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Association Between Race/Ethnicity and COVID-19 Disease Outcomes in the United States: A Qualitative Systematic Review of the Literature

Jacob Smith
The University of Texas Rio Grande Valley, jacob.smith01@utrgv.edu

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Authors: Jacob Smith[a], MPH

Affiliations: [a]University of Texas Rio Grande Valley School of Medicine, Edinburg, Texas, 78541

Abstract

Background/Objective: As studies have shown disparities in coronavirus disease-19 prevalence and severity, we sought to evaluate differences in outcomes of acute SARS-CoV-2 infection by race/ethnicity.

Design: Systematic review

Data Source: Studies from PubMed were included.

Review methods: Articles published in English language from January 1, 2019 through March 22, 2020. Studies included were observational studies that examined racial or ethnic disparities in SARS-CoV-2 infection outcomes in the United States. One reviewer performed data extraction.

Results: Out of a possible 1,944 articles, 99 observational studies (82 individual-level and 17 population-level) were included. Differential rates of hospitalization or otherwise severe illness (as indicated by intensive care unit admission, complications, and/or death) from coronavirus disease-19 (COVID-19) by race/ethnicity were reported, with many studies indicating higher rates of hospitalization for minority populations (particularly African American individuals) and results more mixed on differences in severe illness. Ecological studies showed associations between population-level proportion of minority residents and greater mortality from COVID-19. There were few studies examining racial differences in pediatric populations.

Conclusions: There are disparities in hospitalization for COVID-19, with non-Hispanic black and Hispanic individuals experiencing higher rates. This disparity is not consistently seen in case-fatality among individuals receiving care, suggesting that social and economic inequity, rather than individual biological factors, drive individual-level COVID-19 hospitalization, as well as mortality at the population level.

Introduction

As of 25 March 2021, over 124 million confirmed cases of coronavirus disease 2019 (COVID-19) and 2.7 million confirmed deaths have been reported in the world, with 30,014,615 cases and 545,317 deaths in the United States (U.S.).[1] COVID-19, caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), was declared as a pandemic by the World Health Organization (WHO) on 11 March 2020.[2] SARS-CoV-2 causes a range of illness, from asymptomatic infection to severe pneumonia and fatality.

Various health professionals and organizations have noticed racial or ethnic disparities in rates of COVID-19 infection or COVID-19 outcomes, calling on health professionals, public health departments, and policy makers to recognize and mitigate the role of structural racism and other social and economic determinants on health in historically marginalized groups.[3-6] While the impact of racial and ethnic minority status on poor health outcomes has long been recognized, COVID-19 has highlighted the disparity, with reports showing disproportionately high hospitalization and mortality rates for COVID-19 among minority populations.[3, 7-9] However, there has also been suggestion that, among patients receiving medical care, there is no disparity in clinical outcomes from COVID-19.[10]

In order to assess racial and ethnic disparities in outcomes of COVID-19, we conducted a qualitative systematic review of studies in one database, with a focus on outcomes such as hospitalization, admission to the intensive care unit (ICU), death, or composite severity. Because of differences in COVID-19 mortality reported in county-level and individual-level analyses, we include both population-level and individual-level studies.

Methods

Eligibility Criteria

Studies were included if they were observational in nature (cohort, cross-sectional, case-control, ecological) and examined children or adults in the United States. They had to include information on SARS-CoV-2 infection confirmed by polymerase chain reaction (PCR) or antibody testing in participants, and examine outcomes (mortality, hospitalization, admission to intensive care unit, severity, acute kidney injury, myocardial infarction, cerebrovascular incidents) of SARS-CoV-2 infection. Additionally, studies had to include data on SARS-CoV-2 infection outcome by >1 race or ethnicity. Case reports and case series were not eligible for inclusion. Studies were excluded if they were not available in English language.

Information Sources

One online database (PubMed) was searched for relevant articles. The database was last searched on March 22, 2021.

Search

A literature search was conducted with the search terms: ‘covid-19,’ ‘coronavirus,’ ‘SARS-CoV-2,’ or ‘severe acute respiratory syndrome’ in combination with ‘racial disparities,’ ‘ethnic disparities,’ ‘hispanic,’ or ‘asian’ and ‘outcomes,’ ‘hospitalization,’ ‘hospital admission,’ ‘intensive care,’ ‘mortality,’ or ‘severity.’ The search was filtered such that only results from 2019 to March 22, 2021 were included.

Study Selection

After initial review, studies were screened by title and abstract by the author to determine potential relevance. The full-text articles determined to be relevant were then reviewed for inclusion in the systematic review, with duplicates being removed.

Data Collection Process

Data were taken directly from articles. No additional contact was made with authors of articles to obtain raw data or confirm results. If no comparison of COVID-19 outcomes was made between racial/ethnic groups, the article was exlcuded from the review.

Results

Study Selection

Results from study selection are shown in the study flow diagram in Figure 1. On the initial search, 1,944 studies were identified. Initial screening of title and abstract resulted in exclusion of 1,689 articles. Duplicates were removed to result in 243 possible studies. Full-text articles were then assessed for eligibility; after removal of ineligible articles as shown in Figure 1, 99 studies remained. Characteristics of each study, including design, sample, location, outcomes, and results are given in Table 1.

Study Characteristics

Observational Studies

A total of 82 individual-level cohort and cross-sectional studies were eligible for inclusion, with 75 having a sample consisting of mostly adults (Table 1). These studies spanned from nationwide samples to regional and hospital samples, with representation from all states in the U.S.

Thirty-two studies examined differences in hospital admission by race/ethnicity. Of these, 23 showed significantly higher ratios of hospitalization among black/non-Hispanic black individuals as compared to white/non-Hispanic white individuals,[11-33] with four showing no difference.[34-37] One study showed a nominally lower rate of hospitalization in Maya as compared to non-Maya patients.[38] Twelve studies showed higher rates of COVID-19 hospitalization among

Hispanic individuals as compared to non-Hispanic white individuals,[13, 14, 17-21, 23, 25, 30, 31, 39] with six showing no difference[12, 15, 24, 33, 35, 36] and two showing lower hospitalization among Hispanic individuals.[16, 40]

In contrast, most individual-level studies found statistically similar rates of COVID-19-related mortality, severe illness and/or ICU admission between at least two race/ethnicities.[10, 11, 14-22, 24, 27, 29, 30, 32-37, 40-65] Twelve studies showed higher ratios of severe COVID-19 when comparing minority populations to non-Hispanic white populations.[13, 15, 17, 25, 30, 31, 33, 39, 42, 50, 66-73] Ten showed lower rates of severe COVID-19 among minority populations as compared to non-Hispanic whites.[10, 35, 53, 56, 71, 74-79] One study showed there was no significant difference in prevalence of COVID-19-related thrombotic events between race/ethnicities,[80] and one study showed more severe radiographic presentation of lung disease among non-white vs. white patients with COVID-19.[70]

Ecological Studies

A total of 17 population-level studies were eligible for inclusion (Table 1). Out of these studies, 15 showed a significant positive relationship between proportion of black or other minority residents in a geographic area (most often county-level) and COVID-19 mortality.[81-95] Five studies showed a significant positive relationship between proportion of Hispanic residents and COVID-19 mortality.[83, 87, 90, 91, 93] Two showed no relationship between proportion of population considered a minority and COVID-19 mortality.[96, 97]

Studies in Predominantly Pediatric Populations

Of the individual-level studies, seven had samples of all or mostly pediatric individuals. In the only study that included a sample of children with COVID-19 from across the U.S., non-Hispanic black race/ethnicity predicted increased odds of hospitalization and death compared to

non-Hispanic white race/ethnicity; Hispanic youth also had increased odds of hospitalization.[98] An increased risk of hospitalization and more severe illness was also seen among non-Hispanic black youth in two other studies,[99, 100] and a high proportion of deaths due to COVID-19 in the U.S. was observed in Hispanic and non-Hispanic black children.[101] However, a few studies have shown no differences in hospitalization, severe disease, or time to discharge in minority as compared to non-Hispanic white pediatric populations.[45, 102, 103]

Discussion

Summary of Evidence

Our systematic review revealed national studies and regional studies from across the U.S. that examined racial and ethnic differences in outcomes of COVID-19. While most individual-level studies revealed disparities in hospitalization rates for COVID-19, those that studied in-hospital mortality or case-fatality due to COVID-19 in individuals otherwise receiving care often showed no significant differences by race/ethnicity.[10] This contrasts with population-level studies, where increases in black/other minority population was often associated with increase in COVID-19 related mortality.[81] The combination of these two findings may suggest that disparities in hospitaliation and mortality are not necessarily due to individual-level differences in biology or health behaviors, but may be a result of limited access to care, limited health literacy, and the built environment.

Socioeconomic and health care inequities, in addition to structural racism, have long been known to contribute to adverse health outcomes (including chronic medical conditions), decreased health care access/utilization, and poor living circumstances.[6] Consider, for example, the study by Hawkins et al., where black and Hispanic individuals were found to work more

often in high-risk essential occupations and have higher age-adjusted mortality rates from COVID-19 than white individuals.[104] This study suggests that black and Hispanic individuals may face a higher risk of exposure to SARS-CoV-2, as they are overrepresented in jobs that cannot be performed from home. Minority groups also have disproportionately high rates of low socioeconomic status;[81] this may result in not only a need to work in occupations that require them to be in person but also more crowded living circumstances that promote spread of viral pathogens.[105] Counties with higher levels of segregation were also shown to have higher rates of COVID-19-related mortality, which again suggests that racial inequity is a risk factor for poor outcomes related to COVID-19.[94] Factors such as racial discrimination and other forms of racism may also result in diminished ability of communities and individuals to respond to public health emergencies and seek care, resulting in delay from presentation to treatment or no treatment at all.[4, 106] Structural racism – and its ability to cause toxic levels of stress and resultant inflammation – may also increase risk for greater initial severity of COVID-19 illness.[107]

Furthermore, diseases that have been associated with worse outcomes from SARS-CoV-2, especially in the absence of proper treatment, tend to be more common among historically marginalized groups of people.[6, 108] Many black, Hispanic, and other minority communities have poorer air quality, less access to healthy foods, less access to outdoor recreational areas, and higher rates of crime that lead to such diseases as obesity, hypertension, diabetes and chronic lung disorders that can worsen initial SARS-CoV-2 infection.[109, 110] Thus, hospitalization rates may be higher among minority groups due to the burden of chronic disease they carry.

Racial disparity in hospitalization also appears to exist among children, and there may be a higher odds of death from COVID-19 in non-Hispanic black children,[98, 100] however, further studies must be conducted to more fully examine differences in outcomes in pediatric

populations. Unfortunately, while children tend to suffer less severe disease, the future impact of disparities in COVID-19 outcomes among adults may result in increases in household dysfunction and adverse childhood experiences.[111] Adverse childhood experiences often have intergenerational impacts, which may not bode well for future health in historically marginalized race/ethnicities.

