Journal of Racial and Ethnic Health Disparities (2022) 9:2011–2018
https://doi.org/10.1007/s40615-021-01140-2

Racial Differences and In-Hospital Outcomes Among Hospitalized Patients with COVID-19

Ayman Elbadawi[1] · Islam Y. Elgendy[2] · Douglas Joseph[3] · Chete Eze-Nliam[3] · Penelope Rampersad[3] · Geoffrey Ouma[3] · Rohan Bhandari[3,4] · Lee Kirksey[3,5] · Pulkit Chaudhury[3] · Mina K. Chung[3,4,5] · Ankur Kalra[3,5] · Neil Mehta[5] · John R. Bartholomew[3,5] · Aditya Sahai[3] · Lars G. Svensson[3,4,5] · Scott J. Cameron[3,4,5,6,7]

Received: 18 January 2021 / Revised: 16 August 2021 / Accepted: 17 August 2021 / Published online: 10 September 2021

Abstract

Objective There is a paucity of data on how race affects the clinical presentation and short-term outcome among hospitalized patients with SARS-CoV-2, the 2019 coronavirus (COVID-19).

Methods Hospitalized patients ≥ 18 years, testing positive for COVID-19 from March 13, 2020 to May 13, 2020 in a United States (U.S.) integrated healthcare system with multiple facilities in two states were evaluated. We documented racial differences in clinical presentation, disposition, and in-hospital outcomes for hospitalized patients with COIVD-19. Multivariable regression analysis was utilized to evaluate independent predictors of outcomes by race.

Results During the study period, 3678 patients tested positive for COVID-19, among which 866 were hospitalized (55.4% self-identified as Caucasian, 29.5% as Black, 3.3% as Hispanics, and 4.7% as other racial groups). Hospitalization rates were highest for Black patients (36.6%), followed by other (28.3%), Caucasian patients (24.4%), then Hispanic patients (10.7%) ($p < 0.001$). Caucasian patients were older, and with more comorbidities. Absolute lymphocyte count was lowest among Caucasian patients. Multivariable regression analysis revealed that compared to Caucasians, there was no significant difference in in-hospital mortality among Black patients (adjusted odds ratio [OR] 0.53; 95% confidence interval [CI] 0.26–1.09; $p = 0.08$) or other races (adjusted OR 1.62; 95% CI 0.80–3.27; $p = 0.18$). Black and Hispanic patients were admitted less frequently to the intensive care unit (ICU), and Black patients were less likely to require pressor support or hemodialysis (HD) compared with Caucasians.

Conclusions This observational analysis of a large integrated healthcare system early in the pandemic revealed that patients with COVID-19 did exhibit some racial variations in clinical presentation, laboratory data, and requirements for advanced monitoring and cardiopulmonary support, but these nuances did not dramatically alter in-hospital outcomes.

Keywords Race · COVID-19 · SARS-CoV-2 · Outcomes

✉ Scott J. Cameron
cameros3@ccf.org

[1] Division of Cardiovascular Medicine, University of Texas Medical Branch, Galveston, TX, USA

[2] Department of Medicine, Weill Cornell Medicine-Qatar, Doha, Qatar

[3] Heart Vascular and Thoracic Institute, Cleveland Clinic, Cleveland, OH, USA

[4] Department of Cardiovascular and Metabolic Sciences, Cleveland Clinic, Cleveland, OH, USA

[5] Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, Cleveland, OH, USA

[6] Department of Hematology, Taussig Cancer Institute, Cleveland, OH, USA

[7] Department of Cardiovascular Medicine, Section of Vascular Medicine, Cleveland Clinic Foundation, J3-5, 9500 Euclid Avenue, Cleveland, OH 44195, USA

