	0.0	0.0	100.0	0.0	

[a] denotes a statistically significant result

ance as the reference group, those with Medicare had higher odds of all-cause mortality, HR 2.32 (95% CI 1.71-3.13, p < .001) when controlling for age and comorbid conditions included in the limited CCI score. Additionally, those with "Other" insurance were more likely to experience mortality, HR 1.93 (95% CI 1.13-3.29, p = .020).

DISCUSSION

By May 11, 2023, the end of the COVID-19 Public Health Emergency in the US, in the state of Ohio 3 445 294 cases of COVID-19 were reported along 140 611 hospitalizations and 42 239 deaths.[11] This study's findings add to the past 3 years of data and evidence-based literature regarding the impact of comorbid conditions and social factors on survival in patients hospitalized with COVID-19 in Northwest Ohio. The results showed that White patients had higher rates of mortality than Black patients or those of "Other" races. It was also observed that mortality rates were significantly different by payor status, and that the highest mortality rates were seen in the Medicare and "Other" categories, whereas the lowest mortality rates were seen in the Medicaid category. The age groups including individuals aged 65 years and older had higher mortality than the younger than 65 years age groups. Importantly, Cox regression demonstrated that those who did not have commercial or public insurance had a significantly increased risk of mortality compared to those with commercial insurance when controlling for age and comorbidity index score.

A previously published study investigating social determinants of health and COVID-19 mortality rates at the county level found that after considering age, percentage of the population that is uninsured in the county, number of days since the county reported 10

Table 3. Descriptive Statistics (chi-square test) Investigating Distribution of Comorbid Conditions by Insurance Payor

Comorbidity	Commercial(%)	Medicaid (%)	Medicare (%)	Other (%)	*P* value
Atrial fibrillation	60 (6.2)	26 (7.3)	494 (23.6)	6 (5.5)	< .001[a]
Acute myocardial infarction	27 (2.8)	13 (3.6)	146 (7.0)	7 (6.4)	< .001[a]
Anemia	142 (15.2)	82 (23.0)	627 (29.9)	21 (19.3)	< .001[a]
Asthma	148 (15.2)	60 (16.8)	161 (7.7)	8 (7.3)	< .001[a]
Chronic kidney disease	249 (25.5)	98 (27.5)	1121 (53.5)	42 (38.5)	< .001[a]
Chronic obstructive pulmonary disease	106 (10.9)	63 (17.7)	665 (31.8)	13 (11.9)	< .001[a]
Type 2 Diabetes	329 (33.7)	134 (37.5)	986 (47.1)	48 (44.0)	< .001[a]
Dementia	10 (1.0)	11 (3.1)	406 (19.4)	8 (7.3)	< .001[a]
Depression	131 (13.4)	70 (19.6)	356 (17.0)	10 (9.2)	.004[a]
Congestive heart failure	62 (6.4)	54 (15.1)	634 (30.3)	13 (11.9)	< .001[a]
Hyperlipidemia	391 (40.1)	124 (34.7)	1419 (40.1)	59 (54.1)	< .001[a]
Hypertension	458 (47.0)	113 (31.7)	853 (40.7)	52 (47.7)	< .001[a]
Ischemic heart disease	126 (12.9)	45 (12.6)	788 (37.6)	29 (26.6)	< .001[a]
Malnutrition	37 (3.8)	10 (2.8)	161 (7.7)	7 (6.4)	< .001[a]
Obesity	467 (47.9)	140 (39.2)	651 (31.1)	29 (26.6)	< .001[a]
Osteoarthritis	9 (0.9)	4 (1.1)	152 (7.3)	1 (0.9)	< .001[a]
Stroke	17 (1.7)	8 (2.2)	112 (5.4)	5 (4.6)	< .001[a]

[a] denotes a statistically significant result

positive cases, percentage of individuals who use tobacco products in the county, overcrowding, percentage of people living in rural areas of the county, percentage of child poverty in the county, and percentage of Black individuals in the county, the only variables that were significantly associated with COVID-19 mortality after a stepwise regression were percentage of uninsured individuals and percentage of Black individuals.[12] However, the individual linear models of the study also suggested that the percentage of people living in rural areas of the county and the percentage of individuals over the age of 65 years were key factors.[12] While the current study corroborates the importance of health insurance status and age as contributing factors to COVID-19 mortality, it was not concluded that Black individuals had the highest mortality rate as the previously mentioned study that looked at county data and was perhaps susceptible to ecological fallacy.[12] This was an unexpected finding, as racial and ethnic minorities are overrepresented in the essential workforce, tend to have lower access to health care, and typically have higher rates of uninsured status.[12] However, it is possible that non-White individuals with COVID-19 symptoms were less likely to seek medical care due to other factors, such as lack of trust in the health care system, during the initial stages of the pandemic.

