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MAJOR ARTICLE

Demographic Disparities in Clinical Outcomes of COVID-19: Data From a Statewide Cohort in South Carolina

Xueying Yang,[1,2,3] Jiajia Zhang,[1,2,4] Shujie Chen,[1,2,4] Bankole Olatosi,[1,2,5] Larisa Bruner,[6] Abdoulaye Diedhiou,[6] Cheryl Scott,[6] Ali Mansaray,[6] Sharon Weissman,[1,2,7] and Xiaoming Li[1,2,3]

[1]South Carolina SmartState Center for Healthcare Quality, Arnold School of Public Health, University of South Carolina, Columbia, South Carolina, USA, [2]University of South Carolina Big Data Health Science Center, Columbia, South Carolina, USA, [3]Department of Health Promotion, Education and Behavior, Arnold School of Public Health, University of South Carolina, Columbia, South Carolina, USA, [4]Department of Epidemiology and Biostatistics, Arnold School of Public Health, University of South Carolina, Columbia, South Carolina, USA, [5]Department of Health Services Policy and Management, Arnold School of Public Health, University of South Carolina, Columbia, South Carolina, USA, [6]South Carolina Department of Health and Environmental Control, Columbia, South Carolina, USA, and [7]Department of Internal Medicine, School of Medicine, University of South Carolina, Columbia, South Carolina, USA

Background. Current literature examining the clinical characteristics of coronavirus disease 2019 (COVID-19) patients underrepresent COVID-19 cases who were either asymptomatic or had mild symptoms.

Methods. We analyzed statewide data from 280 177 COVID-19 cases from various health care facilities during March 4–December 31, 2020. Each COVID-19 case was reported using the standardized Case Report Form (CRF), which collected information on demographic characteristics, symptoms, hospitalization, and death. We used multivariable logistic regression to analyze the associations between sociodemographics and disease severity, hospitalization, and mortality.

Results. Among a total of 280 177 COVID-19 cases, 5.2% (14 451) were hospitalized and 1.9% (5308) died. Older adults, males, and Black individuals had higher odds of hospitalization and death from COVID-19 (all $P < 0.0001$). In particular, individuals residing in rural areas experienced a high risk of death (odds ratio [OR], 1.16; 95% CI, 1.08–1.25). Regarding disease severity, older adults (OR, 1.06; 95% CI, 1.03–1.10) and Hispanic or Latino patients (OR, 2.06; 95% CI, 1.95–2.18) had higher odds of experiencing moderate/severe symptoms, while male and Asian patients, compared with White patients, had lower odds of experiencing moderate/severe symptoms.

Conclusions. As the first statewide population-based study using data from multiple health care systems with a long follow-up period in the United States, we provide a more generalizable picture of COVID-19 symptoms and clinical outcomes. The findings from this study reinforce the fact that rural residence and racial/ethnic social determinants of health, unfortunately, remain predictors of adverse health outcomes for COVID-19 patients.

Keywords. COVID-19; disease severity; hospitalization; mortality; South Carolina.

Since the first confirmed case of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus (SARS-CoV-2), in the United States on January 21, 2020, outbreaks of COVID-19 have surged quickly. The United States is among the countries hit the hardest by the pandemic [1]. As of July 19, 2021, there were >34 million COVID-19 cases with 612 105 deaths in the United States. South Carolina, a predominately rural state with significant health care shortage regions, has reported 614 912 COVID-19 cases and 9904 deaths as of July 29, 2021 [2].

The clinical spectrum of SARS-CoV-2 infection ranges from asymptomatic to life-threatening and death. Studies show that the presentation of symptoms plays a fundamental role in informing disease severity after COVID-19 diagnosis. Based on existing research, most individuals infected with SARS-CoV-2 are asymptomatic (around 40%–45% [3]) or experience mild to moderate symptoms [1]. About 14% of all cases become severe, and 5% critical [4]. Ongoing research continues to investigate clinical outcomes of COVID-19 patients in the United States. However, a large heterogeneity exists between these studies because of differences in clinical settings, sample selection methods, and statistical plans, which limits the generalizability of these findings.