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has affected many communities worldwide. Some groups, however, appear to carry a substantially higher risk with COVID-19 infection. Growing data suggests some variation in the effects of COVID-19 on morbidity and mortality among various racial groups [1]. Population-based reports revealed that racial minorities might suffer higher mortality rates per 100,000 people in the United States (U.S.), as well as in the UK [2–4]. Other reports suggest possible variations in access of racial minorities to COVID-19 testing as well as variations in the dissemination of information on health and safety during the COVID-19 pandemic [5]. Despite these data, little is known about the interaction between race and COVID-19 and how these relate to disease presentation, pathophysiology, and complications. Patient-level studies addressing these knowledge gaps are scarce. Our goal was to evaluate real-life data in a large hospital system in an attempt to identify disparities in clinical presentations and in-hospital outcomes across racial groups in the COVID-19 era.

Methods

We utilized clinical data collected on patients ≥ 18 years old at both ambulatory and inpatient Cleveland Clinic facilities in Northeast Ohio and South Florida, as described previously [7]. Each patient tested positive for a SARS-CoV-2 amplicon by reverse transcriptase–polymerase chain reaction (RT-PCR) using patient sputum or nasopharyngeal swabs between March 13, 2020 and May 13, 2020. We excluded patient cases with missing data on race. Clinical data obtained from the electronic medical record included demographics, comorbidities, in-hospital medications (including anti-platelet medications, anticoagulant therapy, non-steroidal anti-inflammatory drugs (NSAIDs), systemic steroids, angiotensin converting enzyme inhibitors (ACEIs), angiotensin receptor blockers (ARBs), hydroxychloroquine, and tocilizumab), laboratory results upon admission, and in-hospital outcomes. Patients were categorized according to their reported racial groups: Caucasian, Black, Hispanic, and other racial groups. The main study outcome was in-hospital mortality. Secondary outcomes examined were as follows: hospitalization rate, intensive care unit (ICU) admission, respiratory support, pressor support, a new hemodialysis requirement, cardiac arrest, acute thrombotic events, and bleeding events.

Thrombotic events were defined as venous thromboembolic (VTE) events including symptomatic deep venous thrombosis (DVT) or acute pulmonary embolism (PE) confirmed by imaging (venous duplex in case of DVT, and computed tomography in case of PE) and arterial thrombotic events (acute myocardial infarction (MI), acute ischemic stroke, or other systemic embolism). Laboratory data were available only at the time of hospital admission. This study was approved by the Cleveland Clinic Institutional Review Board which waived the need of informed consent based on the observational nature of analyzing de-identified data.

Categorical variables were reported as frequencies and percentages and compared using the chi-square test. Continuous variables were reported as mean ± standard deviation or median and interquartile range (IQR) depending on their distribution and compared using the student *t* test or Mann–Whitney *U* test as appropriate. Multivariable regression analysis was conducted to evaluate the effect of race on in-hospital outcomes. The model included the following variables: age, sex, hypertension, diabetes, heart failure, coronary artery disease, chronic obstructive pulmonary disease (COPD), and bronchial asthma. In the multivariable model for in-hospital mortality, we also adjusted for disease severity including need for ICU admission and the need for respiratory or pressor support. Secondary analysis was conducted to evaluate the effect of race on in-hospital outcomes among critically ill patients. Associations were considered significant if the p value was < 0.05. We used the SPSS software (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY) for all statistical analyses.

Results

Between March 13, 2020 and May 13, 2020 3678 patients tested positive for COVID-19. After excluding 336 cases with missing indicators for race, the final cohort consisted of 3342 patients with COVID-19. Among these patients, 1851 (55.4%) were Caucasian, 987 (29.5%) were Black, 395 (11.8%) were Hispanic, and 109 (3.3%) were identified as other. Among the study cohort, 866 COVID-19 positive patients (26.8%) were hospitalized. The rate of hospitalization was highest for Black patients (36.6%), followed by other (28.3%), Caucasian patients (24.4%), and Hispanic patients (10.7%) ($p < 0.001$). After adjusting for age, sex, and medical comorbidities, the rate of hospitalization was higher for Black patients (adjusted odds ratio [OR] 2.03; 95% confidence interval [CI] 1.64–2.51, $p < 0.001$) and other racial groups (adjusted odds ratio OR 1.84; 95% CI 1.06–3.19, $p = 0.03$), compared with Caucasian patients. No difference in hospitalization was observed for Hispanic patients compared with Caucasian patients (adjusted odds ratio OR 0.69; 95% CI 0.46–1.02, $p = 0.06$).