Another study investigated the association of social determinants of health with COVID-19 mortality in rural and urban counties and found that COVID-19 mortality rates per 100 000 people were higher in urban counties than in rural counties (65.43 versus 50.78).[13] For both rural and urban counties, percentage of the Black population, DM rates, and HIV rates were significantly associated with higher mortality. In urban counties, unemployment rate and residential segregation were associated with increased mortality. The results determined that social determinants of health play an important role in explaining differences in COVID-19 mortality rates and support the results of the current study that comorbid conditions affect COVID-19 mortality. Though the current study did not investigate employment status, employment itself is an important social determinant of health that warrants further investigation.

Chronic conditions have been linked to patients with severe COVID-19 infection, and the Hispanic population is more likely to have multiple chronic conditions compared to non-Hispanic White population that may put them at a greater risk of mortality.[14] The Hispanic population also has the lowest rate of health insurance coverage of all ethnic groups in the US, with a 19.8% uninsured rate.[15] Lack of insurance can reduce access to COVID-19 testing and treatment. Language barriers also pose a problem, with 72% of Hispanic individuals speaking a language other than English at home and almost 30% stating they are not fluent in English.[16] These barriers can reduce access to care and preventive health measures.

Other research investigating racial and ethnic disparities in COVID-19 outcomes found that outcomes between Black, Native American, White, and Hispanic populations exist despite comparable Elixhauser comorbidity indices. Compared to Whites, Black patients have longer hospital stays, higher rates of ventilator dependence, and a higher mortality rate.[17] Also compared to White patients, Native American populations have higher odds of ventilator dependence. In the current study, several chronic conditions were found to be associated with increased mortality, particularly: acute myocardial infarction, cancer, cerebrovascular disease, congestive heart failure, chronic kidney disease, chronic obstructive pulmonary disease, dementia, type 2 diabetes, and obesity (included in the limited CCI score). The rates of these chronic conditions also varied across insurance status, where the majority were unsurprisingly highest in the Medicare population. However, several chronic conditions previously shown to be associated with poorer COVID-19 outcomes such as type 2 diabetes, hypertension,

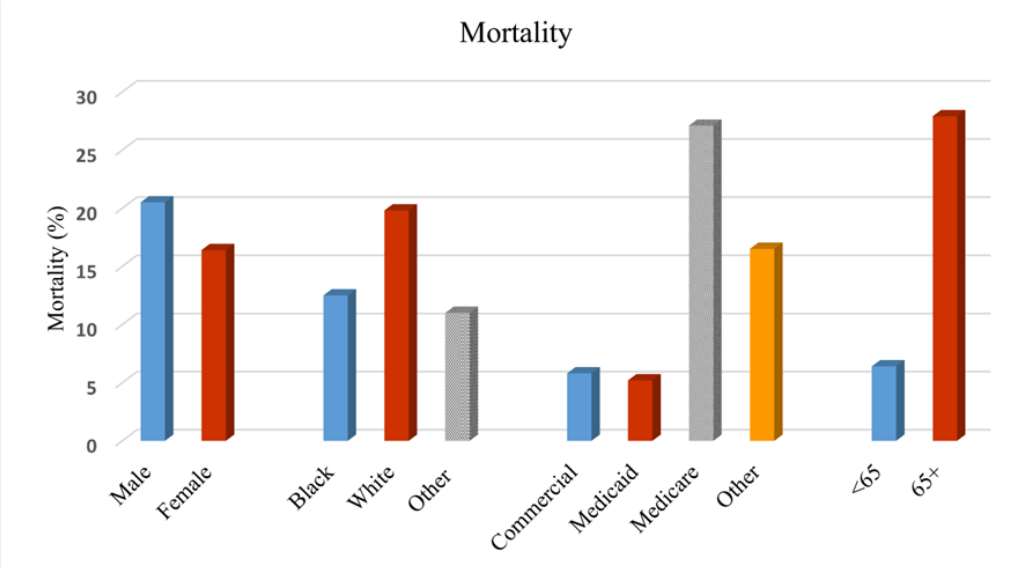

Figure 1. Mortality by Patient Characteristics

Table 4. Cox Proportional Hazard Regression Model Investigating Characteristics Associated with Survival in Patients with Confirmed COVID-19 Infection