Limitations

In the current study, no quantitative synthesis was undertaken, which limits understanding of the results to a qualitative nature. Only one database was queried for articles, which may have limited the total number articles that could have been included in this review. Moreover, the author included several studies that were pre-printed and not yet peer reviewed. Ecological studies may suffer from ecological fallacy. We do not include studies from outside of the U.S. We recommend that observational studies examining differences in outcomes by race/ethnicity standardize by age, as not all did so in this review, and increasing age is known to be associated with significant increases in severity of illness.

Conclusions

There is a need for more high-quality observational studies that examine differences in outcomes of COVID-19 disease, especially as the pandemic continues and evolves. Because hospitalization rates tend to be higher, but in-hospital or post-care mortality rates about the same, among minority race/ethnicities, our review suggests that social and economic inequity may drive disparities in outcome severity. However, access to care appears to aid in reducing mortality. Interventions that address the root cause of inequity (e.g., poverty, segregation, systemic racism) are needed to reduce disparities in COVID-19 outcomes.

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Tables and Figures

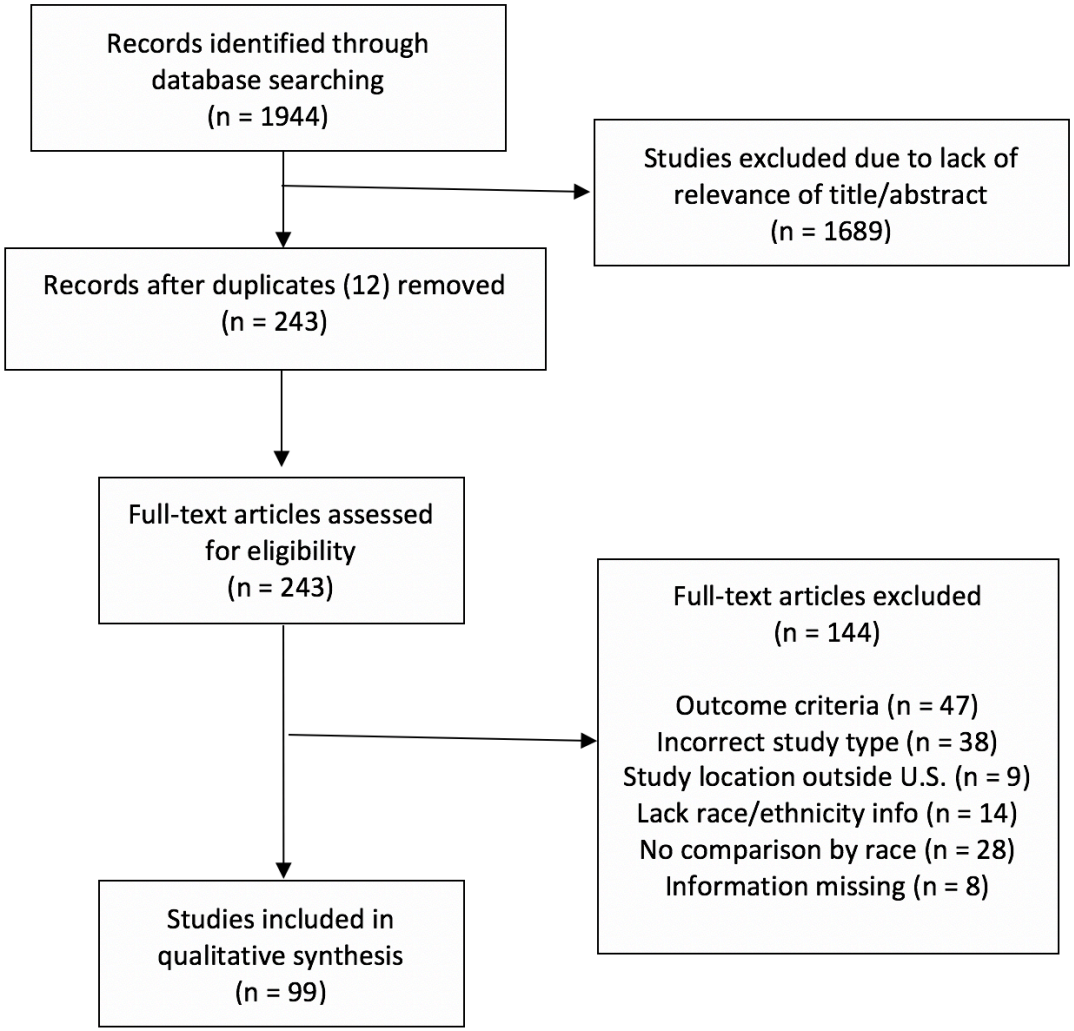

Figure 1. Study PRISMA flow diagram.

Table 1. Characteristics for observational studies of COVID-19 outcome by race/ethnicity.

Study	Design	Sample	Sample size	Location	Outcomes Assessed	Reference Category	Results
Abedi et al., 2020[96]*	Ecological	369 counties	102,178,117	Seven states in U.S.A.	Increase in COVID-19 mortality per percent increase in race/ethnicity, by county (est. (95% CI))	--	Asian: -0.27 (-0.41, -0.12) Black: -0.064 (-0.24, 0.11) Hispanic: -0.21 (-0.38, -0.04) White: 0.12 (-0.05, 0.29)
Abrams et al., 2021[100]	Cross-sectional	Individuals <21 years hospitalized with MIS-C	1,080	U.S.A.	aOR (95% CI) for ICU admission	NH white	NH black: 1.6 (1.0, 2.4) Hispanic: NS Other: NS
Adegunsoye et al., 2020[11]	Cohort	SARS-CoV-2 + individuals	785	Chicago, U.S.A.	aOR (95% CI) for hospitalization, mortality	NH white	Black, hospitalization: 1.51 (1.03, 1.95) Black, mortality: 1.01 (0.20, 5.0)
Adhikari et al., 2020[81]	Ecological	10 U.S. Office of Management and Budget–defined combined statistical areas	--	158 counties in U.S.A.	Adjusted rate ratio (95% CI) for COVID-19 mortality at the county level	Substantially white county	Substantially non-white, less poverty: 2.6 (1.1, 6.5) Substantially non-white, more poverty: 9.3 (4.7, 18.4)
Akanbi et al., 2020[97]	Ecological	70 zip codes in Oakland County	1,257,584	Oakland County, Michigan, U.S.A.	Incidence rate ratio (95% CI) for COVID-19 mortality for each percentage point increase in black population at zip code level	--	1.00 (0.99, 1.01)
Anaele et al., 2021[82]	Ecological	States in the U.S.A.	U.S.A. population	U.S.A.	Increase in COVID-19 deaths	--	0.021 (0.009, 0.033)

					per 100,00 per percent increase in African American in state (est. (95% CI))		
Antwi-Amoabeng et al., 2021[41]	Cross-sectional	SARS-CoV-2 + adults	172	Northern Nevada, U.S.A.	aOR (95% CI) for COVID-19 mortality	Non-Hispanic	Hispanic: 0.029 (0.03, 3.14)
Arrazola et al., 2020[112]	Cross-sectional	SARS-CoV-2 + adults	340,059	U.S.A.	Rate ratio (95% CI) for cumulative incidence of infection	White persons	American Indian/Alaska Native: 3.5 (1.2, 10.1)
Azar et al., 2020[12]	Cohort	SARS-CoV-2 + adults	1,052	Northern California, U.S.A.	aOR (P-value) for hospital admission	NH white	Black (0.007) Asian, Hispanic, other/unknown: NS
Bailey et al., 2021[99]	Cohort	Individuals younger than 25 years with information in PEDSNet	5,374	11 states in the U.S.A.	aOR (95% CI) for severe illness (hospitalization for diagnosis of pneumonia, sepsis, respiratory failure, or COVID-19)	NH white	Black: 1.44 (1.02, 2.04)
Bassett et al., 2020[74]	Cross-sectional	SARS-CoV-2 + individuals at Massachusetts General	866	Massachusetts, U.S.	Test of proportions for percentage in ICU during follow up and death during follow up	--	ICU: NH white: 0.25 NH black: 0.31 Hispanic: 0.33 P=0.044 Death: NH white: 0.18 NH black: 0.11 Hispanic: 0.02 P<0.001
Bassett et al., 2020[66]	Cross-sectional	Individuals with data available in National Center for Health Statistics	U.S.A. population	U.S.A.	Rate ratio (95% CI) for age-standardized COVID-19 mortality per	NH white	NH black: 3.6 (3.5, 3.8) Hispanic: 2.8 (2.7, 3.0)

					100,000 person-years		NH AI/AN: 2.2 (1.8, 2.6) NH A/PI: 1.6 (1.4, 1.7)
Bennett et al., 2021[42]*	Cohort	Hospitalized individuals in the National COVID Cohort Collaborative	174,568	U.S.A.	aOR (p-value) for severe outcome of COVID-19 infection (invasive ventilation, ECMO, death, discharge to hospice)	NH white	Hispanic: 1.04 (0.84) Black: 1.21 (0.09) Asian: 2.36 (0.0017) Other: 1.22 (0.43)
Bhargava et al., 2020[43]	Cohort	SARS-CoV-2 + adults at a single hospital	197	Detroit, Michigan, U.S.A.	OR (95% CI) for severe COVID-19 (requiring mechanical ventilation)	Black	White: 0.7 (0.3, 1.5)
Bixler et al., 2020[101]	Cross-sectional	Deaths due to COVID-19 disease in individuals <21 years	121	U.S.A.	% of deaths by race/ethnicity	--	Hispanic: 44.6% NH AI/AN: 4.1% NH A/PI: 4.1% NH black: 28.9% NH white: 14.0% Other: 1.7%
Boserup et al., 2020[13]	Cross-sectional	Individuals with data in COVID-19 Tracking Project	--	U.S.A.	Rate ratio for hospitalization per 100,000 people COVID-19 mortality rate, by state	NH white of corresponding age group in next cell	Hispanic ages 0-17: 8.7 AI/AN ages 18-49: 11.2 NH black ages 50-64: 9.9 NH black age >64: 7.0 Death rates: often higher among NH black compared to NH white by state
Cardemil et al., 2021[14]	Cohort	Hospitalized, SARS-CoV-2 + Veterans at 5	621	Atlanta, Bronx, Houston, Palo	Adjusted hospitalization	NH white	Hospitalization – Hispanic: 4.6 (3.6, 5.9)