Table 1 Clinical characteristics, medications data, and laboratory data patients with COVID-19 according to race

Characteristics	Caucasian ($n=451$)		Black ($n=345$)		Hispanic ($n=29$)		Other races ($n=41$)		*p*-value
	N	%	*N*	%	*N*	%	*N*	%	
Age									
Mean age (± SD)	66.92 ± 15.75		62.83 ± 16.62		63.20 ± 13.37		56.90 ± 12.65		< 0.001
18–44 years	36	8.00%	44	12.80%	1	3.40%	6	14.60%	< 0.001
45–54 years	54	12.00%	52	15.10%	9	31.00%	13	31.70%	
55–64 years	106	23.50%	91	26.40%	5	17.20%	12	29.30%	
65–74 years	99	22.00%	71	20.60%	8	27.60%	5	12.20%	
≥ 75 years	156	34.60%	87	25.20%	6	20.70%	5	12.20%	
Female sex	198	43.90%	179	51.90%	12	41.40%	12	29.30%	0.02
Tobacco use	202	47.10%	158	47.90%	8	28.60%	15	40.50%	0.22
Chronic obstructive pulmonary disease	65	15.60%	45	14.10%	0	0.00%	1	2.60%	0.03
Asthma	81	19.30%	81	25.10%	4	16.00%	11	28.20%	0.18
Diabetes mellitus	162	38.20%	152	46.20%	14	56.00%	18	47.40%	0.06
Hypertension	313	72.10%	265	78.60%	16	59.30%	22	56.40%	0.01
Coronary artery disease	115	27.40%	56	17.30%	4	16.00%	6	16.20%	0.01
History of heart failure	96	22.90%	69	21.20%	1	4.00%	3	7.90%	0.03
Cancer	103	23.80%	62	18.60%	1	3.70%	3	7.50%	0.01
Prior immunosuppressive therapy	68	16.00%	45	13.60%	2	7.10%	6	15.00%	0.54
Connective tissue disease	63	15.30%	30	9.20%	1	4.00%	2	5.30%	0.02
Inflammatory bowel disease	30	7.20%	10	3.20%	1	4.20%	2	5.30%	0.12
Medications									
Antiplatelets	150	33.30%	129	37.40%	9	31.00%	11	26.80%	0.42

Table 1 (continued)