Characteristics and clinical outcomes of COVID-19 patients have been frequently reported in the existing literature, but the data are not necessarily representative of the full spectrum of disease. Most of these studies have revealed increasing evidence that some racial and ethnic minority groups (eg, Black, Hispanic, or Latino) are over-represented in COVID-19 cases [5–9] and reported a disproportionate burden of hospitalizations, but not necessarily critical illness or death [10], in these groups [11, 12]. Despite an increasing body of US studies investigating clinical outcomes of COVID-19 patients, including hospitalization [6–8, 10, 13–17], mortality [8, 10, 13–16, 18], and intensive care unit (ICU)

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Correspondence: Xueying Yang, PhD, Big Data Health Science Center, South Carolina SmartState Center for Healthcare Quality, Arnold School of Public Health, University of South Carolina, Room 412, Discovery I Building, 915 Greene Street, Columbia, SC 29208 (xueyyang@mailbox.sc.edu).

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admission [16, 18], several knowledge gaps persist in existing research. First, the majority of patient samples were restricted to hospitalized COVID-19 cases or identified from a single health care system, which might be less representative of the majority of the outpatient COVID-19 population, who were either asymptomatic or had mild illness. Second, most of these studies collected data from the city level or hospital level, with relatively small sample sizes (305 to 78 323) and a short observational study period (1–2 months), further restricting the generalization of the findings to all COVD-19 populations. Third, presenting symptoms of COVID-19 patients, particularly nonhospitalized cases, were not previously investigated extensively. We proposed to address these gaps by using data from a population-based statewide cohort, which included all adult confirmed and probable COVID-19 cases in SC between March 4, 2020, and December 31, 2021. The present study analyzed sociodemographic characteristics, disease severity, and clinical outcomes of COVID-19 patients, including hospitalization and mortality.

METHODS

Data Source

Data for this study were derived from the SC statewide Case Report Form (CRF; "Human Infection With 2019 Novel Coronavirus Case Report Form") for SARS-CoV-2 infection issued by the SC Department of Health and Environmental Control (DHEC). The CRF contains information about lab-confirmed and probable cases of COVID-19, including case classification and identification, hospitalization, ICU and death information, case demographics, clinical course, symptoms, medical history, and social history. A total of 280 177 adult COVID-19 patients (age ≥18 years) who met the standardized surveillance case definition for COVID-19 [19] between March 4, 2020, and December 31, 2020, were included in the current study. SC Law (44-29-10) and Regulations (61-20) require mandatory reporting of COVID-19 to DHEC [20]. Where available, reports must include information about diagnoses and results of specific diagnostic tests. The sources of data include clinician reporting, laboratory reporting, reporting by other entities (eg, hospitals, veterinarians, pharmacies, poison centers), death certificates, hospital discharge, or outpatient records [19]. The criteria of case ascertainment were described in the standardized surveillance case definition of COVID-19 [19].

Patient Consent

The study protocol received approval from the institutional review board at the University of South Carolina and relevant SC state agencies.

Measures

Case Demographics

Information on social demographics included age (eg, 40–49, 50–59 years old), gender (eg, female, male, transgender), race (eg, White, Black, Asian), ethnicity (eg, Hispanic/Latino, non-Hispanic/Latino), and residential status. Residential status was defined according to the Rural-Urban Commuting Area (RUCA) codes, as urban areas (ie, metropolitan) or rural areas (ie, micropolitan, rural, and small town areas) [21].

Clinical Course and Symptoms

Clinical course information included symptom category during the onset of illness (ie, symptomatic, asymptomatic, unknown) and development of pneumonia and acute respiratory distress syndrome (ARDS). For symptomatic patients, the CRF documented specific symptoms that were experienced during the illness, such as fever, chills, muscle aches, runny nose, sore throat, new olfactory and taste disorders, headache, fatigue, cough, difficulty breathing, nausea or vomiting, abdominal pain, and diarrhea (Figure 1).