		Veterans Affairs medical centers		Alto, Los Angeles (U.S.A.)	incidence rate ratio (95% CI) Adjusted relative risk for case fatality (95% CI)		NH black: 4.2 (3.4, 5.1) Case fatality – Hispanic: 0.9 (0.6, 1.3) NH black: 0.9 (0.6, 1.5)
Cates et al., 2020[67]	Cohort	Adult veterans hospitalized with COVID-19	4,305	U.S.A.	Adjusted relative risk (95% CI) for several complications; we focus here on respiratory failure	NH white	NH black: 1.14 (1.06, 1.23) NH other: 1.3 (1.08, 1.58) Hispanic: 1.13 (0.99, 1.28)
Chang et al., 2021[113]	Cross-sectional	Medicare beneficiaries	710,980 with COVID-19; 207,600 hospitalized	U.S.A.	Hospitalization rate ratio per 100,000 (no significance tests)	NH white	NH black: 3.3 AI/AN: 3.0 Hispanic: 2.6 A/PI: 1.2
Cheng et al., 2020[83]	Ecological	Non-metropolitan counties	1,976 counties	U.S.A.	Daily incidence rate ratio of COVID-19 deaths per 100,000	Counties in bottom quantile of percent black Counties in bottom quantile of percent Hispanic	Top quantile % black: 1.70 (1.48, 1.95) Top quantile % Hispanic: 1.50 (1.33, 1.69)
Chilimuri et al., 2020[44]	Cohort	Individuals hospitalized with COVID-19	375	New York City, U.S.A.	Comparison of crude case fatality rate due to COVID-19	--	Black: 0.42 Hispanic: 0.44 Other: 0.33
Chishinga et al., 2020[15]*	Cohort	Community-based SARS-CoV-2 + individuals	4,322	Atlanta, Georgia, U.S.A.	Unadjusted OR (95% CI) for: Hospitalization ICU admission Death	NH white	Hospitalization – NH black: 2.0 (1.6, 2.5) Hispanic: 1.0 (0.7, 1.4) NH Asian: 1.0 (0.6, 1.9) ICU admission –

							NH black: 2.5 (1.6, 3.7) Hispanic: 1.5 (0.8, 2.7) NH Asian: 2.5 (1.0, 6.1) Death – NH black: 1.4 (1.0, 2.0) Hispanic: 0.6 (0.3, 1.2) NH Asian: 0.5 (0.1, 2.3)
Cohen et al., 2021[75]	Cohort	Hospitalized adults with COVID-19	9,407	New York metropolitan region	aOR (95% CI) for composite VTE or mortality	White adults	Asian: 1.08 (0.84, 1.38) Black: 0.68 (0.57, 0.81) Other: 0.81 (0.68, 0.96)
Cromer et al., 2020[16]*	Cross-sectional	Adults testing positive for SARS-CoV-2	9,839	Massachusetts, U.S.A.	aOR (95% CI) for COVID-19-related hospitalization and death	NH white	Hospitalization – NH black: 1.39 (1.16, 1.65) Hispanic: 0.77 (0.63, 0.94) NH Asian: 1.53 (1.14, 2.06) Death – NH black: 0.81 (0.57, 1.14) Hispanic: 1.38 (0.80, 2.36) NH Asian: 0.58 (0.30, 1.11)
Dai et al., 2021[17]	Cohort	SARS-CoV-2 + adults in a large health system	54,645	California, Oregon and	aOR (95% CI) for hospitalization	White	Hospitalization – Black: 1.18 (1.02, 1.36)

				Washington, U.S.A.	and in-hospital mortality		Hispanic: 1.31 (1.22, 1.42) Asian: 1.62 (1.43, 1.84) NH/PI: 2.01 (1.55, 2.61) AI/AN: 1.56 (1.17, 2.06) In-hospital mortality - Black: 1.05 (0.73, 1.52) Hispanic: 1.41 (1.15, 1.71) Asian: 0.93 (0.69, 1.25) NH/PI: 1.17 (0.6, 2.28) AI/AN: 1.92 (0.96, 3.81)
Dalsania et al., 2021[84]	Ecological	Counties in the U.S.A.	2,026 counties	U.S.A.	Incidence rate ratio for COVID-19 deaths for each 1% increase in black population among counties with adverse socioeconomic conditions	--	1.009 (1.005, 1.013)
Derespina et al., 2020[102]	Cross-sectional	Critically ill pediatric patients <21 admitted to PICU	70	New York City, U.S.A.	Adjusted hazard ratio (95% CI) for time to hospital discharge	White patients	Black/Latino: 2.76 (0.93, 8.24) Other race: 1.00 (0.29, 3.42)
Escobar et al., 2021[18]	Cross-sectional	SARS-CoV-2 + adults	3,686	Northern California, U.S.A.	aOR (95% CI) for hospitalization and COVID-19-related death	NH white adults	Hospitalization – NH black: 1.47 (1.03, 2.09) Hispanic: 1.42 (1.11, 1.82)

							NH Asian: 1.47 (1.13, 1.92) Death – NH black: 1.07 (0.58, 1.98) Hispanic: 0.96 (0.57, 1.63) NH Asian: 1.15 (0.69, 1.92)
Esenwa et al., 2021[80]	Cross-sectional	Adults hospitalized with COVID-19	4,299	Bronx, New York, U.S.A.	aOR (95% CI) for composite thrombotic events (acute ishemic stroke, deep vein thrombosis, pulmonary embolism, myocardial infarction)	White adults	Asian: 1.97 (0.30, 12.9) Black: 1.46 (.47, 4.54) Hispanic: 1.67 (0.54, 5.17 Other: 2.09 (0.49, 8.98)
Fernandes et al., 2021[45]	Cohort	Youth ≤22 years hospitalized with SARS-CoV-2 or MIS-C	281	New York, New Jersey, Connecticut, U.S.A.	aOR (95% CI) for severe disease (≥48 hours in ICU)	NH white youth	NH black: 1.65 (0.31, 8.87) Hispanic: 0.88 (0.26, 2.98)
Figueroa et al., 2021[85]	Ecological	Counties in the U.S.A.	Number not reported	U.S.A.	Change in COVID-19 death rate per 100,000 persons for each 10% increase in proportion of race/ethnicity in county	--	NH black: 9.3 (8.0, 10.6) Hispanic: 0.4 (-1.5, 2.4) NH other: -11.9 (-14.0, -9.7)
Foo et al., 2021[38]	Cross-sectional	Adults with COVID-19	265	Alameda County, California, U.S.A.	Difference in proportions of non-Maya vs. Maya patients hospitalized for COVID-19, admitted to ICU,	--	Hospitalization (non-Maya vs. Maya): 0.43 vs. 0.27 (p=0.03) ICU admission: 0.14 vs. 0.02 (p=0.01)

					and 30-day hospital mortality		In-hospital mortality: 0.06 vs. 0.0 (p=0.01)
Garcia et al., 2021[68]	Cross-sectional	Individuals in California	10,200 COVID-19-related deaths	California, U.S.A.	Age-specific COVID-19 mortality rate ratio (95% CI)	NH white	NH black: 2.75 (2.54, 2.97) Hispanic: 4.18 (3.99, 4.37) Higher mortality disparity by race/ethnicity observed in younger age groups
Garibaldi et al., 2020[46]	Cohort	Individuals hospitalized for COVID-19	832	Maryland and Washington, D.C., U.S.A.	Adjusted hazard ratio (95% CI) for severe COVID-19 disease or death	White	Non-white: 1.08 (0.81, 1.44)
Gershengorn et al., 2021[19]	Cohort	SARS-CoV-2 + adults	1,256	Miami, Florida, U.S.A.	aOR (95% CI) for hospitalization due to COVID-19 and mortality due to COVID-19	NH white	Hospitalization – NH black: 3.47 (2.44, 5.00) Hispanic black: 2.15 (1.09, 3.99) Hispanic white: 2.43 (1.78, 3.37) Other: 3.6 (2.37, 5.44) Death – NH black: 0.92 (0.11, 7.85) Hispanic black: 0.13 (0.00, 7.13) Hispanic white: 1.35 (0.29, 7.33) Other: 2.08 (0.27, 16.05)
Gianfrancesco et al., 2020[20]	Cross-sectional	Patients with rheumatologic disease	1,324	U.S.A.	aOR (95% CI) for hospitalization and death due to COVID-19	White	Hospitalization – Black: 2.74 (1.9, 3.95)

							Latinx: 1.71 (1.18, 2.49) Asian: 2.69 (1.16, 6.24) Other/mixed: 2.59 (0.97, 6.90) Death – Black: 1.39 (0.69, 2.79) Latinx: 1.67 (0.81, 3.41) Asian: 2.67 (0.58, 12.16) Other/mixed: 2.49 (0.49, 12.65)
Gil et al., 2021[47]	Cohort	Hospitalized SARS-CoV-2 + adults	326	Rhode Island, U.S.A.	Age-adjusted OR (95% CI) for death due to COVID-19	NH white	Hispanic: 1.0 (0.46, 2.16) NH black: 0.88 (0.35, 2.19) Hospitalized hispanic patients noted to be younger
Girardin et al., 2021[69]	Cohort	SARS-CoV-2 + individuals visiting a large quaternary academic health center	4,446	New York City and Long Island, U.S.A.	Adjusted Cox proportional hazard ratio (95% CI) for COVID-19-associated mortality	Non-ethnic minority individuals	Ethnic minority: 1.26 (1.10, 1.44)
Golestaneh et al., 2020[21]	Cohort	SARS-CoV-2 + individuals visiting Montefiore Health System	2,934	Bronx, New York, U.S.A.	aOR (95% CI) for hospitalization due to COVID-19 Adjusted relative risk (95% CI) for in-hospital mortality in COVID-19 patients	NH white	Hospitalization – NH black: 1.7 (1.2, 2.4) Hispanic: 1.5 (1.1, 2.2) Mortality – NH black: 1.2 (0.7, 2.0)

							Hispanic: 1.0 (0.6, 1.7)
Gottlieb et al., 2020[34]	Cohort	Patients at Rush University Medical Center	8,673	Chicago, Illinois, U.S.A.	aOR (95% CI) for hospitalization and critical illness due to COVID-19	Black individuals	Hospitalization – White: 1.04 (0.81, 1.32) Asian: 0.99 (0.51, 1.93) Other: 1.05 (0.78, 1.40) Critical illness – White: 0.86 (0.61, 1.19) Other: 1.21 (0.9, 1.63)
Graff et al., 2021[103]	Cohort	SARS-CoV-2 + patients <21 years at Children's Hospital Colorado	454	Colorado, U.S.A.	OR (95% CI) for hospitalization due to COVID-19	NH white	Black: 1.12 (0.3, 4.3) Hispanic: 1.37 (0.7, 2.7) Other: 0.98 (0.4, 2.4)
Gu et al., 2020[22]	Cohort	Individuals positive for SARS-CoV-2 when tested at University of Michigan	1,139	Michigan, U.S.A.	aOR (95% CI) for hospitalization and ICU admission due to COVID-19	White	Hospitalization – Black: 1.72 (1.15, 2.58) Other: 1.42 (0.79, 2.54) ICU Admission – Black: 1.15 (0.73, 1.82) Other: 0.86 (0.42, 1.78)
Gupta et al., 2021[48]	Cohort	Hospitalized SARS-CoV-2 + individuals at academic medical center	529	New York City, New York, U.S.A.	aOR (95% CI) for COVID-19-related death	Black individuals	Other: 1.38 (0.75, 2.56)

