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Research Article

Socioeconomic Status, Race, and Patient Outcomes in Patients with COVID-19

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Abstract

Background: Data suggest disparities in healthcare outcomes of minority populations. Etiologic factors of these disparities include race-associated comorbidities and socioeconomic status. Health disparities have been further intensified due to COVID-19 and its sequelae. Black and Hispanic people have reported higher infection rates and complications of COVID-19. **Objective**: The purpose of this study was to determine relationships among outcomes of patients with COVID-19 and select demographics including socioeconomic status (SES, reflected by zip code of primary residence), Sequential Organ Failure Assessment Score, race, sex, and payor. **Methods**: A retrospective chart review of 100 patients who were admitted to the ICU of an academic medical center in the south eastern United States with COVID-19 was conducted. **Results:** There were no statistically significant differences between zip code of primary residence (SES), days until organ failure, or patient survival. African American patients had the shortest time to organ failure development. **Conclusions:** While disparities in healthcare outcomes exist in minority populations and those of lower SES, this trend did not manifest in our patient cohort.

Keywords: Health disparities; Race; Socioeconomic status; Data analysis; COVID-19

Introduction

A novel respiratory pathogen, coronavirus SARS-CoV-2, [1] caused an outbreak of respiratory illnesses beginning in Wuhan, China in December 2019 [2] Within weeks, cases had been reported in the United States [3] and Europe,[4] heralding a global pandemic of over 600,000 cases and 28,000 deaths by the end of March 2020[5]. To date, in the United States, there have been over 111 million cases of coronavirus and over 1.2 million reported deaths [6]. Researchers in medicine, public health, and nursing have been reporting the disparities in health care outcomes of minority populations [7]. Some etiologic factors of these disparities that have been identified include race-associated comorbidities, [8-9] destitution/socioeconomic status (SES), [8-12] longstanding distrust of health care providers and health care systems,8 lack of access to health care for treatment of chronic conditions, [9,11] language barriers, [8-10,13] multiple generations living in the same household, [8,9] having jobs that cannot be performed remotely, [9] need to use public transit, [9] low level of education, [10] poor housing conditions, [10] and knowledge deficits about symptoms to report and how to mitigate the spread of COVID-19 [9].

Each of these variables leads to adverse COVID incidence due to the potential for close proximity to others with coronavirus, which leads to increased transmission risk to vulnerable individuals [14]. Non-remote workers potentionally were less able to protect themselves from COVID-19 [15]. Health care disparities have been further intensified due to COVID-19 and its associated sequelae. [8,10,16] Black, indigenous, and people of color (BIPOC) including Hispanic people have reported higher infection rates [16-17] and complications of COVID-19. Data are not consistent regarding infection rate in these racial groups [18] as well as Asian people. According to the Centers for Disease Control and Prevention, [19] the rate of hospitalization for BIPOC patients is 2.3 times higher than White persons. These data are corroborated by others. These latter data compared racial minority populations with majority groups [20-26]. The death rate is up to 1.7 times higher in BIPOC people than non-Hispanic White persons [8,20]. Similarly, Hispanic or Latino persons have a 2.2 times higher hospitalization rate and 1.8 to 3.2 times higher death rate compared to White persons. Data are lower for persons of Asian, non-Hispanic persons with a 0.8 times higher rate of hospitalization and death than White persons [8,16,24]. The risk of death from COVID-19 among Asian populations, however, is similar to that of White populations.

There are inadequate data to discern differences among other racial/ethnic groups.16 Data on differences among various race and ethnic groups (non-Hispanic Black, Asian/Pacific Islander, American Indian/Alaskan Native) are corroborated by others [27]. The mortality rates were similarly lower in non-Hispanic White persons than the other racial groups with an increased risk of death reported in those younger than 65 years of age.27 Data on mortality rates and severity of illness vary among states [28] and are inconsistent [10]. In another study, BIPOC patients accounted for more than 50 percent of in-hospital patients who died from COVID-19. However, Asian persons in this study had more severe cardiopulmonary disease. The authors attributed these latter findings to fear of being attacked based on their race, language barriers, immigration status (which can result in lack of health insurance) and lower SES, the latter of which can impact receipt of high-quality health care [29]. Other data, albeit inconsistent, acknowledge the relationship among these socioeconomic variables, COVID-19 infection rate, and patient outcomes [10,30].

