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Brief communication

The effect of race, socioeconomic status, and comorbidity on patients afflicted with COVID 19: A Local Perspective

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ABSTRACT

Purpose: The aim of this study is to further examine the associations of race, socioeconomic factors, and comorbidity with COVID-19 health outcomes.
Methods: This is a retrospective cohort study of 309 PCR confirmed COVID-19 positive adults who presented to Tulane Medical Center in New Orleans, LA, from March 9 to May 29, 2020. The primary outcomes investigated were need for invasive mechanical ventilation (IMV) and in-hospital mortality. A multivariate analysis was performed to determine socioeconomic and medical risk factors for IMV and in-hospital mortality.
Results: Compared to white patients, Black patients were more likely to present younger, female, obese, unemployed, and underinsured. However, when controlled for common risk factors, Black and white patients had similar risk for IMV and mortality. Increased age (≥65 years), obesity, and increased comorbidity were associated with increased risk for IMV and mortality.
Conclusions: Race and socioeconomic factors may increase risk for COVID-19 infection but did not affect health outcomes within the hospital setting. Therefore, the higher rates of COVID-19 infection and mortality in vulnerable populations may be better explained by lower socioeconomic status, with subsequent higher comorbidity, in these populations. Community health initiatives should be prioritized in response to the COVID-19 pandemic.

Introduction

The world has been stunned by the spread of novel coronavirus disease 2019 (COVID-19) and its effect on disparate populations [1]. Internationally, several risk factors and underlying comorbidities have been noted to increase the prevalence and mortality of COVID-19. Bonanad et al. found that those 60–69 years of age were over three times more likely to die from COVID-19 disease compared to those 50–59 years of age (Odds Ratio =3.13) [2]. Other studies demonstrated that hypertension [3], diabetes mellitus [4], and obesity [5] are associated with increased severity of infection. Knowledge of risk factors and comorbidities are paramount for both risk stratification and optimization of healthcare outcomes.

Abbreviations: BMI, body mass index; CCI, Charlson Comorbidity Index; CI, confidence interval; COVID-19, novel coronavirus-2019; EHR, electronic health record; ICU, intensive care unit; IMV, invasive mechanical ventilation; OR, odds ratio; PCR, polymerase chain reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; SES, socioeconomic status.

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The heterogenous effects of COVID-19 are no more evident than in the United States. Heterogeneity has also been observed by socioeconomic status (SES) and structural racism in the UK, Canada, and Sweden [6-8]. In the United States, there is heterogeneity between different states, with higher prevalence and worse outcomes in states with larger proportions of Black and Hispanic persons [9]. As of August 5, 2021, in the United States, there have been over 35,300,000 confirmed cases and over 615,000 attributed deaths, ranking the United States first worldwide [10]. Much like the Spanish Flu of 1918, the COVID-19 pandemic has differentiated by race and SES, in addition to age [11-15]. In a study comparing the effect of COVID-19 among New York City boroughs, the Bronx (the borough with the highest proportion of Black Americans and lowest median income) had the highest rate of hospitalization and mortality [13]. Similarly, Raifman et al. showed that patients who are Black and reside in low-income households were at increased risk for poor health outcomes, which were thought to be exponentiated by lack of health insurance [14]. On a national level, data through August 5, 2021, demonstrate that non-Hispanic Black and Hispanic or Latino persons have a mortality rate nearly 2.0 and 2.3 times that of non-Hispanic white persons, regardless of age [15]. These results suggest a COVID-19 disparity in the context of racial background and SES. This may be reflective of the association of lower SES and other poor health outcomes, which is well established in the United States [16,17].

COVID-19 related disparities at both the state and local level in Louisiana have been well documented. According to state data through July 28, 2021, 38% of COVID-19 related fatalities were among Black persons [18], despite making up only 33% of the population [19]. This may be reflective of the initial epicenter of COVID-19 in the state being New Orleans [20], a city where the majority (59%) of the population is Black [21]. In a large cohort study primarily based in Louisiana, Black race, public insurance, and low-income residence were associated with higher risk of hospitalization among COVID-19 patients [22]. The aim of this descriptive cohort study is to further understand the impact of race, SES, and comorbidities on health outcomes, at a local level, in those treated for COVID-19 at an academic tertiary care medical center in New Orleans, Louisiana.