Hawkins et al., 2021[104]	Cross-sectional	Workers ages 16-64 in Massachusetts	555 COVID-19 deaths	Massachusetts, U.S.A.	Age-adjusted COVID-19 mortality rate per 100,000 persons (95% CI), by race/ethnicity	--	NH white: 10.7 (9.5, 12.0) Hispanic: 53.4 (43.4, 63.4) NH black: 50.4 (40.5, 60.2) NH Asian: 10.2 (5.5, 14.9) Other: 34.1 (18.2, 50.0)
Hawkins et al., 2020[86]	Ecological	Counties	3,127 counties	U.S.A.	Adjusted rate ratio (95% CI) for COVID-19 fatalities per 100,000 person for each 1% increase in proportion of black people in county	--	1.03 (1.02, 1.05)
Hsu et al., 2021[49]	Cohort	Maintenance dialysis patients positive for SARS-CoV-2 in national dialysis provider	438	29 states in U.S.A.	aOR (95% CI) for all-cause mortality in COVID-19 patients	White	Black: 0.69 (0.40, 1.20) Other: 0.68 (0.32, 1.43)
Ingraham et al., 2020[23]*	Cohort	SARS-CoV-2 + individuals	5,577	12 Midwest hospitals and 60 primary care clinics, U.S.A.	Standardized hazard ratio (95% CI) for hospitalization due to COVID-19	NH white	Black: 1.31 (1.04, 1.65) Asian: 1.78 (1.33, 2.38) Hispanic: 3.02 (2.31, 3.95) Other: 1.89 (1.18, 3.03)
Ioannou et al., 2020[24]	Cohort	SARS-CoV-2 + veterans in Veterans Affairs national health care system	10,131	U.S.A.	Adjusted hazard ratio (95% CI) for COVID-19-related hospitalization and death	White	Hospitalization – Black: 1.13 (1.04, 1.23) Asian: 1.20 (0.79, 1.81)

							AI/AN/NH/PI: 0.74 (0.52, 1.06) Death – Black: 1.04 (0.88, 1.21) Asian: 1.99 (0.85, 4.65) AI/AN/NH/PI: 1.67 (0.99, 2.82) No differences by ethnicity
Iyanda et al., 2021[87]	Ecological	Counties	All U.S. counties	U.S.A.	Case fatality ratio (95% CI) for every one percent increase in ethnic/racial minority	--	Black: 8.33 (4.9, 14.2) Hispanic, non-white: 5.93 (3.6, 9.7) AI: 2.70 (2.0, 3.6) A/PI: 1.66 (1.4, 1.9)
Izurieta et al., 2020[25]	Cohort	Medicare beneficiaries	30,284,193	U.S.A.	aOR (95% CI) for COVID-19-related hospitalization and death	NH white	Hospitalization – NH black: 2.47 (2.17, 2.81) Hispanic: 3.11 (2.37, 4.18) AI/AN: 5.82 (3.25, 10.43) Asian: 1.32 (0.93, 1.87) Death – NH black: 2.81 (2.62, 3.02) Hispanic: 3.31 (2.83, 3.87) AI/AN: 4.22 (2.90, 6.16) Asian: 1.50 (1.23, 1.82)
Joseph et al., 2020[70]	Cohort	Adults hospitalized with	326	Massachusetts, U.S.A.	Adjusted average difference (95%		Non-white vs. NH white:

		COVID-19 at a single institution			CI) in modified Radiographic Assessment of Lung Edema score		6.1 vs. 4.2 Adjusted average difference = 1.6 (0.5, 2.7)
Karmakar et al., 2021[88]	Ecological	Counties	All counties in U.S.A.	U.S.A.	Incidence rate ratio (95% CI) for COVID-19-related mortality per every 1% increase in population of ethnic/racial minority	--	Any racial/ethnic minority: 1.03 (1.02, 1.03)
Khanijahani, 2020[89]	Ecological	Counties	3,142	U.S.A.	Increase in confirmed COVID-19 deaths per 100,000 people (estimate, 95% CI)	One percent increase	% Hispanic: 0.37 (-0.12, 0.86) % Black: 0.66 (0.26, 1.07)
Killerby et al., 2020[26]	Cross-sectional	SARS-CoV-2 + adults	531	Atlanta, Georgia, U.S.A.	aOR (95% CI) for COVID-19-related hospitalization	White	Black: 3.2 (1.8, 5.8)
Kim et al., 2020[50]	Cohort	Adult patients with chronic liver disease positive for SARS-CoV-2 across 21 institutions	867	21 centers in the U.S.A.	aOR (95% CI) for severe COVID-19 (death, hospitalization, oxygen requirement, ICU admission, requirement of vasopressors, or mechanical ventilation)	NH white	NH black: 0.83 (0.54, 1.28) Hispanic: 2.33 (1.47, 3.70) NH Asian: 1.90 (0.85, 4.27) Other: 3.40 (1.31, 8.81)
Ko et al., 2020[28]	Cross-sectional	Community-dwelling, SARS-CoV-2 + adults	5,416	12 states in U.S.A.	Adjusted rate ratio (95% CI) for COVID-19-	NH white	NH black: 4.0 (3.4-4.8) Other: 3.3 (2.8-4.0)

					related hospitalization		
Krause et al., 2020[51]	Cohort	Adult patients with confirmed COVID-19 at one hospital	85	Colorado, U.S.A.	aOR (95% CI) for COVID-19 30-day mortality	Non-Hispanic	Hispanic: 0.28 (0.04, 1.80)
Krishnamoorthy et al., 2021[10]	Cohort	Patients >15 years with COVID-19 admitted to seven hospitals	799	Michigan, U.S.A.	aOR (95% CI) for COVID-19-related death	White	Black: 0.61 (0.37, 0.99) Other: 1.42 (0.58, 3.49)
Lara et al., 2020[29]	Cross-sectional	Patients with gynecologic malignancy and COVID-19 disease	193	New York City, New York, U.S.A.	OR (95% CI) for COVID-19-related hospitalization and death	Non-black	Hospitalizations, black: 2.69 (1.37, 5.26) Death, black: 1.57 (0.71, 3.46)
Lazar et al., 2021[76]	Cohort	Adults with COVID-19 in a single ICU	365	Detroit, Michigan, U.S.A.	aOR (95% CI) for COVID-19 28-day mortality	White	Persons of color: 0.60 (0.37, 0.96)
Li et al., 2020[90]*	Ecological	Counties	2,990 counties	U.S.A.	Adjusted relative risk (95% CI) for COVID-19 cumulative death rate per 100,00 persons by increase in proportion of specified race/ethnicities	--	NH black: 1.13 (1.07, 1.19) Hispanic: 1.08 (1.02, 1.14) AI/AN: 1.1 (1.05, 1.15) Asian: 1.01 (0.97, 1.06) NH/PI: 1.02 (0.98, 1.05)
Liao and Maio, 2021[91]	Ecological	Counties	3,141 counties	U.S.A.	Adjusted mortality rate ratio (95% CI) for COVID-19 mortality per 100,000 persons by each one percent increase in specified	--	Black: 1.076 (1.029, 1.125) Hispanic: 1.105 (1.062, 1.149)

					race/ethnicity in a county		
Lucar et al., 2021[52]	Cohort	Adult patients with COVID-19 admitted to a single medical center	100	Mississippi, U.S.A.	OR (95% CI) for COVID-19-related death	All else besides non-Hispanic black	NH black: 1.70 (0.33, 8.81)
Lundon et al., 2020[30]	Cross-sectional	SARS-CoV-2 + patients at a single health system	8,928	New York, U.S.A.	aOR (95% CI) for COVID-19-related hospitalization and death	White	Hospitalization – African ancestry: 1.47 (1.31, 1.64) Hispanic: 1.29 (1.14, 1.46) Asian: 0.99 (0.89, 1.20) Death – African ancestry: 1.28 (1.10, 1.50) Hispanic: 1.09 (0.92, 1.30) Asian: 0.84 (0.63, 1.12)
Luo et al., 2021[53]	Cross-sectional	Veterans receiving care in Veteran Health Administration with COVID-19	14,259	U.S.A.	Case fatality rate ratio (95% CI)	White	Black: 0.75 (0.68, 0.92) Asian: 0.55 (0.29, 1.03) NH/PI: 0.62 (0.33, 1.15) AI/AN: 1.05 (0.66, 1.65) Other: 0.73 (0.61, 0.90)
Mahajan and Larkins-Pettigrew, 2020[92]	Ecological	Counties	2,886	U.S.A.	Correlation (r, p-value) between COVID-19 case fatality rate and percentage of specific race/ethnicity in county	--	Black: 0.0553 (p=0.0031) White: -0.0479 (p=0.0104) Asian: 0.0258 (p=0.168)

Marmarchi et al., 2021[54]	Cohort	COVID-19 adult patients admitted to the ICU in a single health care system	288	Atlanta, Georgia, U.S.A.	OR (95% CI) for COVID-19-related death	Non-black	Black: 1.36 (0.75, 2.47)
McCarty et al., 2020[55]	Cross-sectional	Patients with COVID-19 hospitalized at nine hospitals	379	Massachusetts, U.S.A.	aOR (95% CI) for COVID-19-related ICU admission or in-hospital mortality	White	ICU admission – Black: 0.77 (0.39, 1.53) Latinx: 1.50 (0.89, 2.52) In-hospital mortality – Black: 0.39 (0.13, 1.12) Latinx: 0.55 (0.23, 1.29)
Mikami et al., 2020[56]	Cohort	Patients with COVID-19 in a single health system	6,493	New York, U.S.A.	Adjusted hazard ratio (95% CI) for COVID-19-related in-hospital death	White	Black: 0.78 (0.65, 0.95) Asian: 0.94 (0.83, 1.08) Other: 1.0 (0.83, 1.19)
Miller et al., 2020[77]	Cohort	SARS-CoV-2 + individuals presenting to an ED in a health system	3,633	Detroit, Michigan, U.S.A.	aOR (95% CI) for COVID-19-related 30-day mortality	White	Black: 0.56 (0.40, 0.77)
Misa et al., 2020[114]	Cross-sectional	Patients testing positive for SARS-CoV-2 in emergency department	95	Alameda Health System, Northern California, U.S.A.	Crude in-hospital mortality	--	Non-black vs. black: 0.013 vs. 0.187
Moreira et al., 2021[98]	Cross-sectional	Children ages 0-19 with COVID-19	27,045	U.S.A.	aOR (95% CI) for COVID-19-related hospitalization and in-hospital death	NH white	Hospitalization – NH black: 2.28 (1.93, 2.70) Hispanic: 1.38 (1.19, 1.61) NH Asian: 1.11 (0.78, 1.61)