The increased rate of COVID-19 infections and death rate are most evident in rural areas [11]. This is partly attributed to limited testing and vaccination rates. Those in rural areas tend to be older, have inadequate or no health insurance, and have more comorbidities, which can put them at increased risk for poorer outcomes from COVID-19. Several of these comorbidities (e.g., hypertension, diabetes, obesity) are common in BIPOC patients. Persons living in rural areas have limited access to health care because of the limited availability of primary care providers [8]. Data also suggest that those living in rural areas were less likely to adhere to COVID-19 prevention methods such as wearing a mask and social distancing [31]. There is also a higher incidence of 'vaccine hesitancy' in persons from rural areas [32]. BIPOC patients living in rural areas have a reported higher infection, hospitalization, and mortality rates when compared to non-hispanic White people [17,31,33-35] and are more vulnerable to COVID-19 infections during surges associated with new variants [7].

Methods

Study Design

A retrospective chart review was performed on 100 patients at least 18 years of age who were admitted to the intensive care unit (ICU) of an academic medical center in the southeast United States and who tested positive for COVID-19 via polymerase chain reaction. All patients admitted to the unit study site were positive for COVID-19; the unit was the first designated COVID-19 intensive care unit of the hospital. The first 100 patients were evaluated for this study. Given a sample size of 100, we were powered at 80% and 5% level of significance to detect moderate effect sizes for all bivariate associations between the measures (r=0.25-0.30 for continuous measures, ω=0.26-0.31 for categorical/dichotomous measures); and powered to detect f2=0.11 to 0.17 for a linear prediction model with up to 5 predictors. For a dichotomous outcome (such as death with an expected rate of 20%), we were also powered to detect odds ratios of 1.95 to 2.32, where an odds ratio of 2.5 is considered to be a moderate effect size.

Study Procedure

This study received exempt status from the Institutional Review Board. Patients were admitted over an 8-month period during a COVID-19 surge. Patients were hospitalized in October 2020 through May 2021. Select patient demographics and study variables (Table 1) were collected from the electronic medical record. Data were recorded as they were reported by the patient or family member (if the patient was unable to self-report). Payor information was collected from a pre-selected group. Medicare and Medicaid are listed as one option (US government sponsored healthcare plan) despite differences in eligibility for individuals and impact of socioeconomic status. Patient race was similarly documented based on patient self-report. There is no specific delineation of types of Black patients (e.g., African, Caribbean immigrant, Black Hispanic) in the hospital's admission database.

Study Instrument

The Sequential Organ Failure Assessment (SOFA) was developed in 1996 to evaluate patients' severity of illness based on the extent of organ dysfunction. It is commonly used in the intensive care unit setting. Good validity and reliability have been reported [36,37]. An interclass correlation coefficient of .889 was established among physicians [36].

Determination of whether patients lived in a vulnerable zip code was derived from the OASIS Online Analytical Statistical Information System website, which delineates the demographic clusters in the state of Georgia https://oasis.state.ga.us/gis/

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demographiccluster/democlusters2011.htm. A description of the address county is provided including where residents rank in terms of the state average income. Based on the patient's reported primary address, the zip code was entered into the website. These data were used to categorize patients into socioeconomic groups.