Outcomes

We analyzed 3 distinct outcomes: disease severity, hospitalization, and mortality of COVID-19. Individuals were asked to indicate any of the symptoms (eg, fever, headache, fatigue) specified on the CRF form. Each symptom had 3 responses, that is, "yes," "no," "unknown." Based on different presenting symptoms of COVID-19 patients, disease severity was categorized into 3 groups. Specifically, COVID-19 patients with no symptoms were categorized as asymptomatic; individuals who had any of the various mild signs and symptoms of COVID-19 (eg, fever, cough, sore throat, malaise, headache, muscle pain, nausea, vomiting, diarrhea, loss of taste and smell) were categorized as mild; whereas COVID-19 patients with difficulty breathing or who had developed pneumonia or ARDS were categorized as moderate/severe. Because we do not have other clinical indicators to separate moderate from severe illness, we combined them together. In the CRF, hospitalization was measured with 1 question, that is, "Was the patient hospitalized?" Responses were categorized as "yes," "no," "unknown." Patients with no response to this question were treated as unknown. We then dichotomized the hospitalization status as 1 if the response is "yes" and 0 to indicate no hospital admission. Similarly, death was measured using the question "Did the patient die as a result of this illness?" Response categories were "yes," "no," and "unknown." We used a similar strategy to define patient's death status where 1 indicated death and 0 indicated no death, including living and unknown status.

Statistical Analysis

Descriptive statistics were used to characterize the disease severity and clinical outcomes for COVID-19 cases. We used the chi-square test to compare differences between groups. We used logistic regression models to explore the association between sociodemographic characteristics and symptom severity (multinomial), hospitalization, and death in COVID-19 cases. We reported odds ratios (ORs) and 95% CIs for each model in

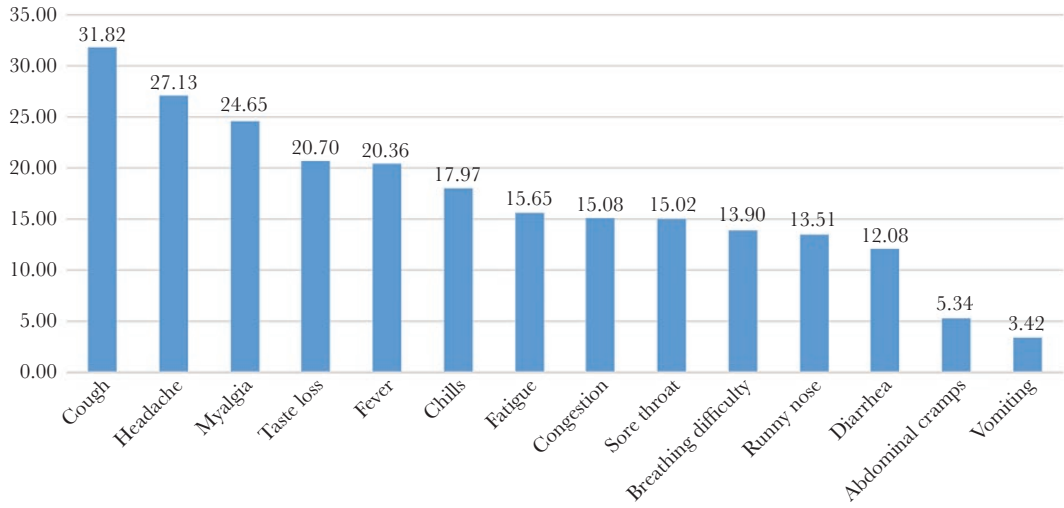

Figure 1. Percentages of symptoms among COVID-19 patients in South Carolina (n = 280 177). Abbreviation: COVID-19, coronavirus disease 2019.

tables and forest plots. *P* values <.05 were considered statistically significant. All statistical analyses were performed using SAS software, version 9.4 (SAS Institute, Inc., Cary, NC, USA) and R software (version 3.6.2).