Characteristics	Caucasian ($n=451$)		Black ($n=345$)		Hispanic ($n=29$)		Other races ($n=41$)		*p*-value
	N	%	*N*	%	*N*	%	*N*	%	
Therapeutic AC	95	21.10%	47	13.60%	1	3.40%	6	14.60%	0.01
Prophylactic AC	302	67.00%	260	75.40%	18	62.10%	27	65.90%	0.05
NSAID	142	34.10%	122	38.10%	8	28.60%	14	35.00%	0.59
Systemic steroids	80	19.20%	55	17.20%	6	21.40%	5	12.50%	0.67
ACEI	72	17.30%	59	18.40%	2	7.10%	7	17.50%	0.51
ARBs	48	11.50%	39	12.20%	3	10.70%	2	5.00%	0.61
Hydroxychloroquine	184	57.00%	94	41.60%	15	62.50%	19	59.40%	0.02
Tocilizumab	49	15.20%	11	4.90%	3	12.50%	4	12.50%	0.02
Laboratory data on admission[a]									
C-reactive protein (mg/L)	7 (3.1, 13.5)		6.25 (2.38, 11.6)		6.9 (1.6, 10.24)		5.6 (4.15, 14.25)		0.21
Lactate (mmol/L)	1.5 (1.1, 1.8)		1.3 (1.1, 2.0)		1.05 (0.6, 1.73)		1.4 (1.2, 1.4)		0.65
D-dimer (ng/mL)	1080 (520, 2570)		1345 (665, 3680)		980 (470, 3462)		940 (825, 1385)		0.14
White blood cells ($\times 10^9$/L)	6.89 (4.69, 8.45)		7.13 (5.23, 8.34)		6.50 (5.22, 7.90)		7.04 (6.77, 8.37)		0.37
Absolute neutrophil count ($\times 10^9$/L)	4.48 (3.08, 6.73)		4.41 (3.08, 6.14)		3.97 (3.35, 5.28)		4.52 (3.66, 6.94)		0.52
Absolute lymphocyte count ($\times 10^9$/L)	0.88 (0.62, 1.26)		1.17 (0.83, 1.69)		1.05 (0.63, 1.25)		1.08 (0.74, 1.22)		<0.001
Hemoglobin count (g/dL)	13.20 (11.60,14.60)		13.00 (11.28,14.43)		13.25 (11.60,14.05)		13.60 (12.45,15.55)		0.02

Table 1 (continued)

Characteristics	Caucasian ($n=451$)		Black ($n=345$)		Hispanic ($n=29$)		Other races ($n=41$)		*p*-value
	N	%	*N*	%	*N*	%	*N*	%	
Platelet count ($\times 10^9$/L)	193 (155, 248)		200 (154, 260)		199 (157, 231)		210 (163, 273)		0.73
Serum albumin	3.70 (3.30, 4.00)		3.80 (3.50, 4.10)		4.00 (3.60, 4.18)		3.80 (3.50, 3.95)		< 0.001
ALT	22 (15,39)		24 (15,36)		27 (20,44)		31 (21,44)		0.08
AST	34 (23,50)		35 (25,52)		29 (23,46)		37 (27,59)		0.36

AC anticoagulant medications, *ALT* alanine aminotransferase enzyme, *AST* aspartate aminotransferase enzyme, *AC* anticoagulation, *NSAID* non-steroidal anti-inflammatory medications

[a]Laboratory data were available as follows: C-reactive protein (70.4%), lactate (30.6%), D-dimer (39.4%), white blood cells (86.7%), platelets (87.5%), albumin (83.3%), ALT/AST (82.5%) and hemoglobin (87.5%)

In Table 1, the baseline characteristics of hospitalized patients with COVID-19 are displayed according to race. Among racial groups, Caucasian patients were generally older, followed by Hispanic patients, Black patients, and other races (66.92 ± 15.75 vs. 62.83 ± 16.62 vs. 63.20 ± 13.37 vs. 56.90 ± 12.65 years, respectively; $p < 0.001$). Hospitalized patients ≥ 75 years were more frequent among Caucasians (34.6%), followed by Black patients (25.2%), Hispanic patients (20.7%), then other racial groups (12.2%). Among female patients hospitalized with COVID-19, the majority were Black (51.9%), followed by Caucasians (43.9%), Hispanics (41.4%), then other racial groups (29.3%) ($p = 0.02$). Caucasian patients were more likely to have a history of chronic obstructive pulmonary disease (COPD), coronary artery disease (CAD), heart failure, cancer, and connective tissue disease. Black patients were more likely to have hypertension and diabetes. The inpatient administration of anti-platelet medications, anticoagulant therapy, NSAIDs, systemic steroids, ACEIs, and ARBs was similar across various racial groups. Caucasians were more likely to receive therapeutic anticoagulation, while Blacks were less likely to receive hydroxychloroquine and tocilizumab, compared with other racial groups.