Age	**Overall (n=100)**
Mean (SD)	62.4 (17.12)
Range	25 - 99
Median	63.5
Gender	
Male	57 (57%)
Female	43 (43%)
SOFA score	
Mean (SD)	5.8 (3.16)
Range	Jan-14
Median	5
Survived or not	
Died	23 (23%)
Survived	77 (77%)
Organ Failure or not	
Organ Failure No	27 (27%)
Organ Failure Yes	73 (73%)
Race: AA vs Caucasian vs Other	
AA	60 (60%)
Caucasian	26 (26%)
Asian, Hispanic, Unknown	14 (14%)
Payor	
Government	12 (12%)
HMO	21 (21%)
Medicare/Medicaid	60 (60%)
Commercial, Blue Cross Blue Shield	7 (7%)
Zip code Vulnerable Yes vs No	
No	56 (56%)
Yes	44 (44%)
Note: AA, African American; HMO, Health Maintenance Organization; SOFA, Sequential Organ Failure Assessment.	

Table 1: Descriptive Statistics of Sample.

Data Analysis

All data were reviewed for completeness, missing values, outliers, and possible typographical errors or other unusual or invalid values. Descriptive statistics were run for all demographics. Comparisons tests (t-tests for continuous data and chi-square tests for ordinal and categorical data) were performed for all demographics. Regression analyses (linear or logistic as needed for each outcome) were performed to determine the relationships among the independent and dependent variables. SPSS v.28 (IBM Corp. Released 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp.) Statistical analysis software were used for all analyses with 5% level of significance used for all tests.

Results

The one-hundred COVID patient ages ranged from 25 - 99 years with an average age of 62.4 (SD 17.1) years. Slightly more were male (57%), and African American (AA) (60%). The majority had Medicare/Medicaid (60.0%) as their payor with 21% having a health maintenance organization (HMO), 12% having government insurance and 7% having either commercial or private (Blue Cross Blue Shield) insurance. Forty-four percent of the patients lived in a vulnerable zip code. Sequential Organ Failure Assessment (SOFA) scores for the 100 patients ranged from 1 to 14 with a median score of 5. The majority survived (77%) despite 73% having organ failure (Table 1).

There was a significant association between survival and organ failure with none of the patients without organ failure dying ($p < .001$). However, there were no other significant differences between the patients who survived and those who did not for zip code of primary residence, age, sex, payor, nor race. However, descriptively, the patients who died were more non-Caucasian; a higher proportion of AA and Asian, Hispanic, or unknown (Table 2).

	Died (N=23)	Survived (n=77)	Total (n=100)	p value
Age				0.325[1]
Mean (SD)	65.52 (15.5)	61.49 (17.56)	62.4 (17.12)	
Range	34 – 90	25 – 99	25 – 99	
Median	66	61	63.5	
SOFA Score				0.689[2]
Mean (SD)	6.13 (3.63)	5.69 (3.02)	5.79 (3.16)	
Range	1 – 13	2 – 14	1 – 14	
Organ Failure or Not				< 0.001[3]
Organ Failure No	0 (0%)	27 (35.1%)	27 (27%)	
Organ Failure Yes	23 (100%)	50 (64.9%)	73 (73%)	
Race (AA vs Caucasian vs Other)				0.068[4]
AA	16 (69.6%)	44 (57.1%)	60 (60%)	
Caucasian	2 (8.7%)	24 (31.2%)	26 (26%)	
Asian, Hispanic, Unknown	5 (21.7%)	9 (11.7%)	14 (14%)	
Payor				0.454[4]
Government	4 (17.4%)	8 (10.4%)	12 (12%)	
HMO	5 (21.7%)	16 (20.8%)	21 (21%)	
Medicare/Medicaid	14 (60.9%)	46 (59.7%)	60 (60%)	
Commercial, Blue Cross Blue Shield	0 (0%)	7 (9.1%)	7 (7%)	
Zip Code Vulnerable Yes vs No				0.592[3]
No	14 (60.9%)	42 (54.5%)	56 (56%)	
Yes	9 (39.1%)	35 (45.5%)	44 (44%)	
1. Linear Model ANOVA				
2. Kruskal-Wallis rank sum test				
3. Pearson’s Chi-squared test				
4. Fisher’s Exact Test for Count Data				
Note: AA, African American; HMO, Health Maintenance Organization; SOFA, Sequential Organ Failure Assessment.				