RESULTS

Demographics and Disease Severity

A total of 280 177 COVID-19 cases were included in this analysis; 58.4% were aged 18–49 years (mean [SD], 45.7 [18.9]), 54.9% were female, and 53.7% were White. Slightly over half (51.5% or 144 157/280 177) of the cases were asymptomatic, 34.4% (96 252/280 177) were mild, and 14.2% (39 768/280 177) were moderate/severe cases (Table 1). Table 1 shows the baseline characteristics of the population, comparing asymptomatic, mild, and moderate/severe cases. Figure 1 illustrates the frequency of symptoms, with cough, headache, myalgia, taste loss, and fever being the most common ones. Hospitalization occurred in 5.2% (n = 14 451) of the COVID-19 cases, and 1.9% (n = 5308) died from COVID-19 (Table 2). Table 2 shows the baseline characteristics of the population by the dichotomized hospitalization (yes/no) or mortality (yes/no) outcome. Individuals with moderate/severe disease accounted for the largest proportion of all the clinical outcomes (ie, hospitalization [3.0%], ICU admission [0.6%], respiratory support [1.7%], and death [0.9%]) (Figure 2).

Association Between Sociodemographics, Disease Severity, Hospitalization, and Mortality

For COVID-19 disease severity, individuals who were older (65+; OR, 1.06; 95% CI, 1.03–1.10) and Hispanic or Latino (OR, 2.06; 95% CI, 1.95–2.18) were more likely to be moderate/severe cases, whereas male (OR, 0.84; 95% CI, 0.82–0.86) and Asian individuals (OR, 0.84; 95% CI, 0.75–0.95) were less likely to be moderate/severe cases (Table 3; Supplementary Figure 1).

Regarding hospitalization, older adults (65+; OR, 16.53; 95% CI, 15.65–17.46), males (OR, 1.39; 95% CI, 1.33–1.44), Asians (OR, 1.36; 95% CI, 1.10–1.68), Blacks (OR, 2.44; 95% CI, 2.33–2.55) or Hispanics (OR, 1.43; 95% CI, 1.29–1.57), and mild (OR, 1.16; 95% CI, 1.09–1.23) or moderate/severe (OR, 10.41; 95% CI, 9.87–10.97) cases were more likely to require hospitalization.

In terms of COVID-19-related mortality, individuals who were older adults (65+; OR, 66.74; 95% CI, 57.06–78.06), male (OR, 1.38; 95% CI, 1.30–1.47), Blacks (OR, 1.50; 95% CI, 1.40–1.61), and those living in a rural area (OR, 1.16; 95% CI, 1.08–1.25) had higher odds of mortality than their counterparts (Table 4; Supplementary Figure 1).

DISCUSSION

To the best of our knowledge, this is the first statewide population-based US study investigating COVID-19 disease severity and outcomes. This study provides robust evidence-based demographic disparities in COVID-19 disease severity, hospitalization, and mortality, particularly rural–urban disparities in COVID-19 mortality, which have rarely been reported in prior studies. Previous studies have focused more on the attributes of individuals who were more or less vulnerable (eg, race, gender) and paid little attention to the distinctive prospects for urban and rural areas [22]. In our study, people living in rural areas had higher risk of death, yet they did not require more hospitalization than urban residents. It is possible that rural residents were not hospitalized due to less health care accessibility, as is often the case. However, they risk presenting with higher disease severity later on, and are thus more likely to die due to less access to preventive therapies, such as monoclonal antibody therapy, which could slow the progression of disease. Another possible explanation is that the rural population might