							NH other: 2.95 (2.28, 3.82) NH/PI: 0.25 (0.12, 0.54) AI/AN: 0.20 (0.03, 1.42) In-hospital death – NH black: 2.96 (1.30, 6.73) Hispanic: 0.88 (0.36, 2.13) NH other: 3.33 (0.90, 12.37)
Muhammad et al., 2021[57]	Cohort	Adult patients hospitalized for COVID-19 at a single hospital	200	Washington, D.C., U.S.A.	OR (95% CI) for COVID-19 mortality	Non-black	Black: 1.52 (0.69, 3.32)
Muñoz-Price et al., 2020[27]	Cross-sectional	Adults with COVID-19 at an academic medical system	369	Milwaukee, Wisconsin, U.S.A.	aOR (95% CI) for hospitalization, ICU admission, and in-hospital death	All other race/ethnicities	Hospitalization – Black: 1.85 (1.0, 3.67) ICU admission – Black: 1.52 (0.75, 3.07) In-hospital death – Black: 1.43 (0.14, 14.1)
O'Malley et al., 2021[115]	Cross-sectional	Adults with type 1 diabetes mellitus who tested positive for SARS-CoV-2	113	22 states in the U.S.A.	aOR (95% CI) for COVID-19-related hospitalization	NH white	Minority race/ethnicity: 3.63 (1.42, 9.70)
Ogedegbe et al., 2020[35]	Cohort	Patients with COVID-19 in a health system	4,843	New York University Langone Health System, U.S.A.	aOR (95% CI) for COVID-19 hospitalization, critical illness	NH white	Hospitalization – NH black: 0.9 (0.7, 1.1) Hispanic: 1.0 (0.8, 1.2)

					Adjusted hazard ratio (95% CI) for COVID-19 mortality		NH Asian: 1.6 (1.1, 2.3) NH other: 1.4 (1.0, 1.9) Critical illness – NH black: 0.6 (0.4, 0.8) Hispanic: 0.9 (0.7, 1.2) NH Asian: 1.3 (0.9, 1.8) NH other: 1.2 (0.8, 1.8) Mortality – NH black: 0.7 (0.6, 0.9) Hispanic: 1.0 (0.8, 1.2) NH Asian: 1.3 (0.9, 1.7) NH other: 0.9 (0.7, 1.2)
Ojinnaka et al., 2020[93]	Ecological	Counties	254	Texas, U.S.A.	Regression (coef., 95% CI) for prediction of COVID-19 fatality per 100,00 persons for percent increase in each specified race/ethnicity in a county	--	NH black: 5.08 (0.11, 10.04) NH white: 4.78 (-0.28, 9.83) Asian: 5.17 (-0.11, 10.45) Hispanic: 5.41 (0.52, 10.31)
Panagiotou et al., 2021[78]	Cohort	Nursing home residents with COVID-19	5,256	U.S.A.	aOR (95% CI) for 30-day all-cause mortality	White	Black: 0.77 (0.62, 0.96) Other: 0.60 (0.45, 0.81)

Paul et al., 2021[94]	Ecological	Counties	All U.S. counties	U.S.A.	Adjusted mortality risk ratio (95% CI) (5-unit change in independent variable)	-	For every 5% increase in black population – Rural: 1.051 (1.029, 1.074) Urban: 1.041 (1.014, 1.068)
Pennington et al., 2021[71]	Cohort	Hospitalized adults diagnosed with COVID-19	181,813 patients	U.S.A. hospitals	Adjusted risk ratio (95% CI) for ICU admission, mortality	NH white	ICU Admission – NH black: 1.02 (1.00-1.03) NH Asian: 1.11 (1.08-1.15) Hispanic: 1.08 (1.05-1.10) Other: 1.07 (1.05-1.09) Death – NH black: 0.96 (0.92 – 0.99) NH Asian: 1.16 (1.09 – 1.23) Hispanic: 1.15 (1.09-1.20), Other: 1.13 (1.06-1.21)
Poulson et al., 2020[72]	Cohort	White and non-Hispanic black patients diagnosed with COVID-19	76,442 white and 48,338 non-Hispanic black	U.S.A.	Adjusted risk ratio (95% CI) for ICU admission, mortality	White	ICU admission – Non-Hispanic black 1.68 ($p<0.0001$) Mortality – Non-Hispanic black: 1.36 ($p<0.001$)
Poulson et al., 2021[31]	Cohort	Patients diagnosed with COVID-19	78,323	U.S.A.	Adjusted risk ratio (95% CI) for hospitalization, ICU admission, and mortality	NH white	Hospital Admission – Hispanic white: 1.35 (1.32, 1.38) Hispanic black: 1.58 (1.53, 1.64)

							Hispanic multiple / other: 1.50 (1.46, 1.54) ICU Admission – Hispanic white: 1.30 (1.18, 1.42) Hispanic black: 2.27 (1.96, 2.63) Hispanic multiple / other: 2.06 (1.93, 2.21) Mortality – Hispanic white: 1.36 (1.31, 1.43) Hispanic black: 1.72 (1.59, 1.86) Hispanic multiple / other: 1.68 (1.61, 1.75)
Price-Haywood et al., 2020[32]	Cohort	Patients with COVID-19 seen at an Ochsner health facility	3,481	Louisiana, U.S.A.	aOR (95% CI) for hospitalization adjusted hazard ratio (95% CI) for in-hospital death	White	Hospitalization – Black: 1.96 (1.62, 2.37) In-hospital death – Black: 0.89 (0.68, 1.17)
Quan et al., 2021[58]	Cohort	Hospitalized adults with COVID-19	2,038	Michigan, U.S.A.	aOR (95% CI) for ICU admission and death	White	ICU admission – Black: 1.13 (0.88, 1.44) Death – Black: 0.86 (0.64, 1.14)
Razjouyan et al., 2021[59]	Cohort	Veterans hospitalized with COVID-19	4,790	U.S.A.	aOR (95% CI) for ICU admission, death	White	ICU Admission – Black: 1.08 (0.95, 1.23) Hispanic: 1.07 (0.86, 1.33)

							Death – Black: 1.16 (0.97, 1.38) Hispanic: 1.22 (0.90, 1.66)
Renelus et al., 2020[33]	Cohort	Adults hospitalized with COVID-19	734	Single hospital in New York, U.S.A.	OR (95% CI) for hospitalization Hazard ratio (95% CI) for death	White	Hospitalization – Black: 1.89 (1.59, 2.24) Hispanic: 0.84 (0.66, 1.07) Death – Black: 1.30 (0.95, 1.78) Hispanic: 1.84 (1.21, 2.80) Asian: 2.06 (1.08, 3.93) Other: 2.12 (1.11, 4.06)
Rentsch et al., 2020[60]	Cohort	Veterans tested for SARS-CoV-2	254,595	U.S.A.	aOR (95% CI) for 30-day COVID-19 mortality	White	Black: 0.97 (0.80, 1.17) Hispanic: 0.99 (0.73, 1.34)
Rodriguez et al., 2020[61]	Cross-sectional	Patients hospitalized with COVID-19	7,868	88 hospitals in the U.S.A.	aOR (95% CI) for in-hospital mortality	NH white	NH black: 0.93 (0.76, 1.14) Hispanic: 0.90 (0.73, 1.11) Asian: 1.31 (0.96, 1.80)
Rosenthal et al., 2020[79]	Cohort	Patients with COVID-19 treated in U.S. hospitals	64,781 patients	592 U.S.A. Hospitals	aOR (95% CI) for in-hospital mortality	White	Black: 0.75 (0.69-0.92) Other/Unknown: 0.95 (0.88-1.03)
Saffary et al., 2020[95]	Ecological	Counties	3,108 U.S. Counties	U.S.A.	Global Spatial Correlation of COVID-19 Cases and Deaths	--	Cases Black American: 0.174 Hispanic: 0.008 NH white: -0.203

					(Bivariate Moran's I)		Deaths Black American: 0.264 Hispanic: -0.002 NH white: -0.137
Salter et al., 2021[36]	Cross-sectional	Patients with MS and SARS-CoV-2 in COViMS Registry	1,626 patients	North America	OR (95% CI) for hospitalization, ICU admission, death	NH white	Hospitalization Black: 1.47 (0.98 – 2.22) Hispanic/Latinx: 0.77 (0.41 – 1.44) Other: 0.82 (0.33 – 2.08) ICU admission: Black: 2.28 (1.22-4.23) Hispanic/Latinx: 1.76 (0.76-4.09) Other: 0.94 (0.20-4.36) Death: Black: 1.60 (0.65 – 3.93) Hispanic/Latinx: 0.57 (0.10-3.18) Other: 2.95 (0.45-19.5)
Shah et al., 2020[62]	Cross-sectional	Hospitalized COVID-19 patients in rural Southwest Georgia	522 patients	Phoebe Putney Health System, Southwest Georgia, U.S.A.	OR (95% CI) In-Hospital Mortality	White	Black: 0.82 (0.37-1.78)
Silver et al., 2020[63]	Cross-sectional	SARS-CoV-2 + Patients admitted to an urban safety net hospital in New	249 patients	Safety Net Hospital in New Orleans, Louisiana, U.S.A.	Day 14 outcome (adjusted proportional odds of better	All other racial/ethnic groups	Black: 0.91 (0.70-1.20)

		Orleans, Louisiana			outcomes, 95% CI)		
Twigg et al., 2020[64]	Cohort	SARS-CoV-2+ patients ≥18 years admitted to the ICU	242 patients	Two urban, academic referral hospitals in Indianapolis, Indiana, U.S.A.	Hazard Ratio (95% CI) for in-hospital mortality	Caucasian	African American 0.6 (0.3-1.3) Hispanic/Latino: 0.2 (0.03-1.7) Other: 0.5 (0.1-2.7)
Valenzuela et al., 2020[40]	Cohort	Hispanic and Non-Hispanic SARS-CoV-2+ patients at large suburban academic tertiary care hospital ER	2,039 patients	Long Island, New York, U.S.A.	OR (95% CI) for hospital admission, ICU admission, mortality	NH white	Hospital Admission – Hispanic: 0.69 (0.52-0.92) ICU Admission - Hispanic: 1.04 (0.70-1.53) Mortality - Hispanic: 0.82 (0.46-1.47)
Vaughan et al., 2021[39]	Cross-sectional	SARS-CoV-2+ cases from Stanford Health Care Laboratory in March, 2020	257 cases	Stanford Health Care, U.S.A.	OR (95% CI) of Hospital admission and/or death	Caucasian	Asian 4.8 (1.6-14.2) Hispanic: 3.6 (1.1-11.9) Other/Unknown: 2.3 (0.7-7.1)
Wang et al., 2020[65]	Cohort	Patients at Mount Sinai tested for COVID-19	28,336 patients	Mount Sinai Health System, NYC, New York, U.S.A.	In-Hospital Mortality (Log Odds Ratio, p-value)	Caucasian	Black: 1.04 (0.815) Asian: 1.04 (0.914) Hispanic: 0.93 (0.723) Other: 0.99 (0.975) Unknown: 0.86 (0.750)
Wiley et al., 2021[37]	Cohort	SARS-CoV-2+ Patients presenting to academic emergency rooms	831 patients	Atlanta, Georgia, U.S.A.	Hospital Admission aOR (95% CI), In-Hospital Mortality aOR (95% CI)	Non-black	Hospital Admission – Black: 1.22 (0.76-1.94) In-Hospital Mortality – Black: 1.24 (0.70-2.25)