Patient laboratory data on admission are also displayed in Table 1. There were no differences among various racial groups in the median values of C-reactive protein or D-dimer. While we recently demonstrated total white blood cell count (WBC) driven by neutrophilia was the only independent predictor of thrombosis in COVID-19 patients [7], while focusing on racial groups, we failed to identify differences in platelet count, total WBC, or absolute neutrophil count. The absolute lymphocyte count was lower among Caucasian patients (0.88 [0.62, 1.26] × 10^9/L) compared with Black patients (1.17 [0.83, 1.69] × 10^9/L), Hispanic patients (1.05 [0.63, 1.25] × 10^9/L), and other racial groups (1.08 [0.74, 1.22] × 10^9/L) ($p < 0.001$).

In-hospital outcomes among racial groups are displayed in Table 2. Data for in-hospital mortality was available for 780/866 (90%) of hospitalized patients. Multivariable regression was applied only for patients with complete datasets. In an unadjusted model, compared with Caucasian patients, in-hospital mortality was lower in Black patients (unadjusted odds OR 0.46; 95% CI 0.28–0.74, $p = 0.001$), but no difference was observed when compared with the other racial groups. On multivariable regression analysis, compared with Caucasians, in-hospital mortality was similar for Black patients (adjusted OR 0.53; 95% CI 0.26–1.08; $p = 0.08$), or other racial groups (adjusted OR 1.76; 95% CI 0.38–8.08; $p = 0.47$). The frequency of critical illness, (requiring ICU admission, mechanical ventilation, or pressor support) was lower among Hispanic patients (17.2% vs. 36.4%, adjusted OR 0.24; 95% CI 0.07–0.83; $p = 0.02$), while no difference was observed with Black patients (29.6%

Table 2 In-hospital outcomes according to race

	Rate	Unadjusted OR	95% CI		*p*-value	Adjusted OR	95% CI		*p*-value
Mortality									
Caucasian	16.5%	Reference category				Reference category			
Blacks	8.3%	.455	.282	.736	.001	.53	.26	1.09	.08
Hispanics	0.0%	NA				NA			
Other races	10.5%	.594	.204	1.729	.339	1.76	.38	8.08	.47
ICU admission									
Caucasian	36.4%	Reference category				Reference category			
Blacks	29.4%	0.73	0.54	0.98	0.04	0.71	0.51	.997	.048
Hispanics	17.2%	0.37	0.14	0.97	0.04	0.24	0.07	0.83	0.02
Other races	43.9%	1.37	0.72	2.61	0.34	1.62	0.80	3.27	0.18
Respiratory support									
Caucasian	46.3%	Reference category				Reference category			
Blacks	28.4%	0.46	0.34	0.62	0.01	0.43	0.31	0.60	0.01
Hispanics	20.7%	0.30	0.12	0.76	0.01	0.24	0.08	0.73	0.01
Other races	43.9%	0.91	0.48	1.73	0.76	1.33	0.66	2.68	0.42
Pressor support									
Caucasian	18.8%	Reference category				Reference category			
Blacks	11.0%	0.53	0.35	0.80	0.01	0.49	0.31	0.77	0.01
Hispanics	10.3%	0.50	0.15	1.68	0.26	0.41	0.09	1.79	0.23
Other races	24.4%	1.39	0.66	2.94	0.39	1.48	0.65	3.36	0.35
Hemodialysis									
Caucasian	19.1%	Reference category				Reference category			
Blacks	11.0%	0.53	0.35	0.79	0.01	0.49	0.31	0.78	0.01
Hispanics	13.8%	0.68	0.23	2.00	0.48	0.64	0.18	2.23	0.48
Other races	24.4%	1.37	0.65	2.90	0.41	1.49	0.65	3.38	0.35
Cardiac arrest									
Caucasian	0.9%	Reference category				Reference category			
Blacks	0.9%	0.98	0.22	4.41	0.98	0.47	0.05	4.82	0.52
Hispanics	3.4%	3.99	0.43	36.91	0.22	13.86	0.93	207.13	0.06
Other races	0.0%	NA				NA			
Thrombotic complications									
Caucasian	5.5%	Reference category				Reference category			
Blacks	4.8%	0.92	0.49	1.75	0.80	1.21	0.59	2.48	0.61
Hispanics	6.9%	1.32	0.30	5.87	0.72	0.75	0.09	6.02	0.79
Other races	0.0%	NA				NA			
Bleeding events									
Caucasian	5.8%	Reference category				Reference category			
Blacks	6.1%	1.06	0.59	1.92	0.85	0.81	0.41	1.61	0.54
Hispanics	3.4%	0.58	0.08	4.46	0.60	0.69	0.09	5.47	0.73
Other races	2.4%	0.41	0.05	3.09	0.39	0.45	0.06	3.56	0.45