Table 1. Sociodemographic Distribution of COVID-19 Disease Severity

Characteristics	Overall	Asymptomatic	Mild	Moderate/Severe	P Value[b]
Total	n = 280 177 (100%)	n = 144 157 (51.45%)	n = 96 252 (34.35%)	n = 39 768 (14.19%)	
Age					<.0001
Mean (SD), y	45.7 (18.9)				
18–49 y, No. (%)	163 508 (58.36)	85 664 (52.39)	57 052 (34.89)	20 792 (12.72)	
50–64 y, No. (%)	65 067 (23.22)	32 050 (49.26)	23 112 (35.52)	9905 (15.22)	
65+ y, No. (%)	51 602 (18.42)	26 443 (51.24)	16 088 (31.18)	9071 (17.58)	
Gender,[a] No. (%)					<.0001
Female	146 669 (54.86)	71 678 (48.87)	52 393 (35.72)	22 598 (15.41)	
Male	120 695 (45.14)	63 654 (52.74)	41 022 (33.99)	16 019 (13.27)	
Race,[a] No. (%)					<.0001
White	127 725 (53.68)	45 487 (35.61)	58 824 (46.06)	23 414 (18.33)	
Black	58 915 (24.76)	23 479 (39.85)	24 174 (41.03)	11 262 (19.12)	
Asian	2611 (1.1)	989 (37.88)	1177 (45.08)	445 (17.04)	
Other or unknown	48 704 (20.47)	34 878 (71.61)	9898 (20.32)	3928 (8.07)	
Ethnicity,[a] No. (%)					<.0001
Not Hispanic or Latino	162 507 (65.3)	54 977 (33.83)	75 825 (46.66)	31 705 (19.51)	
Hispanic or Latino	16 155 (6.49)	5774 (35.74)	7179 (44.44)	3202 (19.82)	
Unknown	70 184 (28.2)	55 393 (78.93)	10 924 (15.56)	3867 (5.51)	
RUCA,[a] No. (%)					<.0001
Urban	218 522 (81.67)	112 902 (51.67)	74 719 (34.19)	30 901 (14.14)	
Rural	49 052 (18.33)	23 885 (48.69)	17 651 (35.98)	7516 (15.32)	

Abbreviations: COVID-19, coronavirus disease 2019; RUCA, Rural-Urban Commuting Area codes.

[a]The sample size of these variables is not equal to the total sample size due to missing data.

[b]The *P* value is from chi-square test results and compared the rate differences of 3 categories of COVID-19 disease severity outcomes (ie, asymptomatic, mild, moderate/severe) across each exposure variable.

have more baseline comorbidities (eg, hypertension, diabetes), which greatly increase the risk of adverse COVID-19 outcomes. These findings inform us that the uniform state policies and actions might be insensitive to vulnerable rural areas and can have unintended consequences in amplifying inequalities. National programs need concerted efforts to improve the social and economic status in lagging areas.

Studies show that asymptomatic COVID-19-infected persons play a significant role in active transmission. According to the Centers for Disease Control and Prevention's (CDC's) best estimate, the infectiousness of asymptomatic individuals relative to symptomatic is 75% [23]. Thus, asymptomatic cases "substantially contribute to community transmission, making up at least 50% of the driving force" of COVID-19 infections [3]. However, determining the actual number of asymptomatic COVID-19 cases has been a significant challenge for researchers and public health officials. The proportion of asymptomatic cases in the present study is comparable to that of a narrative review [4] but higher than the best estimate (30%) reported by the CDC [23]. The data sources in our study incorporate statewide data about daily testing capacity and changes in testing rates over time, so we believe the findings from this study can provide a more accurate estimation of the proportion of COVID-19 infections that are asymptomatic. Given the large proportion of asymptomatic cases, it is crucial that everyone including individuals who do not show symptoms adheres to public health guidelines, such as mask wearing and social distancing.

Consistent with previous studies, older age was associated with hospitalization and mortality [6, 17, 24]. Older patients were less likely to display mild symptoms but more likely to display moderate/severe symptoms of COVID-19. Others have reported that older individuals with COVID-19 often present with nonspecific and atypical symptoms such as delirium, postural instability, or diarrhea [25–27], rather than the typical respiratory symptoms and fever. According to a meta-analysis, gastrointestinal symptoms including vomiting and diarrhea are strong predictors of developing severe COVID-19 illness [28]. Some of the atypical symptoms (eg, delirium) that occur in older adults might not be measured in our study. That may partially explain why older adults with fewer common symptoms are not necessarily less likely to develop severe symptoms. Therefore, we must prioritize the needs of older adults in our response to the COVID-19 pandemic.