Material and methods

Study design and patient population

In this retrospective cohort study, we reviewed medical records of patients who presented to a single tertiary care hospital in New Orleans, Louisiana, from April 11 to May 29, 2020. In-hospital outcomes were assessed through June 12, 2020. Adult (≥18 years old) men and women who tested positive for SARS-CoV-2 by PCR were enrolled. Both patients admitted to the hospital and those who were directly discharged from the emergency department were included in this analysis. This study was approved by the Tulane University Biomedical Institutional Review Board and informed consent was waived.

Data collection

Data were retrospectively extracted via chart review by three authors (NM, AB, BC) using the institution's electronic health record (EHR) system. The sociodemographic information collected included age, sex, self-identified race, insurance coverage, and employment status (employed, unemployed, retired, disabled, student). For statistical analysis, disabled patients and students were considered unemployed. The common insurance types were Medicare (a federal insurance program for adults who are 65 years of age or older, disabled, or on dialysis), Medicaid (a federal-state program for low-income individuals), and private insurance (which is most often provided through employers). The EHR categorizes racial background as Black, white, Other, or Unknown. Patients with Unknown racial backgrounds were included with the Other racial group. Our EHR does not record ethnicity, thus we were unable to group patients by ethnicity.

Medical comorbidities were categorized based on the Charlson Comorbidity Index (CCI). The CCI is a validated system designed to categorize comorbidities, and each category is assigned a "weighted" score. The total score is used to predict clinical prognosis, with a higher score representing a poorer prognosis [23,24]. Body mass index (BMI, kg/m^2) and smoking history (past or present) were recorded for each participant. Intensive care unit (ICU) admission was also extracted from the EHR. The primary outcomes investigated were need for invasive mechanical ventilation (IMV) and in-hospital mortality comparing patients by racial background. Secondary exposures of interest were employment and insurance status.

Statistical analysis

Statistical analysis included bivariate cross-tabulation and Fisher's exact test between each of the independent factors and the outcomes of interest. Independent factors that demonstrated a significant association with the outcomes of interest were considered potential confounders and were included in the multivariate analysis. Additionally, employment status and racial background were selected *a priori* to be included in the multivariate models as the objective of the study is to elucidate the socioeconomic determinants of IMV and mortality in patients with COVID-19. A multivariate logistic regression model was used to calculate adjusted odds ratio (OR) and 95% confidence interval (CI). Statistical significance was set as (α=0.05). All statistical analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

Characteristics of the study population presenting to the hospital stratified by race

The majority of the 309 patients hospitalized for COVID-19 were Black: 240 (78%) Black, 40 (13%) white, 29 (9%) Other (Table 1). As compared to non-Black patients, Black patients were noted to be significantly younger (≥65 years: 32% vs 60%, P = .001), more likely to be female (60% vs 35%, P = .005), and more likely to be obese (55% vs. 36%, P = .037). Additionally, Black patients were more likely to be underinsured compared to their non-Black counterparts: Medicaid insurance (30% vs. 13%), uninsured (5.4% vs. 0.0%). With respect to employment, Black patients were more likely be unemployed (43% vs 20%) than their non-Black counterparts. Black and non-Black patients had similar baseline comorbidities on presentation, with similar CCI scores (P = .47). Rates of ICU admission (P>0.99), IMV (P = .35), and in-hospital mortality (P = .80) were also similar.