Table 2: Survival-Comparison Characteristics.

Additionally, there were no significant differences between patients who had organ failure versus those who did not for age, sex, race, zip code of primary residence, and payor. However, patients who had organ failure were more likely to have Medicare/Medicaid as their payor (Table 3). The only significant difference was for SOFA scores. That is, patients with organ failure had significantly higher SOFA scores (median 6) compared to patients without organ failure (median 3), (p = .003.) (Table 3). When looking at length of stay, there was no significant effect for age nor SOFA scores and no significant differences between sex, race, payor, and zip code of primary residence categories.

	Organ Failure No (n=27)	Organ Failure Yes (n=73)	Total (n=100)	p value
Age				0.147[1]
Mean (SD)	58.33 (18.23)	63.93 (16.56)	62.42 (17.12)	
Range	27 – 94	25 – 99	25 – 99	
Median	58	64	63.5	
SOFA Score				0.003[2]
Mean (SD)	4.44 (2.93)	6.29 (3.12)	5.79 (3.16)	
Range	2 – 14	1 – 13	1 – 14	
Median	3	6	5	
Survived or Not				< 0.001[3]
Died	0 (0%)	23 (31.5%)	23 (23%)	
Survived	27 (100%)	50 (68.5%)	77 (77%)	
Sex				0.527[3]
Male	14 (51.9%)	43 (58.9%)	57 (57/%)	
Female	13 (48.1%)	30 (41.1%)	43 (43%)	
Race: AA vs Caucasian vs Other				0.158[4]
AA	12 (44.4%)	48 (65.8%)	60 (60%)	
Caucasian	10 (37%)	16 (21.9%)	26 (26%)	
Asian, Hispanic, Unknown	5 (18.5%)	9 (12.3%)	14 (14%)	
Payor				0.099[4]
Government	3 (11.1%)	9 (12.3%)	12 (12%)	
HMO	8 (29.6%)	13 (17.8%)	21 (21%)	
Medicare/Medicaid	12 (44.4%)	48 (65.8%)	60 (60%)	
Commercial, Blue Cross	4 (14.8%)	3 (4.1%)	7 (7%)	
Zip Code Vulnerable Yes vs No				0.336[3]
No	13 (48.1%)	43 (58.9%)	56 (56%)	
Yes	14 (51.9%)	30 (41.1%)	44 (44%)	
1. Linear Model ANOVA				
2. Kruskal-Wallis rank sum test				
3. Pearson's Chi-squared test				
4. Fisher's Exact Test for Count Data				
Note: AA, African American; HMO, Health Maintenance Organization; SOFA, Sequential Organ Failure Assessment				

Table 3: Organ Failure-Comparison Characteristics.

When looking at days to organ failure, there was no significant effect for age nor SOFA scores. However, higher SOFA scores (greater than 5) did show shorter days to organ failure (3.6 days) compared to those with lower SOFA scores (5 or less) mean days to organ failure (6.0 days.) Additionally, there were no significant difference between sex, race, payor, and zip code of primary residence categories for days to organ failure. However, AAs had the shortest time to organ failure (2.5 days) compared to Caucasian (7.0 days) and other racial groups (7.8 days). Patients with Medicare/Medicaid as their payor had the shortest time to organ failure (3.3 days), followed by government insurance (4.3 days), health maintenance organization (HMO) (7.1 days) and commercial/private insurance (7.4 days). For the SOFA scores, no significant correlation was seen for age and no significant differences seen for sex, race, payor and zip code of primary residence categories.

Discussion

The purpose of this study was to determine relationships among outcomes of patients with COVID-19 and select demographics including socioeconomic status (SES, reflected by zip code of primary residence), Sequential Organ Failure Assessment Score, race, sex, and payor. The COVID-19 pandemic has augmented the known disparities that exist in health care. It was observed that infection rates and mortality numbers were increased in disadvantaged communities [38-43]. while previous studies have reported these disparities during the pandemic, this study focused on clinical outcomes with a primary focus on SES.