While there is not a significant difference in the proportion of male and female COVID-19 cases, a disparity in hospitalization and death was observed. According to a recent meta-analysis using data from 46 countries and 44 US states, the gender differences observed in COVID-19 are a worldwide phenomenon, with men being more likely to die or require intensive care unit (ICU) admission for COVID-19 [29]. The

Table 2. Sociodemographic Disparities of COVID-19 Hospitalization and Mortality (n = 280 177)

	Hospitalization			Mortality		
Characteristics[b]	No[a] (n = 265 726)	Yes (n = 14 451)	*P* Value	No[a] (n = 274 869)	Yes (n = 5308)	*P* Value[c]
Age			<.0001			<.0001
18–49 y, No. (%)	161 207 (98.59)	2 301 (1.41)		163 311 (99.88)	197 (0.12)	
50–64 y, No. (%)	61 514 (94.54)	3553 (5.46)		64 308 (98.83)	759 (1.17)	
65+ y, No. (%)	43 005 (83.34)	8597 (16.66)		47 250 (91.57)	4352 (8.43)	
Gender, No. (%)			<.0001			<.0001
Female	139 548 (95.14)	7121 (4.86)		144 158 (98.29)	2511 (1.71)	
Male	113 641 (94.16)	7054 (5.84)		117 984 (97.75)	2711 (2.25)	
Race, No. (%)			<.0001			<.0001
White	120 673 (94.48)	7052 (5.52)		124 888 (97.78)	2837 (2.22)	
Black	53 384 (90.61)	5531 (9.39)		57 309 (97.27)	1606 (2.73)	
Asian	2487 (95.25)	124 (4.75)		2571 (98.47)	40 (1.53)	
Other or unknown	47 455 (97.44)	1249 (2.56)		48 224 (99.01)	480 (0.99)	
Ethnicity, No. (%)			<.0001			<.0001
Not Hispanic or Latino	151 085 (92.97)	11422 (7.03)		158 570 (97.58)	3937 (2.42)	
Hispanic or Latino	15 426 (95.49)	729 (4.51)		16 011 (99.11)	144 (0.89)	
Unknown	68 658 (97.83)	1526 (2.17)		69 458 (98.97)	726 (1.03)	
RUCA, No. (%)			<.0001			<.0001
Urban	207 715 (95.05)	10 807 (4.95)		214 713 (98.26)	3809 (1.74)	
Rural	45 809 (93.39)	3243 (6.61)		47 789 (97.43)	1263 (2.57)	
Symptom, No. (%)			<.0001			<.0001
Asymptomatic	141 112 (97.89)	3045 (2.11)		142 416 (98.79)	1741 (1.21)	
Mild	93 272 (96.9)	2980 (3.1)		95 225 (98.93)	1027 (1.07)	
Moderate/severe	31 342 (78.81)	8426 (21.19)		37 228 (93.61)	2540 (6.39)	

Abbreviations: COVID-19, coronavirus disease 2019; RUCA, Rural-Urban Commuting Area codes.

[a]The options of "no," "unknown," and missing value were all grouped into the "no" category.

[b]The sample size of some variables is not equal to the total sample size due to missing data.

[c]The *P* value is from chi-square test results and compared the rate differences of the dichotomized hospitalization and mortality across each exposure variable.

driving factors behind the gender difference may include fundamental differences in immune response (eg, CD4+ T cells, type 1 interferon, estrogen level) [30, 31] or cultural and behavioral differences (eg, smoking, handwashing frequency) [32, 33]. Therefore, an appreciation of how gender influences COVID-19 outcomes will have important implications for clinical management and mitigation strategies for this disease.