Rates of IMV

A total of 50 (16%) patients required IMV in our cohort (Table 2). The majority of those who required IMV were Black (n = 40, 80%), but this association was not significant (P = .48). There were significant differences in rates of IMV when stratified by age, BMI, and CCI score. Persons ≥65 years were more likely to require IMV compared to those <65 years (23% vs 12%, P = .01). Obese patients were more likely to require IMV compared to non-obese patients (69% vs 31%, P = .005). Additionally, patients with

Table 1
Characteristics of patients hospitalized with COVID-19 pneumonia

	All (n = 309)	Black (n = 240)	White (n = 40)	P-value *
Age ≥65 years	115 (37)	77 (32)	24 (60)	.001
Female Sex	171 (55)	143 (60)	14 (35)	.005
Obesity (BMI ≥30 kg/m^2)	155 (51)	130 (55)	14 (36)	.037
Employment status				
Unemployed	124 (40)	102 (43)	8 (20)	.001
Employed	101 (33)	84 (35)	12 (30)	
Retired	84 (27)	54 (23)	20 (50)	
Insurance				
Medicaid	85 (28)	73 (30)	5 (13)	.023
Medicare	140 (45)	104 (43)	22 (55)	
Private	65 (21)	50 (21)	13 (33)	
Uninsured	19 (6.2)	13 (5.4)	0 (0)	
Smoking history (past or present)	62 (21)	46 (19)	11 (28)	.29
CCI score				
0	87 (28)	62 (26)	14 (35)	.47
1	98 (32)	81 (34)	9 (23)	
2	45 (15)	34 (14)	6 (15)	
≥3	79 (26)	63 (26)	11 (28)	
ICU admission	66 (21)	50 (21)	8 (20)	>.99
IMV	50 (16)	40 (17)	4 (10)	.35
Died	40 (13)	28 (12)	5 (13)	.80

Presented as number (%).
CCI, Charlson Comorbidity Index.
IMV, invasive mechanical ventilation.
* Fisher's exact test between Black and White patients.

Table 2
Stratified analyses for IMV and in-hospital mortality

	Not Ventilated (n = 259)	Ventilated (n = 50)	P value *	Alive (n = 269)	Dead (n = 40)	P value *
Age ≥65 years	88 (34)	27 (54)	0.01	87 (32)	28 (70)	<.001
Female Sex	140 (54)	31 (62)	0.35	149 (55)	22 (55)	>.99
Race						
Black	200 (77)	40 (80)	0.48	212 (79)	28 (70)	.17
White	36 (14)	4 (8)		35 (13)	5 (13)	
Other	23 (8.9)	6 (12)		22 (8.2)	7 (18)	
Obesity (BMI ≥30 kg/m^2)	121 (47)	34 (69)	0.005	137 (52)	18 (46)	.61
Employment status						
Unemployed	106 (41)	18 (36)	0.08	109 (41)	15 (38)	.046
Employed	89 (34)	12 (24)		93 (35)	8 (20)	
Retired	64 (25)	20 (40)		67 (25)	17 (43)	
Insurance						
Medicaid	72 (28)	13 (26)	0.08	79 (29)	6 (15)	.007
Medicare	111 (43)	29 (58)		112 (42)	28 (70)	
Private	57 (22)	8 (16)		59 (22)	6 (15)	
Uninsured	19 (7.3)	0 (0)		19 (7.1)	0 (0)	
Smoking	53 (21)	9 (18)	0.85	54 (20)	8 (20)	>.99
CCI Score						
0	80 (31)	7 (14)	0.001	84 (31)	3 (7.5)	<.001
1	84 (32)	14 (28)		88 (33)	10 (25)	
2	40 (15)	5 (10)		40 (15)	5 (13)	
≥3	55 (21)	24 (48)		57 (21)	22 (55)	
CCI Score						
<3	204 (79)	26 (52)	<0.001	212 (79)	18 (45)	<.001
≥3	55 (21)	24 (48)		57 (21)	22 (55)	
IMV	–	–		23 (8.6)	27 (68)	<.001
Died	13 (5.0)	27 (54)	<0.001	–	–	

Presented as number (%).
CCI, Charlson Comorbidity Index.
IMV, invasive mechanical ventilation.
* Fisher's exact test.

a CCI score ≥3 were more likely to require IMV compared to those with a CCI score <3 (30% vs. 11%, P<.001). Sex (P = .35), employment status (P = .08), and insurance (P = .08) were not associated with need for IMV.