Zelner et al., 2020[73]	Cross-sectional	Confirmed and probable COVID-19 infections from the Michigan Disease Surveillance System	49,701 cases	Michigan, U.S.A.	Age and sex-standardized mortality rate ratios (95% CI)	White	Black: 6.9 (6.5,7.3) Latino: 2.2 (1.8, 2.6) A/PI: 2.2 (1.7, 2.7) Native American: 0.7 (0.3, 1.3) Other: 4.2 (3.4, 5.1)

*Denotes pre-print study; non-peer-reviewed
NH = non-Hispanic
AI/AN = American Indian or Alaska Native
A/PI = Asian or Pacific Islander
NH/PI = Native Hawaiian/Pacific Islander
aOR = adjusted odds ratio; CI = confidence interval; ICU = intensive care unit

References

1. Johns Hopkins University. COVID-19 dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). Accessed March 25, 2021. https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6
2. World Health Organization. *Coronavirus disease 2019 (COVID-19) Situation Report – 51*. 2021. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf?sfvrsn=1ba62e57_10
3. Alcendor DJ. Racial Disparities-Associated COVID-19 Mortality among Minority Populations in the US. *J Clin Med*. Jul 30 2020;9(8)doi:10.3390/jcm9082442
4. Erhunmwunsee L, Seewaldt VL, Rebbeck TR, Winn RA. From COVID-19 to cancer, watching social determinants decide life: When will we stop spectating? *J Natl Med Assoc*. Mar 13 2021;doi:10.1016/j.jnma.2021.02.003
5. Ferdinand KC, Nasser SA. African-American COVID-19 Mortality: A Sentinel Event. *J Am Coll Cardiol*. Jun 2 2020;75(21):2746-2748. doi:10.1016/j.jacc.2020.04.040
6. Lopez L, Hart LH, Katz MH. Racial and Ethnic Health Disparities Related to COVID-19. *JAMA*. 2021;325(8):719-720. doi:10.1001/jama.2020.26443
7. Karaca-Mandic P, Georgiou A, Sen S. Assessment of COVID-19 Hospitalizations by Race/Ethnicity in 12 States. *JAMA Intern Med*. Jan 1 2021;181(1):131-134. doi:10.1001/jamainternmed.2020.3857
8. Baltrus PT, Douglas M, Li C, et al. Percentage of Black Population and Primary Care Shortage Areas Associated with Higher COVID-19 Case and Death Rates in Georgia Counties. *South Med J*. Feb 2021;114(2):57-62. doi:10.14423/smj.0000000000001212
9. Khunti K, Singh AK, Pareek M, Hanif W. Is ethnicity linked to incidence or outcomes of covid-19? *Bmj*. Apr 20 2020;369:m1548. doi:10.1136/bmj.m1548
10. Krishnamoorthy G, Arsene C, Jena N, et al. Racial disparities in COVID-19 hospitalizations do not lead to disparities in outcomes. *Public Health*. Jan 2021;190:93-98. doi:10.1016/j.puhe.2020.11.021
11. Adegunsoye A, Ventura IB, Liarski VM. Association of Black Race with Outcomes in COVID-19 Disease: A Retrospective Cohort Study. *Ann Am Thorac Soc*. Oct 2020;17(10):1336-1339. doi:10.1513/AnnalsATS.202006-583RL
12. Azar KMJ, Shen Z, Romanelli RJ, et al. Disparities In Outcomes Among COVID-19 Patients In A Large Health Care System In California. *Health Aff (Millwood)*. Jul 2020;39(7):1253-1262. doi:10.1377/hlthaff.2020.00598
13. Boserup B, McKenney M, Elkbuli A. Disproportionate Impact of COVID-19 Pandemic on Racial and Ethnic Minorities. *Am Surg*. Dec 2020;86(12):1615-1622. doi:10.1177/0003134820973356
14. Cardemil CV, Dahl R, Prill MM, et al. COVID-19-Related Hospitalization Rates and Severe Outcomes Among Veterans From 5 Veterans Affairs Medical Centers: Hospital-Based Surveillance Study. *JMIR Public Health Surveill*. Jan 22 2021;7(1):e24502. doi:10.2196/24502
15. Chishinga N, Gandhi NR, Onwubiko UN, et al. Characteristics and Risk Factors for Hospitalization and Mortality among Persons with COVID-19 in Atlanta Metropolitan Area. *medRxiv*. Dec 16 2020;doi:10.1101/2020.12.15.20248214

16. Cromer SJ, Lakhani CM, Wexler DJ, Burnett-Bowie SM, Udler M, Patel CJ. Geospatial Analysis of Individual and Community-Level Socioeconomic Factors Impacting SARS-CoV-2 Prevalence and Outcomes. *medRxiv*. Sep 30 2020;doi:10.1101/2020.09.30.20201830
17. Dai CL, Kornilov SA, Roper RT, et al. Characteristics and Factors Associated with COVID-19 Infection, Hospitalization, and Mortality Across Race and Ethnicity. *Clin Infect Dis*. Feb 20 2021;doi:10.1093/cid/ciab154
18. Escobar GJ, Adams AS, Liu VX, et al. Racial Disparities in COVID-19 Testing and Outcomes : Retrospective Cohort Study in an Integrated Health System. *Ann Intern Med*. Feb 9 2021;doi:10.7326/m20-6979
19. Gershengorn HB, Patel S, Shukla B, et al. Association of Race and Ethnicity with COVID-19 Test Positivity and Hospitalization Is Mediated by Socioeconomic Factors. *Ann Am Thorac Soc*. Mar 16 2021;doi:10.1513/AnnalsATS.202011-1448OC
20. Gianfrancesco MA, Leykina LA, Izadi Z, et al. Association of Race and Ethnicity With COVID-19 Outcomes in Rheumatic Disease: Data From the COVID-19 Global Rheumatology Alliance Physician Registry. *Arthritis Rheumatol*. Mar 2021;73(3):374-380. doi:10.1002/art.41567
21. Golestaneh L, Neugarten J, Fisher M, et al. The association of race and COVID-19 mortality. *EClinicalMedicine*. Aug 2020;25:100455. doi:10.1016/j.eclinm.2020.100455
22. Gu T, Mack JA, Salvatore M, et al. Characteristics Associated With Racial/Ethnic Disparities in COVID-19 Outcomes in an Academic Health Care System. *JAMA Netw Open*. Oct 1 2020;3(10):e2025197. doi:10.1001/jamanetworkopen.2020.25197
23. Ingraham NE, Purcell LN, Karam BS, et al. Racial/Ethnic Disparities in Hospital Admissions from COVID-19 and Determining the Impact of Neighborhood Deprivation and Primary Language. *medRxiv*. Sep 3 2020;doi:10.1101/2020.09.02.20185983
24. Ioannou GN, Locke E, Green P, et al. Risk Factors for Hospitalization, Mechanical Ventilation, or Death Among 10 131 US Veterans With SARS-CoV-2 Infection. *JAMA Netw Open*. Sep 1 2020;3(9):e2022310. doi:10.1001/jamanetworkopen.2020.22310
25. Izurieta HS, Graham DJ, Jiao Y, et al. Natural history of COVID-19: Risk factors for hospitalizations and deaths among >26 million U.S. Medicare beneficiaries. *J Infect Dis*. Dec 16 2020;doi:10.1093/infdis/jiaa767
26. Killerby ME, Link-Gelles R, Haight SC, et al. Characteristics Associated with Hospitalization Among Patients with COVID-19 - Metropolitan Atlanta, Georgia, March-April 2020. *MMWR Morb Mortal Wkly Rep*. Jun 26 2020;69(25):790-794. doi:10.15585/mmwr.mm6925e1
27. Muñoz-Price LS, Nattinger AB, Rivera F, et al. Racial Disparities in Incidence and Outcomes Among Patients With COVID-19. *JAMA Netw Open*. Sep 1 2020;3(9):e2021892. doi:10.1001/jamanetworkopen.2020.21892
28. Ko JY, Danielson ML, Town M, et al. Risk Factors for COVID-19-associated hospitalization: COVID-19-Associated Hospitalization Surveillance Network and Behavioral Risk Factor Surveillance System. *Clin Infect Dis*. Sep 18 2020;doi:10.1093/cid/ciaa1419
29. Lara OD, Smith MJ, Wang Y, et al. Racial disparities in patients with coronavirus disease 2019 infection and gynecologic malignancy. *Cancer*. Dec 9 2020;doi:10.1002/cncr.33335
30. Lundon DJ, Mohamed N, Lantz A, Goltz HH, Kelly BD, Tewari AK. Social Determinants Predict Outcomes in Data From a Multi-Ethnic Cohort of 20,899 Patients Investigated for COVID-19. *Front Public Health*. 2020;8:571364. doi:10.3389/fpubh.2020.571364