The COVID-19 pandemic has highlighted persistent racial/ethnic health disparities in the United States. Black,

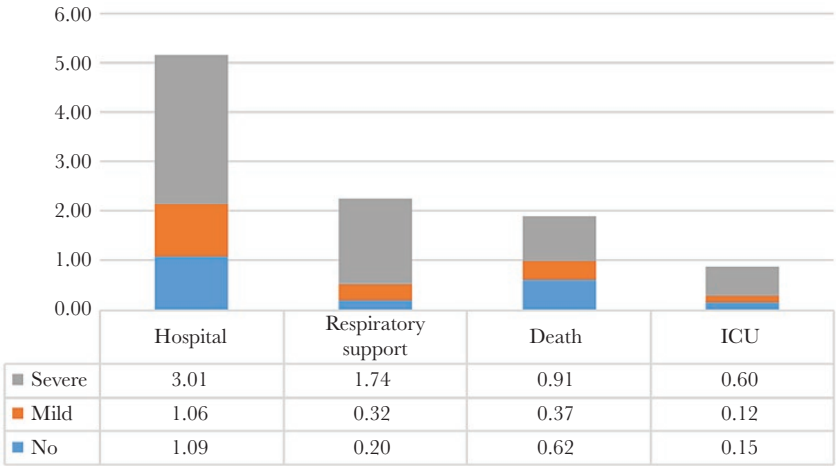

Figure 2. Clinical outcomes of COVID-19 patients stratified by disease severity (n = 280 177). Abbreviations: COVID-19, coronavirus disease 2019; ICU, intensive care unit.

Table 3. Associations Between Sociodemographics and COVID-19 Disease Severity[a]

Characteristics	Mild vs Asymptomatic, OR (95% CI)	*P* Value	Moderate/Severe vs Asymptomatic, OR (95% CI)	*P* Value
Age				
18–49 y	Ref			
50–64 y	0.95 (0.93–0.98)	<.0001	1.12 (1.08–1.16)	<.0001
65+ y	0.68 (0.66–0.70)	<.0001	1.06 (1.03–1.10)	.0004
Gender				
Female	Ref			
Male	0.92 (0.91–0.94)	<.0001	0.84 (0.82–0.86)	<.0001
Race				
White	Ref			
Black	0.84 (0.82–0.86)	<.0001	1.00 (0.97–1.03)	.8964
Asian	0.85 (0.77–0.93)	.0006	0.84 (0.75–0.95)	.0058
Other or unknown	0.3 (0.29–0.32)	<.0001	0.32 (0.30–0.34)	<.0001
Ethnicity				
Not Hispanic or Latino	Ref			
Hispanic or Latino	1.75 (1.68–1.84)	<.0001	2.06 (1.95–2.18)	<.0001
Unknown	0.33 (0.32–0.34)	<.0001	0.28 (0.27–0.29)	<.0001
RUCA				
Urban	Ref			
Rural	1.00 (0.98–1.03)	.7961	0.99 (0.95–1.02)	.4014

Abbreviations: COVID-19, coronavirus disease 2019; RUCA, Rural-Urban Commuting Area codes.

[a]Missing data were deleted in this regression analysis (n = 206 657).

Asian, and minority ethnic groups (termed "BAME" in the UK34) are over-represented among cases of hospitalization and deaths from COVID-19 in the present study. This is consistent with findings from both national and international studies [7, 35]. Of note, the crude risks of COVID-19 hospitalization and death among Hispanics or Latinos were lower

Table 4. Associations Between Sociodemographics and COVID-19 Hospitalization and Mortality[a]