vs. 36.4%, adjusted OR 0.73; 95% CI 0.52–1.02; $p=0.07$) and other racial groups (43.9% vs. 36.4%, adjusted OR 1.61; 95% CI 0.80–3.26; $p=0.18$) compared with Caucasian patients. Compared with Caucasians, ICU admissions were less frequent for Black patients (adjusted OR 0.71; 95% CI 0.51–0.997; $p=0.048$) and Hispanic patients (adjusted OR 0.24; 95% CI 0.70–0.83, $p=0.02$). No difference was observed in ICU admissions when comparing Caucasian patients with other racial groups (adjusted OR 1.62; 95% CI 0.80–3.6; $p=0.18$). Compared with Caucasian patients, Black patients were less likely to require advanced airway support (adjusted OR 0.43; 95% CI 0.31–0.60; $p=0.01$), pressor support (adjusted OR 0.49; 95% CI 0.31–0.77; $p=0.01$), or hemodialysis (adjusted OR 0.49; 95% CI 0.31–0.78, $p=0.01$), and Hispanic patients were less likely to require advanced airway support (adjusted OR 0.24; 95% CI 0.08–0.73; $p=0.01$). No differences were observed comparing Caucasian patients to other racial groups with respect

to advanced airway or hemodynamic support or hemodialysis. For patients testing positive for COVID-19, there was no difference among racial groups in the incidence of cardiac arrest or the occurrence of thrombotic or bleeding events.

Results of secondary analysis including critically ill patients only appear in Supplemental Tables 1 and 2. Due to few observations among patients of Hispanic race and other racial groups, the comparative analyses were conducted among Caucasian versus Black patients only. Compared with Caucasian patients, critically ill Black patients had higher median values of serum creatinine, while no differences were observed in other laboratory values. There were no differences among critically ill Caucasian and Black patients in in-hospital mortality, cardiac arrest, thrombotic, or bleeding complications. Critically ill Black patients were less likely to require hemodialysis compared with Caucasian patients (37.3% vs. 52.4%, adjusted OR 0.47; 95% CI 0.26–0.83; $p=0.02$).

Discussion

In this observational analysis of a large integrated healthcare including 3342 patients with COVID-19, we found that the likelihood of hospitalization was highest among Black patients. Among the cohort of hospitalized patients with COVID-19, we found that Caucasian patients were older and had a greater number of comorbidities including COPD, CAD, heart failure, cancer, and connective tissue diseases. However, Black patients hospitalized with COVID-19, conversely, were more likely to be women with a higher prevalence of hypertension and diabetes. There were no racial differences in the adjusted rates of in-hospital mortality. Black and Hispanic patients were less likely to be admitted to the ICU or require respiratory support. Black patients were less likely to require pressor support or new hemodialysis requirement compared with Caucasians.