Variable	Hazard Ratio Estimate	95% Confidence Interval	*P* Value
Limited CCI	1.32	1.26 – 1.38	< .001[a]
Race – Black	ref		
Race – Other	1.05	0.55 – 2.00	.880
Race – White	1.54	1.18 – 2.01	.002[a]
Sex – Female	ref		
Sex – Male	1.06	0.90 – 1.24	.480
Hyperlipidemia – No	ref		
Hyperlipidemia – Yes	0.88	0.74 – 1.05	.170
Obesity – No	ref		
Obesity – Yes	0.72	0.61 – 0.84	< .001[a]
Ventilator Use – No	ref		
Ventilator Use – Yes	4.25	3.61 – 5.0	< .001[a]
Insurance Payor – Commercial	ref		
Insurance Payor – Medicaid	1.16	0.69 – 1.96	.580
Insurance Payor – Medicare	2.32	1.71 – 3.13	< .001[a]
Insurance Payor – Other	1.93	1.13 – 3.29	.020[a]

[a] denotes a statistically significant result

and ischemic heart disease were higher in patients without commercial or public insurance coverage, particularly compared to those with commercial insurance.

Past research has also demonstrated that higher COVID-19 all-cause mortality rates are seen in counties with a higher proportion of Black residents and greater levels of adverse social determinants of health indicators.[18] The results also suggested that the percentage of uninsured adults, incarceration rate, percentage of adults without a high school diploma, and percentage of households without internet are also linked to increased COVID-19 mortality, further stressing the influence of social determinants of health.

The sample included in these analyses is more representative of the Northwest Ohio population, and therefore this could be another explanation of why the research findings are different in regard to mortality as compared to another study that looked at populations from surrounding communities with a different demographic distribution, such as Michigan, and found that the rates of disease incidence and mortality due to COVID-19 were twice as high than for Whites for all groups except Native Americans. [19]

An important finding refers to the protective effect of obesity observed in this study. Since the authors adjusted in the analyses for ventilator use and severe disease, younger and healthier obese patients might be the ones who were discharged alive after the COVID-19 hospitalization.

The study used the limited age-adjusted CCI that has been shown to be the best predictor for severe clinical outcome in hospitalized patients with COVID-19 infection[20] as compared to CCI which is calculated by considering 19 different comorbidities and was developed in 1987.[21]

The current study is subject to a number of weaknesses, including all of those that are applicable to retrospective studies. An important limitation of this study is the fact that other covariates with a potential confounding or mediator effect such as having a primary care physician, area-level access to health care facilities, social history data or other factors were not collected, and therefore not included in the analyses. Stepwise regression has limitations and may lead to model overfitting. However, due to the limited availability of these potential confounder and mediator variables, other methodological approaches such as a directed acyclic graph (DAG) using the minimal adjustment set for confounding variables were not used.

The study also did not assess the effect on mortality of other clinical variables such as inflammatory markers, in-hospital management, or prehospitalization medication.

PUBLIC HEALTH IMPLICATIONS

While the current study identified social determinants of health associated with COVID-19 mortality that have already been established in published literature, an interesting finding was that, overall, insurance status was significantly associated with mortality in the cohort of patients. Particularly, those without public or commercial insurance had higher odds of mortality within the study period, even after adjusting for preexisting conditions, age, and race. Additional research into these associations is warranted. Another finding warranting additional research is that White individuals had a higher mortality rate than those of "Other" races, as this finding was unexpected. Potential explanations for this finding, considering the composition of the cohort, include White individuals being older upon hospital admission and White individuals being more likely to have access to and seek medical care compared to those of "Other" races.