	Hospitalization		Mortality	
Characteristics	OR (95% CI)	P Value	OR (95% CI)	P Value
Age				
18–49 y	Ref		Ref	
50–64 y	3.93 (3.70–4.16)	<.0001	8.85 (7.46–10.50)	<.0001
65+	16.53 (15.65–17.46)	<.0001	66.74 (57.06–78.06)	<.0001
Gender				
Female	Ref			
Male	1.39 (1.33–1.44)	<.0001	1.38 (1.30–1.47)	<.0001
Race				
White	Ref			
Black	2.44 (2.33–2.55)	<.0001	1.50 (1.40–1.61)	<.0001
Asian	1.36 (1.10–1.68)	.0043	1.35 (0.96–1.90)	.0813
Other or unknown	1.07 (0.99–1.16)	.1007	0.96 (0.84–1.08)	.4848
Ethnicity				
Not Hispanic or Latino	Ref			
Hispanic or Latino	1.43 (1.29–1.57)	<.0001	1.03 (0.85–1.24)	.7934
Unknown	0.70 (0.66–0.75)	<.0001	0.89 (0.81–0.99)	.0249
RUCA				
Urban	Ref			
Rural	1.04 (0.99–1.09)	.0953	1.16 (1.08–1.25)	<.0001
Symptom				
Asymptomatic	Ref			
Mild	1.16 (1.09–1.23)	<.0001	0.78 (0.72–0.86)	<.0001
Moderate/severe	10.41 (9.87–10.97)	<.0001	4.30 (3.98–4.63)	<.0001

Abbreviations: COVID-19, coronavirus disease 2019; RUCA, Rural-Urban Commuting Area codes.

[a]Missing data were deleted in these regression analyses (n = 206 657).

than non-Hispanics or Latinos. However, such differences could be explained by the differences in their demographic distributions. Hispanics or Latinos comprised of a higher proportion of younger populations than their counterpart (75.6% vs 54.0%) (Supplementary Table 1), and a significant interaction effect of age and ethnicity in affecting hospitalization and death was detected (Supplementary Table 2). This result could explain the inverse association (positive) between Hispanics or Latinos and COVID-19 hospitalization after adjusting the other variables. The likely causes of racial/ethnic health disparities in COVID-19 outcomes have been discussed extensively in prior studies [8, 10, 13, 15, 34, 36–41]. Some literature has argued that minority communities may be more susceptible to severe complications of COVID-19 because of existing disparities in underlying conditions known to be associated with COVID-19 mortality, including hypertension, cardiovascular disease, kidney disease, and diabetes. This might also support the assertion that existing structural determinants (eg, housing, economic stability, and work circumstances) pervasive in Black and Hispanic communities may explain the disproportionately higher out-of-hospital deaths due to COVID-19 infections in these populations. This might indicate that Black individuals are less likely to be identified in the outpatient setting, potentially reflecting differences in health care access or utilization. Additional research is needed to fully understand the impact of racial/ethnic disparities on COVID-19 outcomes. Given the over-representation of racial/ethnic minority patients with critical outcomes within this cohort, it is important for public health officials to ensure that prevention activities prioritize communities and racial/ethnic groups most affected by COVID-19.

The findings in this report are subject to several limitations. First, there were missing values for the outcomes, such as hospitalization and mortality. The missing values might cause inaccurate estimation of clinical outcomes. For example, if more hospitalized or deceased patients were misclassified into missing data, the outcomes might be underestimated in this study. Second, some important variables, such as underlying conditions, were not included in the current analysis. It is quite possible that our findings could be explained by differences in comorbid conditions or other factors in different populations. These conditions would merit separate analyses because of their clinical significance to COVID-19 research.

Despite the limitations, this study is still one of the first US statewide population-based studies using the entire population to investigate the presenting symptoms and clinical outcomes of COVID-19 patients. Such a population-based study can minimize sampling selection bias and is more representative of all COVID-19 cases. Our results revealed that severe illness was strongly associated with hospitalization and mortality. However, the differences in symptom distribution are not reflected in disparities in hospitalization and mortality in certain gender and racial minority groups. The findings from this study reinforce the fact that underlying health system disparities remain a challenge. South Carolina is often reflective of the "Deep South" states. Preexisting structural disparities were exacerbated during COVID-19 and put already vulnerable populations at higher risk. Rural residence and racial and ethnic social determinants of health unfortunately remain predictors of adverse health outcomes for COVID-19 patients. The effects are ongoing, making it a priority for interventions and policies to alleviate these problems in both the short and long term.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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