Our analysis evaluated differences with COVID-19 at the time of presentation and outcomes across racial groups in the U.S. Some differences in patient and clinical characteristics were observed. For patients with COVID-19, the likelihood of hospitalization was higher among Black individuals compared with any other racial group. The exact reason for this observation could not be explored using this type of study design. Racial differences in access to testing for SARS-CoV-2 might play a role since inhabitants of less affluent communities may have limited access to healthcare, and therefore may be sicker when presenting for evaluation at a hospital. Diabetes and hypertension were reported as significant comorbidities in the prevalence of severe COVID-19 [8, 9]. This observation may contribute to the higher hospitalization rate for Black patients who more commonly had hypertension and diabetes in our study.

Data on racial disparities for SARS-CoV-2 infection is derived mostly from administrative databases rather than real-life data. Understanding differences in demographics and clinical comorbidities of hospitalized COVID-19 patients among and between racial strata is important to determine where individualized patient care is required. Variations in comorbid conditions might be related to the significant differences in age across the examined racial groups. Alternatively, the frequency of comorbidities in our cohort of COVID-19 patients including hypertension and diabetes may simply reflect the higher prevalence in the Black community [13–15].

We demonstrated a lower absolute lymphocyte count at admission among Caucasian patients compared with other races hospitalized with COVID-19. Lymphopenia is a cardinal laboratory finding among patients with COVID-19 and may have prognostic value [7]. Moreover, lymphopenia has been associated with an enhanced inflammatory response ("cytokine storm"), and cytokines are known mediators of lymphocyte apoptosis [15]. This study cannot confirm if the magnitude of lymphopenia is related to a true difference in pathophysiological response to SARS-CoV-2 infection or to biological differences among racial groups.

In-hospital mortality across racial groups was not different after accounting for patient demographics and disease severity. We also did not observe any racial differences in the rates of thrombotic complications or bleeding events. Since thrombosis appears to be a major feature for patients in the COVID-19 era [7, 10–12], these data may immediately inform clinical practice. Our results differ from population studies showing higher mortality for racial minorities with COVID-19 and may reflect a sensitivity to race or awareness of intrinsic biases in treatment options in our healthcare system compared with others [2, 3]. However, prior studies did not always adjust for the known differences in comorbidities across racial groups [5].

Hispanic and Black patients were less likely to be admitted to the ICU in our cohort, and Black patients were less likely to have hemodynamic interventions or adverse consequences thereof (the need for pressor support and hemodialysis, respectively). Due to the observational nature of this study, our findings are hypothesis-generating only and warrant exploration in larger cohorts. A study using similar statistical models utilizing the American Heart Association (AHA) COVID-19 Disease Registry reached the literature in preliminary form at the time of submitting our study and concluded in-hospital patient mortality, and major adverse cardiovascular outcomes did not differ among racial groups [17]. While we show features of hospitalization including ICU care have a racial predilection, our overall conclusion regarding patient mortality is the same and supports an additional report toward the beginning of the COVID-19 pandemic [18].

Our analysis has certain limitations. Firstly, as an observational analysis, the possibility for selection and allocation bias exists. We attempted to reduce allocation bias by conducting multivariable adjustments. Secondly, the smaller sample size for certain racial groups might alter the estimation of true differences in outcomes. Thirdly, we only collected laboratory data upon admission, which might have changed during the course of the hospitalization. Fourth, we did not systematically collect data on other medications as antiviral, convalescent plasma, immune modulatory therapy, and antibiotics. Lastly, our study lacks granular data on the socioeconomic status of each racial group which limits our conclusions.

Conclusions

In this single healthcare system analysis, patients with COVID-19 exhibited racial variations in clinical presentation, laboratory data, and in-hospital outcomes. No differences were observed for in-hospital mortality across various racial groups in spite of differences in ICU level care, hemodynamic and respiratory support, and hemodialysis. Further research is warranted to characterize the interaction between race and COVID-19.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40615-021-01140-2.

Acknowledgements The authors thank Livia Timpanaro-Perrotta for assistance with Institutional Review Board approval and maintenance of data.