The key question in health disparities research seeks to understand what factors are associated with poorer health outcomes. The conditions leading to these disparities are tied to several factors including the function of social determinants of health. Social Determinants of Health are defined as “the conditions in the environment where people are born, live, work, play, worship and age that affect a wide range of health, function, and quality of life outcomes and risks” [42]. Conflicting results of studies evaluating the relationship between SES and ICU mortality are reported. Some previous data suggest that patients of lower SES are less likely to survive [43-46]. Other data suggest no relationship between these two variables [47-53] our study supports these latter findings of no relationship between lower SES and ICU mortality.

Lower SES is often associated with a higher incidence of pre-existing conditions (e.g., hypertension, obesity, diabetes) that may influence severity of illness associated with COVID-19.47 However, during the pandemic, as with other public health crises, larger health care systems are called to provide access to care. During a public health crisis, health care systems suspend business as usual and enact their disaster preparedness plans. These plans provide for shared resources and access to populations as needed. The COVID-19 pandemic stressed the capacity of these systems and amplified that the systems in place to prevent undue harm especially to those in disadvantaged areas and situations were not adequate [39,40,54].

Our findings also did not corroborate previous data on the relationship between age and survival. No statistically significant relationship was reported in our sample (p =0.325). The centers for disease control and prevention, [38] using the age group range of 18 to 29 years as the reference, reports an increased risk of death of 3.5 to 350 times as patients from 30 to 85+ years old were hospitalized for COVID-19. Other data suggest an increased risk of death by 7.8% in patients aged over 80 years [55]. Two possible explanations for the higher risk of death with age is the lower number of older patients who received first and second COVID-19 boosters when compared to the original vaccine series and the wavering immunity over time from the original vaccines [56]. In our study, we did not record the vaccination status of those admitted. Another explanation is the number of aforementioned comorbidities associated with mortality in COVID-19 progressively rises with age [57].

With more than 3 million deaths worldwide and widespread social and economic costs, the pandemic must demand change and investment in resilience and people-centeredness, starting with health systems. COVID-19 offers a new opportunity for solidarity both within and between countries. It also reminds us that health is more than health care and that health and wellness require a systematic approach to design systems that can work together to provide for all populations [58]. Programs aimed at addressing health disparities should focus on modifiable factors. A full analysis of the COVID-19 experience on all populations with a focus on marginalized populations is essential for the development of effective strategies for the future. Future strategies should focus on creating healthy populations able to collectively prevent and respond to crises, leaving no one behind.

Limitations of this study are four-fold. First, this was a single-site study. As such, this limits the external validity of the findings. Second, the study was conducted in an academic medical center during one of the COVID-19 surges. The multidisciplinary team had access to a plethora of data that may have influenced clinical decision-making and hence, our results. Third, there was no distinction between Medicare and Medicaid patients in our analysis as these data are not separated during the admission process; there is only one option for these two forms of healthcare coverage. Patients in these two groups may differ in socioeconomic status. Fourth, SES status in this study was operationalized by zip code of primary residence. SES can vary within zip codes. The OASIS website describes where residents rank in terms of the state average income. Finally, patients' COVID-19 vaccination status was unknown, as these data are not collected during the admission process.

Conclusion

While the pandemic is over, COVID-19 remains a leading cause of death in the United States. The overall death rates remain highest among Black and American Indian people [59] while the average number of new cases of COVID-19 are continuing to decrease, those admitted to the ICU require equitable evidence-based quality care. As of December 17, 2023, there were 2,457 patients with COVID-19 in the ICU in the United States [60].

Our study findings provide additional insight into the relationship among factors that influence outcomes of patients with COVID-19 with a focus on SES. Future research should expand to include other factors that directly influence SES in relation to patient outcomes. Further, comparing the impact on SES on patient outcomes in countries outside of the United States where other types of health insurance are available may provide better insight into the relationship among the study variables.

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