31. Poulson M, Neufeld M, Geary A, et al. Intersectional Disparities Among Hispanic Groups in COVID-19 Outcomes. *J Immigr Minor Health*. Feb 2021;23(1):4-10. doi:10.1007/s10903-020-01111-5
32. Price-Haywood EG, Burton J, Fort D, Seoane L. Hospitalization and Mortality among Black Patients and White Patients with Covid-19. *N Engl J Med*. Jun 25 2020;382(26):2534-2543. doi:10.1056/NEJMsa2011686
33. Renelus BD, Khoury NC, Chandrasekaran K, et al. Racial Disparities in COVID-19 Hospitalization and In-hospital Mortality at the Height of the New York City Pandemic. *J Racial Ethn Health Disparities*. Sep 18 2020:1-7. doi:10.1007/s40615-020-00872-x
34. Gottlieb M, Sansom S, Frankenberger C, Ward E, Hota B. Clinical Course and Factors Associated With Hospitalization and Critical Illness Among COVID-19 Patients in Chicago, Illinois. *Acad Emerg Med*. Oct 2020;27(10):963-973. doi:10.1111/acem.14104
35. Ogedegbe G, Ravenell J, Adhikari S, et al. Assessment of Racial/Ethnic Disparities in Hospitalization and Mortality in Patients With COVID-19 in New York City. *JAMA Netw Open*. Dec 1 2020;3(12):e2026881. doi:10.1001/jamanetworkopen.2020.26881
36. Salter A, Fox RJ, Newsome SD, et al. Outcomes and Risk Factors Associated With SARS-CoV-2 Infection in a North American Registry of Patients With Multiple Sclerosis. *JAMA Neurol*. Mar 19 2021;doi:10.1001/jamaneurol.2021.0688
37. Wiley Z, Kubes JN, Cobb J, et al. Age, Comorbid Conditions, and Racial Disparities in COVID-19 Outcomes. *J Racial Ethn Health Disparities*. Jan 7 2021:1-7. doi:10.1007/s40615-020-00934-0
38. Foo PK, Perez B, Gupta N, et al. High Rates of COVID-19 Infection Among Indigenous Maya at a US Safety-Net Health System in California. *Public Health Rep*. Feb 16 2021:33354921990370. doi:10.1177/0033354921990370
39. Vaughan L, Veruttipong D, Shaw JG, Levy N, Edwards L, Winget M. Relationship of socio-demographics, comorbidities, symptoms and healthcare access with early COVID-19 presentation and disease severity. *BMC Infect Dis*. Jan 9 2021;21(1):40. doi:10.1186/s12879-021-05764-x
40. Valenzuela RG, Michelen Y, Bracey A, et al. Outcomes in Hispanics With COVID-19 Are Similar to Those of Caucasian Patients in Suburban New York. *Acad Emerg Med*. Dec 2020;27(12):1260-1269. doi:10.1111/acem.14146
41. Antwi-Amoabeng D, Beutler BD, Awad M, et al. Sociodemographic Predictors of Outcomes in COVID-19: Examining the Impact of Ethnic Disparities in Northern Nevada. *Cureus*. Feb 4 2021;13(2):e13128. doi:10.7759/cureus.13128
42. Bennett TD, Moffitt RA, Hajagos JG, et al. The National COVID Cohort Collaborative: Clinical Characterization and Early Severity Prediction. *medRxiv*. Jan 13 2021;doi:10.1101/2021.01.12.21249511
43. Bhargava A, Fukushima EA, Levine M, et al. Predictors for Severe COVID-19 Infection. *Clin Infect Dis*. Nov 5 2020;71(8):1962-1968. doi:10.1093/cid/ciaa674
44. Chilimuri S, Sun H, Alemam A, et al. Predictors of Mortality in Adults Admitted with COVID-19: Retrospective Cohort Study from New York City. *West J Emerg Med*. Jul 8 2020;21(4):779-784. doi:10.5811/westjem.2020.6.47919
45. Fernandes DM, Oliveira CR, Guerguis S, et al. Severe Acute Respiratory Syndrome Coronavirus 2 Clinical Syndromes and Predictors of Disease Severity in Hospitalized Children and Youth. *J Pediatr*. Mar 2021;230:23-31.e10. doi:10.1016/j.jpeds.2020.11.016

46. Garibaldi BT, Fiksel J, Muschelli J, et al. Patient Trajectories Among Persons Hospitalized for COVID-19 : A Cohort Study. *Ann Intern Med*. Jan 2021;174(1):33-41. doi:10.7326/m20-3905
47. Gil RM, Touzard-Romo F, Sanchez MC, et al. Characteristics and Outcomes of Hispanic/Latinx patients with Coronavirus Disease 19 (COVID-19) Requiring Hospitalization in Rhode Island: a Retrospective Cohort Study. *Ann Epidemiol*. Mar 15 2021;doi:10.1016/j.annepidem.2021.03.003
48. Gupta R, Agrawal R, Bukhari Z, et al. Higher comorbidities and early death in hospitalized African-American patients with Covid-19. *BMC Infect Dis*. Jan 18 2021;21(1):78. doi:10.1186/s12879-021-05782-9
49. Hsu CM, Weiner DE, Aweh G, et al. COVID-19 Among US Dialysis Patients: Risk Factors and Outcomes From a National Dialysis Provider. *Am J Kidney Dis*. Jan 17 2021;doi:10.1053/j.ajkd.2021.01.003
50. Kim D, Adeniji N, Latt N, et al. Predictors of Outcomes of COVID-19 in Patients with Chronic Liver Disease: US Multi-center Study. *Clin Gastroenterol Hepatol*. Sep 17 2020;doi:10.1016/j.cgh.2020.09.027
51. Krause M, Douin DJ, Kim KK, Fernandez-Bustamante A, Bartels K. Characteristics and Outcomes of Mechanically Ventilated COVID-19 Patients-An Observational Cohort Study. *J Intensive Care Med*. Mar 2021;36(3):271-276. doi:10.1177/0885066620954806
52. Lucar J, Wingler MJB, Cretella DA, et al. Epidemiology, Clinical Features, and Outcomes of Hospitalized Adults with COVID-19: Early Experience from an Academic Medical Center in Mississippi. *South Med J*. Mar 2021;114(3):144-149. doi:10.14423/smj.0000000000001222
53. Luo J, Jeyapalina S, Stoddard GJ, Kwok AC, Agarwal JP. Coronavirus disease 2019 in veterans receiving care at veterans health administration facilities. *Ann Epidemiol*. Mar 2021;55:10-14. doi:10.1016/j.annepidem.2020.12.003
54. Marmarchi F, Liu M, Rangaraju S, et al. Clinical Outcomes of Critically Ill Patients with COVID-19 by Race. *J Racial Ethn Health Disparities*. Jan 19 2021:1-5. doi:10.1007/s40615-021-00966-0
55. McCarty TR, Hathorn KE, Redd WD, et al. How Do Presenting Symptoms and Outcomes Differ by Race/Ethnicity Among Hospitalized Patients with COVID-19 Infection? Experience in Massachusetts. *Clin Infect Dis*. Aug 22 2020;doi:10.1093/cid/ciaa1245
56. Mikami T, Miyashita H, Yamada T, et al. Risk Factors for Mortality in Patients with COVID-19 in New York City. *J Gen Intern Med*. Jan 2021;36(1):17-26. doi:10.1007/s11606-020-05983-z
57. Muhammad R, Ogunti R, Ahmed B, et al. Clinical Characteristics and Predictors of Mortality in Minority Patients Hospitalized with COVID-19 Infection. *J Racial Ethn Health Disparities*. Feb 4 2021:1-11. doi:10.1007/s40615-020-00961-x
58. Quan D, Luna Wong L, Shallal A, et al. Impact of Race and Socioeconomic Status on Outcomes in Patients Hospitalized with COVID-19. *J Gen Intern Med*. Jan 27 2021:1-8. doi:10.1007/s11606-020-06527-1
59. Razjouyan J, Helmer DA, Li A, et al. Differences in COVID-19-Related Testing and Healthcare Utilization by Race and Ethnicity in the Veterans Health Administration. *J Racial Ethn Health Disparities*. Mar 10 2021:1-8. doi:10.1007/s40615-021-00982-0

60. Rentsch CT, Kidwai-Khan F, Tate JP, et al. Patterns of COVID-19 testing and mortality by race and ethnicity among United States veterans: A nationwide cohort study. *PLoS Med*. Sep 2020;17(9):e1003379. doi:10.1371/journal.pmed.1003379
61. 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*. Nov 17 2020;doi:10.1161/circulationaha.120.052278
62. Shah P, Owens J, Franklin J, et al. Demographics, comorbidities and outcomes in hospitalized Covid-19 patients in rural southwest Georgia. *Ann Med*. Nov 2020;52(7):354-360. doi:10.1080/07853890.2020.1791356
63. Silver V, Chapple AG, Feibus AH, et al. Clinical Characteristics and Outcomes Based on Race of Hospitalized Patients With COVID-19 in a New Orleans Cohort. *Open Forum Infect Dis*. Sep 2020;7(9):ofaa339. doi:10.1093/ofid/ofaa339
64. Twigg HL, 3rd, Khan SH, Perkins AJ, et al. Mortality Rates in a Diverse Cohort of Mechanically Ventilated Patients With Novel Coronavirus in the Urban Midwest. *Crit Care Explor*. Aug 2020;2(8):e0187. doi:10.1097/cce.0000000000000187
65. Wang Z, Zheutlin A, Kao YH, et al. Hospitalised COVID-19 patients of the Mount Sinai Health System: a retrospective observational study using the electronic medical records. *BMJ Open*. Oct 26 2020;10(10):e040441. doi:10.1136/bmjopen-2020-040441
66. Bassett M, Chen J, Krieger N. Variation in racial/ethnic disparities in COVID-19 mortality by age in the United States: A cross-sectional study. *PLoS medicine*. 10/20/2020 2020;17(10):e1003402. doi:10.1371/journal.pmed.1003402
67. Cates J, Lucero-Obusan C, Dahl RM, et al. Risk for In-Hospital Complications Associated with COVID-19 and Influenza - Veterans Health Administration, United States, October 1, 2018-May 31, 2020. *MMWR Morb Mortal Wkly Rep*. Oct 23 2020;69(42):1528-1534. doi:10.15585/mmwr.mm6942e3
68. Garcia E, Eckel SP, Chen Z, Li K, Gilliland FD. COVID-19 Mortality in California Based on Death Certificates: Disproportionate Impacts Across Racial/Ethnic Groups and Nativity. *Ann Epidemiol*. Mar 18 2021;doi:10.1016/j.annepidem.2021.03.006
69. Girardin JL, Seixas A, Ramos Cejudo J, et al. Contribution of pulmonary diseases to COVID-19 mortality in a diverse urban community of New York. *Chron Respir Dis*. Jan-Dec 2021;18:1479973120986806. doi:10.1177/1479973120986806
70. Joseph NP, Reid NJ, Som A, et al. Racial and Ethnic Disparities in Disease Severity on Admission Chest Radiographs among Patients Admitted with Confirmed Coronavirus Disease 2019: A Retrospective Cohort Study. *Radiology*. Dec 2020;297(3):E303-e312. doi:10.1148/radiol.2020202602
71. Pennington AF, Kompaniyets L, Summers AD, et al. Risk of Clinical Severity by Age and Race/Ethnicity Among Adults Hospitalized for COVID-19-United States, March-September 2020. *Open Forum Infect Dis*. Feb 2021;8(2):ofaa638. doi:10.1093/ofid/ofaa638
72. Poulson M, Geary A, Annesi C, et al. National Disparities in COVID-19 Outcomes between Black and White Americans. *J Natl Med Assoc*. Aug 7 2020;doi:10.1016/j.jnma.2020.07.009
73. Zelner J, Trangucci R, Naraharisetti R, et al. Racial Disparities in Coronavirus Disease 2019 (COVID-19) Mortality Are Driven by Unequal Infection Risks. *Clin Infect Dis*. Mar 1 2021;72(5):e88-e95. doi:10.1093/cid/ciaa1723