Rates of in-hospital mortality

A total of 40 (13%) patients died while hospitalized in our cohort (Table 2). The majority of the attributable deaths were in Black patients (n = 28, 70%), but this association was not significant (P = .17). There were significant differences in mortality when stratified by age, insurance status, and CCI score. Patients ≥65 years were more likely to die in the hospital than those <65 years (24% vs 6.2%, P<.001). Additionally, patients with a CCI score ≥3 were more likely to die compared to those with a CCI score <3 (28% vs. 7.8%, P<.001). Sex (P>.99) and obesity (P = .61) were not associated with in-hospital mortality.

Table 3
Multivariate analysis of factors associated with the risk of IMV and in-hospital mortality

	Ventilated (n = 50) *	P value †	In-Hospital Mortality (n = 40) *	P value †
Age				
<65 years	1 (Reference)		1 (Reference)	
≥65 years	2.5 (0.84–7.4)	.10	6.0 (1.9–19)	.002
Race				
Black	1 (Reference)		1 (Reference)	
White	0.47 (0.14–1.5)	.21	0.87 (0.28–2.7)	.81
Other	2.1 (0.74–6.2)	.16	3.8 (1.3–11)	.019
BMI				
<30	1 (Reference)		1 (reference)	
≥30	3.7 (1.8 – 7.9)	<.001	1.2 (0.54–2.5)	.71
Employment				
No	1 (Reference)		1 (Reference)	
Yes	0.96 (0.35 – 2.6)	.93	0.79 (0.22 – 2.8)	.71
Retired	1.4 (0.47 – 4.0)	.57	0.43 (0.15–1.2)	.12
Insurance				
Medicaid	1.6 (0.54–4.8)	.39	1.1 (0.31–4.2)	.85
Medicare	1 (Reference)		1 (Reference)	
Private	1.4 (0.40–4.7)	.62	1.8 (0.44–7.4)	.41
CCI Score				
0	1 (Reference)		1 (Reference)	
1	1.5 (0.54–4.1)	.45	3.0 (0.74–12.1)	.12
2	0.95 (0.26–3.5)	.94	2.9 (0.59–14)	.19
≥3	4.1 (1.5–11)	.008	9.5 (2.4–38)	.002

Presented as odds ratio (95% Confidence Interval).
CCI, Charlson Comorbidity Index.
IMV, invasive mechanical ventilation.
* Multivariate logistic regression model analysis includes age, race, employment, BMI, obesity, insurance, and CCI score.
† Fisher's exact test.

Multivariate analysis of covariates associated with IMV

In multivariate analysis, adjusted for age, race, BMI, employment, insurance status, and CCI score, compared to Black patients, there was no difference in risk for IMV in white (OR=0.47. 95% CI 0.14–1.5, P = .21) or Other (OR=2.1, 95% CI 0.74–6.2, P = .16) patients (Table 3). Obese patients had an increased risk of IMV (OR=3.74, 95% CI 1.77–7.87, P<.001) when compared to non-obese patients. When compared to a CCI score of 0, a CCI score ≥3 was associated with increased risk for IMV (OR=4.06, 95% CI 1.45–11.41, P = .008). Rates of IMV were similar in patients <65 years compared to those ≥65 years (P = .10). When compared to having Medicare insurance, there was no difference in risk for IMV in those with Medicaid (P = .39) or private insurance (P = .62). There was no association between employment status and need for IMV.

Multivariate analysis of covariates associated with in-hospital mortality

In multivariate analysis adjusted for age, race, BMI, employment, insurance status, and CCI score, compared to Black patients, there was an increased risk in Other patients (OR=3.8, 95% CI 1.3–11, P = .022) for in-hospital mortality; however, white patients had similar outcomes (OR=0.87, 95% CI 0.28–2.7, P = .81). When compared to those <65 years old, patient ≥65 years old had an increased risk of in-hospital mortality (OR=6.0, 95% CI 1.9–19, P = .002) (Table 3). When compared to a CCI score of 0, a CCI score ≥3 was associated with increased risk for in-hospital mortality (OR=9.5, 95% CI 2.4–38, P = .002). When compared to non-obese patients, there was no difference in risk of in-hospital mortality in obese patients (P = .71). When compared to having Medicare insurance, there was no difference in risk of in-hospital mortality with having Medicaid (P = .85) or private insurance (P = .41). There was no association between employment status and in-hospital mortality.