REFERENCES

1. John Hopkins University. Johns Hopkins Coronavirus Resource Center. Published 2023. https://coronavirus.jhu.edu/map.html
2. Drake P, Rudowitz R. Tracking social determinants of health during the COVID-19 pandemic. KFF. Published April 21, 2022. Accessed August

21, 2022.
https://www.kff.org/coronavirus-covid-19/issue-brief/tracking-social-determinants-of-health-during-the-covid-19-pandemic/

3. Corallo B, Moreno S. Analysis of recent national trends in Medicaid and CHIP enrollment. KFF. Published August 3, 2022. Accessed August 21, 2022.
https://www.kff.org/coronavirus-covid-19/issue-brief/analysis-of-recent-national-trends-in-medicaid-and-chip-enrollment/#:~:text=Data%20show%20that%20Medicaid%2FCHIP
4. Yancy C. COVID-19 and African Americans. *JAMA*. 2020;323(19):1891-1892.
https://doi.org/10.1001/jama.2020.6548
5. Garg S, Kim L, Whitaker M, et al. Hospitalization rates and characteristics of patients hospitalized with laboratory-confirmed Coronavirus Disease 2019 — COVID-NET, 14 States, March 1–30, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(15):458-464.
https://doi.org/10.15585/mmwr.mm6915e3
6. US Census Bureau. Household Pulse Survey Data Tables. Census.gov. Published August 5, 2022. Accessed August 21, 2022.
https://www.census.gov/programs-surveys/household-pulse-survey/data.html
7. US Department of Health and Human Services. COVID-19 hospitalizations. COVID-NET. Published 2022. Accessed August 21, 2022.
https://gis.cdc.gov/grasp/covidnet/COVID19_3.html
8. National Center for Health Statistics. Provisional COVID-19 deaths: Distribution of deaths by race and Hispanic origin. Centers for Disease Control and Prevention. Data.CDC.gov. Published August 17, 2022. Accessed August 21, 2022.
https://data.cdc.gov/NCHS/Provisional-COVID-19-Deaths-Distribution-of-Deaths/pj7m-y5uh
9. Center for Immunization and Respiratory Diseases, Division of Viral Diseases. Risk for COVID-19 infection, hospitalization, and death by race/ethnicity. Centers for Disease Control and Prevention. Published July 28, 2022. Accessed August 21, 2022.
https://stacks.cdc.gov/view/cdc/105453
10. Williams M. COVID-19 and the social determinants of health. Harvard Medical School Primary Care Review. Published July 28, 2020. Accessed July 26, 2021.
https://info.primarycare.hms.harvard.edu/review/covid-social-determinants-health
11. Ohio Department of Health. COVID-19 Dashboard. Published 2023. Accessed May 11, 2023.
https://coronavirus.ohio.gov/dashboards
12. Lam S, Hohman E, Pavon-Harr V, et al. Social determinates of health and COVID-19 mortality rates at the county level. *IEEE Xplore*. 2020;159-165.
https://doi.org/10.1109/MCNA50957.2020.9264276
13. Paul R, Arif A, Pokhrel K, Ghosh S. The association of social determinants of health with COVID-19 mortality in rural and urban counties. *J Rural Health*. 2021;37(2):278-286.
https://doi.org/10.1111/jrh.12557
14. Cheng Y, Kanaya A, Araneta M, et al. Prevalence of diabetes by race and ethnicity in the United States, 2011-2016. *JAMA*. 2019;322(24):2389.
https://doi.org/10.1001/jama.2019.19365
15. Agency for Healthcare Research and Quality. 2018 National Healthcare Quality and Disparities Report | Agency for Healthcare Research & Quality. AHRQ. Published September 2019. Accessed July 25, 2021.
https://www.ahrq.gov/research/findings/nhqrdr/nhqdr18/index.html
16. Office of Minority Health. Hispanic/Latino - The Office of Minority Health. HHS.gov. Published October 12, 2021. Accessed August 23, 2022.
https://minorityhealth.hhs.gov/omh/browse.aspx?lvl=3&lvlid=64
17. Qeadan F, VanSant-Webb E, Tingey B, et al. Racial disparities in COVID-19 outcomes exist despite comparable Elixhauser comorbidity indices between Blacks, Hispanics, Native Americans, and Whites. *Sci Rep*. 2021;11(1).
https://doi.org/10.1038/s41598-021-88308-2
18. Dalsania A, Fastiggi M, Kahlam A, et al. The relationship between social determinants of health and racial disparities in COVID-19 mortality. *J Racial Ethn Health Disparities*. 2021:1-8.
https://doi.org/10.1007/s40615-020-00952-y
19. Zelner J, Trangucci R, Naraharisetti R, et al. Racial disparities in coronavirus disease 2019 (COVID-19) mortality are driven by unequal infection risks. *Clin Infect Dis*. 2021;1;72(5):e88-e95.
https://doi.org/10.1093/cid/ciaa1723
20. Kim DH, Park HC, Cho A, Kim J, Yun KS, Kim J, Lee YK. Age-adjusted Charlson comorbidity index score is the best predictor for severe clinical outcome in the hospitalized patients with COVID-19 infection. *Medicine* (Baltimore). 2021 May 7;100(18):e25900.
https://doi.org/10.1097/MD.0000000000025900
21. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373-83.
https://doi.org/10.1016/0021-9681(87)90171-8