74. Bassett IV, Triant VA, Bunda BA, et al. Massachusetts general hospital Covid-19 registry reveals two distinct populations of hospitalized patients by race and ethnicity. *PLoS One*. 2020;15(12):e0244270. doi:10.1371/journal.pone.0244270
75. Cohen SL, Gianos E, Barish MA, et al. Prevalence and Predictors of Venous Thromboembolism or Mortality in Hospitalized COVID-19 Patients. *Thromb Haemost*. Jan 20 2021;doi:10.1055/a-1366-9656
76. Lazar MH, Fadel R, Gardner-Gray J, et al. Racial Differences in a Detroit, MI, ICU Population of Coronavirus Disease 2019 Patients. *Crit Care Med*. Mar 1 2021;49(3):482-489. doi:10.1097/ccm.0000000000004735
77. Miller J, Fadel RA, Tang A, et al. The Impact of Sociodemographic Factors, Comorbidities and Physiologic Response on 30-day Mortality in COVID-19 Patients in Metropolitan Detroit. *Clin Infect Dis*. Sep 18 2020;doi:10.1093/cid/ciaa1420
78. Panagiotou OA, Kosar CM, White EM, et al. Risk Factors Associated With All-Cause 30-Day Mortality in Nursing Home Residents With COVID-19. *JAMA Intern Med*. Jan 4 2021;doi:10.1001/jamainternmed.2020.7968
79. Rosenthal N, Cao Z, Gundrum J, Sianis J, Safo S. Risk Factors Associated With In-Hospital Mortality in a US National Sample of Patients With COVID-19. *JAMA Netw Open*. Dec 1 2020;3(12):e2029058. doi:10.1001/jamanetworkopen.2020.29058
80. Esenwa C, Unda SR, Altschul DJ, et al. The effect of race on composite thrombotic events in patients with COVID-19. *Thromb Res*. Mar 2021;199:10-13. doi:10.1016/j.thromres.2020.12.015
81. Adhikari S, Pantaleo NP, Feldman JM, Ogedegbe O, Thorpe L, Troxel AB. Assessment of Community-Level Disparities in Coronavirus Disease 2019 (COVID-19) Infections and Deaths in Large US Metropolitan Areas. *JAMA Netw Open*. Jul 1 2020;3(7):e2016938. doi:10.1001/jamanetworkopen.2020.16938
82. Anaele BI, Doran C, McIntire R. Visualizing COVID-19 Mortality Rates and African-American Populations in the USA and Pennsylvania. *J Racial Ethn Health Disparities*. Feb 9 2021:1-8. doi:10.1007/s40615-020-00897-2
83. Cheng KJG, Sun Y, Monnat SM. COVID-19 Death Rates Are Higher in Rural Counties With Larger Shares of Blacks and Hispanics. *J Rural Health*. Sep 2020;36(4):602-608. doi:10.1111/jrh.12511
84. Dalsania AK, Fastiggi MJ, Kahlam A, et al. The Relationship Between Social Determinants of Health and Racial Disparities in COVID-19 Mortality. *J Racial Ethn Health Disparities*. Jan 5 2021:1-8. doi:10.1007/s40615-020-00952-y
85. Figueroa JF, Wadhera RK, Mehtsun WT, Riley K, Phelan J, Jha AK. Association of race, ethnicity, and community-level factors with COVID-19 cases and deaths across U.S. counties. *Healthc (Amst)*. Mar 2021;9(1):100495. doi:10.1016/j.hjdsi.2020.100495
86. Hawkins RB, Charles EJ, Mehaffey JH. Socio-economic status and COVID-19-related cases and fatalities. *Public Health*. Dec 2020;189:129-134. doi:10.1016/j.puhe.2020.09.016
87. Iyanda AE, Boakye KA, Lu Y, Oppong JR. Racial/Ethnic Heterogeneity and Rural-Urban Disparity of COVID-19 Case Fatality Ratio in the USA: a Negative Binomial and GIS-Based Analysis. *J Racial Ethn Health Disparities*. Feb 26 2021:1-14. doi:10.1007/s40615-021-01006-7
88. Karmakar M, Lantz PM, Tipirneni R. Association of Social and Demographic Factors With COVID-19 Incidence and Death Rates in the US. *JAMA Netw Open*. Jan 4 2021;4(1):e2036462. doi:10.1001/jamanetworkopen.2020.36462

89. Khanijahani A. Racial, ethnic, and socioeconomic disparities in confirmed COVID-19 cases and deaths in the United States: a county-level analysis as of November 2020. *Ethn Health*. Jan 2021;26(1):22-35. doi:10.1080/13557858.2020.1853067
90. Li D, Gaynor SM, Quick C, et al. Unraveling US National COVID-19 Racial/Ethnic Disparities using County Level Data Among 328 Million Americans. *medRxiv*. Dec 4 2020;doi:10.1101/2020.12.02.20234989
91. Liao TF, De Maio F. Association of Social and Economic Inequality With Coronavirus Disease 2019 Incidence and Mortality Across US Counties. *JAMA Netw Open*. Jan 4 2021;4(1):e2034578. doi:10.1001/jamanetworkopen.2020.34578
92. Mahajan UV, Larkins-Pettigrew M. Racial demographics and COVID-19 confirmed cases and deaths: a correlational analysis of 2886 US counties. *J Public Health (Oxf)*. Aug 18 2020;42(3):445-447. doi:10.1093/pubmed/fdaa070
93. Ojinnaka CO, Adepoju OE, Burgess AV, Woodard L. Factors Associated with COVID-Related Mortality: the Case of Texas. *J Racial Ethn Health Disparities*. Nov 9 2020:1-6. doi:10.1007/s40615-020-00913-5
94. Paul R, Arif A, Pokhrel K, Ghosh S. The association of social determinants of health with COVID-19 mortality in rural and urban counties. *J Rural Health*. Feb 22 2021;doi:10.1111/jrh.12557
95. Saffary T, Adegboye OA, Gayawan E, Elfaki F, Kuddus MA, Saffary R. Analysis of COVID-19 Cases' Spatial Dependence in US Counties Reveals Health Inequalities. *Front Public Health*. 2020;8:579190. doi:10.3389/fpubh.2020.579190
96. Abedi V, Olulana O, Avula V, et al. Racial, Economic and Health Inequality and COVID-19 Infection in the United States. *medRxiv*. May 1 2020;doi:10.1101/2020.04.26.20079756
97. Akanbi MO, Rivera AS, Akanbi FO, Shoyinka A. An Ecologic Study of Disparities in COVID-19 Incidence and Case Fatality in Oakland County, MI, USA, During a State-Mandated Shutdown. *J Racial Ethn Health Disparities*. Oct 29 2020:1-8. doi:10.1007/s40615-020-00909-1
98. Moreira A, Chorath K, Rajasekaran K, Burmeister F, Ahmed M. Demographic predictors of hospitalization and mortality in US children with COVID-19. *Eur J Pediatr*. Jan 20 2021:1-5. doi:10.1007/s00431-021-03955-x
99. Bailey LC, Razzaghi H, Burrows EK, et al. Assessment of 135 794 Pediatric Patients Tested for Severe Acute Respiratory Syndrome Coronavirus 2 Across the United States. *JAMA Pediatr*. Feb 1 2021;175(2):176-184. doi:10.1001/jamapediatrics.2020.5052
100. Abrams JY, Oster ME, Godfred-Cato SE, et al. Factors linked to severe outcomes in multisystem inflammatory syndrome in children (MIS-C) in the USA: a retrospective surveillance study. *Lancet Child Adolesc Health*. Mar 9 2021;doi:10.1016/s2352-4642(21)00050-x
101. Bixler D, Miller AD, Mattison CP, et al. SARS-CoV-2-Associated Deaths Among Persons Aged <21 Years - United States, February 12-July 31, 2020. *MMWR Morb Mortal Wkly Rep*. Sep 18 2020;69(37):1324-1329. doi:10.15585/mmwr.mm6937e4
102. Derespina KR, Kaushik S, Plichta A, et al. Clinical Manifestations and Outcomes of Critically Ill Children and Adolescents with Coronavirus Disease 2019 in New York City. *J Pediatr*. Jul 16 2020;226:55-63.e2. doi:10.1016/j.jpeds.2020.07.039
103. Graff K, Smith C, Silveira L, et al. Risk Factors for Severe COVID-19 in Children. *Pediatr Infect Dis J*. Apr 1 2021;40(4):e137-e145. doi:10.1097/inf.0000000000003043

104. Hawkins D, Davis L, Kriebel D. COVID-19 deaths by occupation, Massachusetts, March 1-July 31, 2020. *Am J Ind Med*. Apr 2021;64(4):238-244. doi:10.1002/ajim.23227
105. Chen J, Krieger N. Revealing the Unequal Burden of COVID-19 by Income, Race/Ethnicity, and Household Crowding: US County Versus Zip Code Analyses. *Journal of public health management and practice*. Jan/Feb 2021 2021;27(Suppl 1)doi:10.1097/PHH.0000000000001263
106. Kim SJ, Bostwick W. Social Vulnerability and Racial Inequality in COVID-19 Deaths in Chicago. *Health Educ Behav*. Aug 2020;47(4):509-513. doi:10.1177/1090198120929677
107. Yehia BR, Winegar A, Fogel R, et al. Association of Race With Mortality Among Patients Hospitalized With Coronavirus Disease 2019 (COVID-19) at 92 US Hospitals. *JAMA Netw Open*. Aug 3 2020;3(8):e2018039. doi:10.1001/jamanetworkopen.2020.18039
108. Hsu HE, Ashe EM, Silverstein M, et al. Race/Ethnicity, Underlying Medical Conditions, Homelessness, and Hospitalization Status of Adult Patients with COVID-19 at an Urban Safety-Net Medical Center - Boston, Massachusetts, 2020. *MMWR Morb Mortal Wkly Rep*. Jul 10 2020;69(27):864-869. doi:10.15585/mmwr.mm6927a3
109. Ajufo E, Rao S, Navar AM, Pandey A, Ayers CR, Khera A. U.S. population at increased risk of severe illness from COVID-19. *Am J Prev Cardiol*. Jun 2021;6:100156. doi:10.1016/j.ajpc.2021.100156
110. Brandt EB, Beck AF, Mersha TB. Air pollution, racial disparities, and COVID-19 mortality. *J Allergy Clin Immunol*. Jul 2020;146(1):61-63. doi:10.1016/j.jaci.2020.04.035
111. Fraiman YS, Litt JS, Davis JM, Pursley DM. Racial and ethnic disparities in adult COVID-19 and the future impact on child health. *Pediatr Res*. Feb 9 2021:1-3. doi:10.1038/s41390-021-01377-x
112. Arrazola J, Masiello MM, Joshi S, et al. COVID-19 Mortality Among American Indian and Alaska Native Persons - 14 States, January-June 2020. *MMWR Morb Mortal Wkly Rep*. Dec 11 2020;69(49):1853-1856. doi:10.15585/mmwr.mm6949a3
113. Chang MH, Moonesinghe R, Truman BI. COVID-19 Hospitalization by Race and Ethnicity: Association with Chronic Conditions Among Medicare Beneficiaries, January 1-September 30, 2020. *J Racial Ethn Health Disparities*. Jan 8 2021:1-10. doi:10.1007/s40615-020-00960-y
114. Misa NY, Perez B, Basham K, et al. Racial/ethnic disparities in COVID-19 disease burden & mortality among emergency department patients in a safety net health system. *Am J Emerg Med*. Sep 24 2020;doi:10.1016/j.ajem.2020.09.053
115. O'Malley G, Ebekozien O, Desimone M, et al. COVID-19 Hospitalization in Adults with Type 1 Diabetes: Results from the T1D Exchange Multicenter Surveillance Study. *J Clin Endocrinol Metab*. Jan 23 2021;106(2):e936-e942. doi:10.1210/clinem/dgaa825