Discussion

Despite Black patients making up 47% of Tulane Medical Center's patient population in 2019, Black patients made up 78% of our cohort, and Black women were disproportionately affected. However, when controlled for confounding factors, our intragroup analysis showed comparable rates of IMV and in-hospital mortality between Black and white patients. Our results could be explained by our skewed study population or consistency of excellent care in a single tertiary care hospital. These findings are consistent with an institutional study published by Ochsner Health Center and a recent multicenter publication by Yehia et al. [22,25]. These reports suggest that Black people are at higher-risk for community-acquired COVID-19 infection requiring hospital presentation; however, once in the hospital-setting, there is no difference in health outcomes between Black and white patients. The observed racial disparity in COVID-19 exposure risk must be viewed in the context of SES and this must be explored further [26]. For example, it has been suggested that minorities and those from lower SES background have a more difficult time self-isolating due to work conditions, reliance on public transportation, and over-crowded households and neighborhoods which may increase their risk of acquired community infection [27,28]. In New Orleans, Louisiana, census data estimates that 77% of people who use public transportation as their primary source of transportation to work are Black, while 22% are white [29]. These disparities are similar to those seen in the H1N1 pandemic and are confounded by years of institutional racism, which has become increasingly acknowledged as a determinant of health outcomes [30,31]. Despite this increasing recognition, many states did not include racial and ethnic minority groups in their vaccine planning committees [32].

Although there was no significant difference based on race or socioeconomic factors, increased age (≥65 years old), obesity, and increased CCI were associated with a higher risk of adverse outcomes in our cohort. Obese patients and those with a CCI score ≥3 were nearly four times more likely to be ventilated. Patients

≥65 years and those with a CCI score ≥3 were six times and nine times more likely to die, respectively. Several comorbidities linked to increased severity of COVID-19 infection, such as hypertension, cardiovascular disease, obesity, and diabetes, have an increased prevalence in people of lower SES and Black Americans, which could explain the higher infection and mortality rates per capita in these patient populations [27,33,34]. It is with this lens that we must view the severity of the pandemic in lower SES and minority communities. Although age is not modifiable, obesity and comorbidities are modifiable risk factors for poor health outcomes in COVID-19 disease. Long-term solutions will be best served by identifying and targeting vulnerable populations and implementing community-based health interventions to decrease comorbidities and ensure access to COVID-19 vaccines [35].

There were some limitations to our study. First, this is a single-center study thus may not be generalizable. Additionally, as there is a limited sample size ($n = 309$), we may not have the power to demonstrate significant differences between groups.

Conclusions

Overall, we take these data to support that racial and SES factors increase the risk for community exposure to, and infection with, COVID-19 but do not affect outcomes once within the hospital setting. These data underscore the importance of a community health approach which include racial and ethnic minority groups in the planning of our responses to this global pandemic. As the current pandemic has taught us, we still have a great deal of the same disparities seen with the H1N1 pandemic and have a dire need to address these now, and for future pandemic preparedness.

Credit author statement

Nicholas Mankowski: Conceptualization, Methodology, Validation, Investigation, Writing – Original Draft, Writing – Review & Editing. Zaid Al-Qurayshi: Conceptualization, Methodology, Investigation, Writing – Review & Editing. Spenser Souza: Conceptualization, Methodology, Writing – Original Draft, Writing – Review & Editing. Brett Campbell: Investigation, Writing – Original Draft. Adam Beighley: Investigation, Writing – Original Draft. Joshua Denson: Conceptualization, Writing – Review & Editing. Brandon Mauldin: Conceptualization, Writing – Review & Editing. Christine Bojanowski: Conceptualization, Writing – Review & Editing. Paul Friedlander: Conceptualization, Methodology, Validation, Investigation, Writing – Review & Editing. Jerry Zifodya: Conceptualization, Methodology, Validation, Investigation, Writing – Original Draft, Writing – Review & Editing.

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