APPENDIX

Figure. Kaplan-Meier survival curve by type of insurance

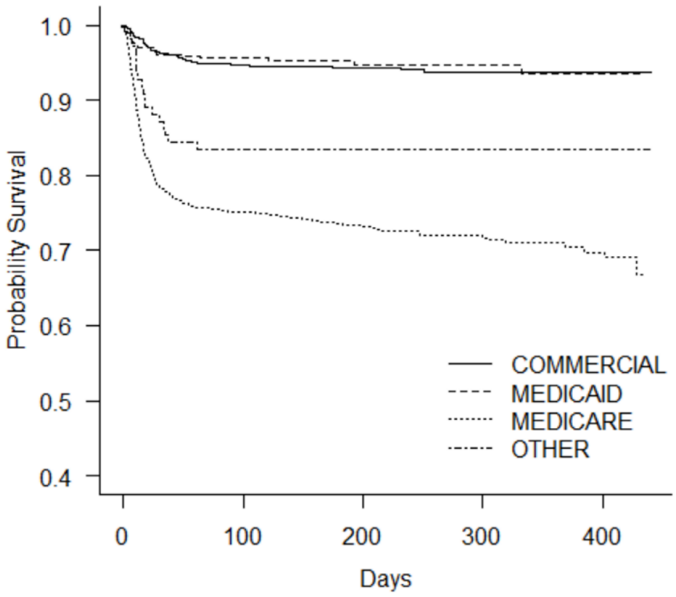

Figure. Kaplan-Meier survival curve by race

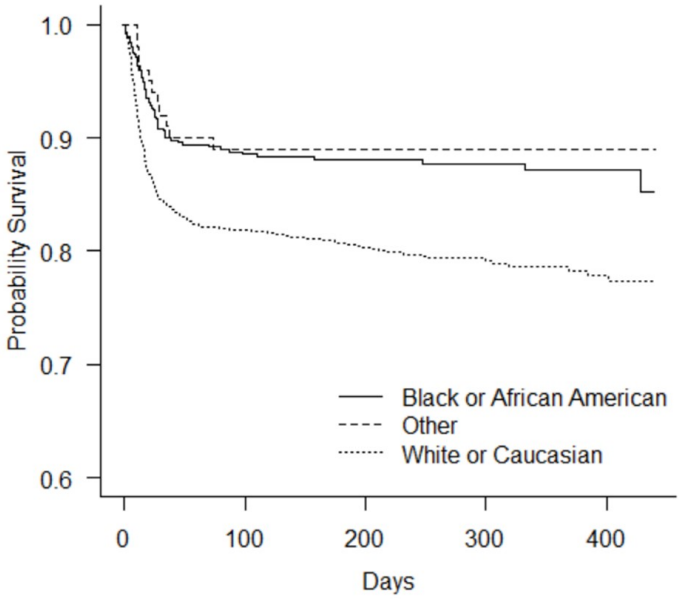

Table. Unadjusted Cox proportional hazard regression models investigating characteristics associated with survival in patients with confirmed COVID-19 infection

Variable	Hazard Ratio Estimate	95% Confidence Interval	*P* Value
Race – Black	ref		
Race – Other	0.70	0.32 – 1.56	.385
Race – White	1.41	1.05 – 1.90	.024*
Sex – Female	ref		
Sex – Male	1.23	1.02 – 1.48	.032*
Hyperlipidemia – No	ref		
Hyperlipidemia – Yes	1.09	0.91 – 1.32	.349
Obesity – No	ref		
Obesity – Yes	1.19	0.99 – 1.44	.065
Ventilator Use – No	ref		
Ventilator Use – Yes	0.68	0.53 – 0.87	.002*
Insurance Payor – Commercial	ref		
Insurance Payor – Medicaid	1.01	0.52 – 1.96	.969
Insurance Payor – Medicare	6.14	4.30 – 8.75	< .001*
Insurance Payor – Other	4.64	2.55 – 8.42	< .001*