Funding Financial support from NHLBI R01HL158801 and LRP HL120200 to SJC. NHLBI R01HL111314, AHA 810959 and AHA 814633 to MKC.

Declarations

Competing Interests The authors declare no competing interests.

References

1. Alsan M, Stantcheva S, Yang D, Cutler D. Disparities in coronavirus 2019 reported incidence, Knowledge, and Behavior Among US Adults. JAMA Netw Open. 2020;3:e2012403.
2. Al Rifai M, Shapiro MD, Sayani S, et al. Racial and geographic disparities in internet use in the United States among patients with atherosclerotic cardiovascular disease. Am J Cardiol. 2020;134:146–7.
3. Chin-Hong P, Alexander KM, Haynes N, Albert MA, The Association of Black C. Pulling at the heart: COVID-19, race/ethnicity and ongoing disparities. Nat Rev Card. 2020;17:533–5.
4. Williamson EJ, Walker AJ, Bhaskaran K, et al. Factors associated with COVID-19-related death using OpenSAFELY. Nature. 2020;584:430–6.
5. Holtgrave DR, Barranco MA, Tesoriero JM, Blog DS, Rosenberg ES. Assessing racial and ethnic disparities using a COVID-19 outcomes continuum for New York State. Ann Epidemiol. 2020;48:9–14.
6. La Marca A, Capuzzo M, Paglia T, Roli L, Trenti T, Nelson SM. Testing for SARS-CoV-2 (COVID-19): a systematic review and clinical guide to molecular and serological in-vitro diagnostic assays. Reprod Biomed Online. 2020;41:483–99.
7. Elbadawi A, Elgendy IY, Sahai A, et al. Incidence and outcomes of thrombotic events in symptomatic patients with COVID-19. Arterioscler Thromb Vasc Biol. 2020:ATVBAHA120315304.
8. Apicella M, Campopiano MC, Mantuano M, Mazoni L, Coppelli A, Del Prato S. COVID-19 in people with diabetes: understanding the reasons for worse outcomes. Lancet Diabetes Endocrinol. 2020;8:782–92.
9. Huang S, Wang J, Liu F, et al. COVID-19 patients with hypertension have more severe disease: a multicenter retrospective observational study. Hypertens Res. 2020;43:824–31.
10. Zuo Y, Estes SK, Ali RA, et al. Prothrombotic autoantibodies in serum from patients hospitalized with COVID-19. Sci Transl Med. 2020;12.
11. Merz LE, Sinnenberg L, Gerhard-Herman MD, Vaduganathan M. Extensive arterial thrombosis in Covid-19. Am J Cardiol. 2020;134:148–9.
12. Smilowitz NR, Subashchandran V, Yuriditsky E, et al. Thrombosis in hospitalized patients with viral respiratory infections versus COVID-19. Am Heart J. 2020;231:93–5.
13. Lackland DT. Racial differences in hypertension: implications for high blood pressure management. Am J Med Sci. 2014;348:135–8.
14. Waldron FA, Benenson I, Jones-Dillon SA, et al. Prevalence and risk factors for hypertensive crisis in a predominantly African American inner-city community. Blood Press. 2019;28:114–23.
15. Terpos E, Ntanasis-Stathopoulos I, Elalamy I, et al. Hematological findings and complications of COVID-19. Am J Hematol. 2020;95:834–47.
16. Signorello LB, Schlundt DG, Cohen SS, et al. Comparing diabetes prevalence between African Americans and Whites of similar socioeconomic status. Am J Public Health. 2007;97:2260–7.
17. Rodriguez F, Solomon N, de Lemos JA, et al. Racial and ethnic differences in presentation and outcomes for patients hospitalized with COVID-19: Findings from the American Heart Association's COVID-19 Cardiovascular Disease Registry. Circulation. 2020.
18. Richardson S, Hirsch JS, Narasimhan M, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York city area. JAMA. 2020;323:2052–9.