

Racial and Ethnic Disparities in Covid-19 Illness Severity Accounting for Concomitant Comorbidities: A Cohort Study

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Abstract

Background Multiple reports have highlighted important racial and ethnic differences in the degree to which Americans may be vulnerable to severe forms of Covid-19 illness. Whether or not racial or ethnic disparities are related to variations in the underlying burden of comorbidities or other predisposing factors remains unclear.

Methods We identified patients diagnosed with Covid-19, based on a positive PCR for SARS-CoV-2, from the electronic health record of a large multi-hospital system located in Southern California. We developed an illness severity score, based on the level of care each patient required (not admitted to the hospital; required hospital admission but never required intensive care; required intensive level care but never intubation; and, required intubation during hospitalization) and assessed for associations with clinical and demographic factors for each patient using ordinal logistic regression.

Results A total of 571 patients with Covid-19 were identified a majority of whom were male (56%), with a mean age of 55±21 years. There were 81 (14%) patient who identified as African American, and 101 (18%) as Hispanic. A total of 202 (36%) patients required hospitalization without need for intensive care, 43 (8%) required intensive care without intubation, and 64 (11%) required intubation while also receiving intensive care. Of the total sample, African American race (OR 2.33, 95% CI 1.44-3.78, P=0.001) and Hispanic ethnicity (OR 1.97, 95% CI 1.14-3.12, P=0.004) were associated with greater illness severity.

Conclusions Racial and ethnic disparities in the severity of Covid-19 illness persist, even when controlling for baseline comorbidities. It remains unclear if these differences are related to variations in physiologic response to SARS-CoV-2, differential timing of presentation or disparities in care.

Background

Worldwide transmission of coronavirus disease 2019 (Covid-19) has been rapid, with marked variability in the severity of illness seen among infected individuals – ranging from only mild symptoms to life-threatening clinical presentations.(1) Multiple reports have highlighted important racial and ethnic differences in the degree to which individuals in the U.S. may be vulnerable to the more severe forms of Covid-19 illness.(2, 3) Whether or not racial or ethnic disparities are related to variations in the underlying burden of comorbidities or other predisposing factors is not known.

Methods

The enlarging population of Covid-19 patients cared for by our U.S. multi-center health system allowed us to examine the severity of Covid-19 illness by race and ethnicity, controlling for known and presumed risk factors. We curated demographic and clinical data for all Covid-19 confirmed patients from the combined electronic health record of the multi-site Cedar-Sinai Health System, in Los Angeles, California, which includes a catchment area of 1.8 million individuals, 80% of whom identify as a racial or ethnic minority. Laboratory testing for SARS-CoV-2 was performed using reverse transcriptase polymerase chain reaction of extracted RNA from nasopharyngeal swabs. To capture variation in comorbid status, in a way that is not represented by distinct medical history variables alone, we calculated the Elixhauser Comorbidity Index with van Walraven weighting for all patients based on all available data.(4) Our primary outcome was an illness severity score, with higher values assigned to more intensive levels of clinical care based on the following stepwise categories: 0 = clinically deemed to not require admission; 1 = required hospital admission but never required intensive care; 2 = required intensive level care but never intubation; and, 3 = required intubation during hospitalization. The Cedars-Sinai institutional review board approved all protocols. Per convention, we considered a two-sided $P < 0.05$ as statistically significant for association analyses, and $P < 0.10$ as statistically significant for interaction analyses.(5) Patients in this study were included in a prior, preliminary analysis of our cohort.(6) The results of the current study are derived from a now much larger sample, including individuals not previously studied.

Results

Of the total 571 patients with confirmed Covid-19 studied, the mean age was 55 ± 21 years; the study sample included 318 (56%) males, 81 (14%) African Americans, and 101 (18%) Hispanics with the clinical characteristics shown in Table 1. Of the total sample, 202 (36%) required hospitalization without need for intensive care, 43 (8%) required intensive care without intubation, and 64 (11%) required intubation while also receiving intensive care. In ordinal logistic regression models, adjusting for all covariates shown in Fig. 1, both African American race (OR 2.33, 95% CI 1.44–3.78, $P = 0.001$) and Hispanic ethnicity (OR 1.97, 95% CI 1.14–3.12, $P = 0.004$) were associated with greater illness severity. While there were no significant interactions by race, we observed a paradoxical interaction with ethnicity such that diabetes was associated with greater illness severity in non-Hispanics compared to Hispanics.

Table 1
Demographic and Clinical Characteristics of All Patients with Covid-19 by Race and Ethnicity

	Race					P value	Ethnicity		P value
	Overall	African American	White	Asian	Other/Mixed /Unknown		Hispanic	Non-Hispanic	
N	571	81	355	55	80		101	470	
Age, years, mean (SD)	54.80 (20.88)	60.26 (19.04)	56.53 (21.25)	48.76 (20.60)	45.70 (17.64)	< 0.001	48.86 (18.37)	56.07 (21.18)	0.002
Male sex, n (%)	318 (55.7)	43 (53.1)	201 (56.6)	26 (47.3)	48 (60.0)	0.47	53 (52.5)	265 (56.4)	0.544
Obesity, n (%)	93 (16.3)	22 (27.2)	64 (18.0)	2 (3.6)	5 (6.2)	< 0.001	27 (26.7)	66 (14.0)	0.003
Hypertension, n (%)	218 (38.2)	56 (69.1)	135 (38.0)	15 (27.3)	12 (15.0)	< 0.001	35 (34.7)	183 (38.9)	0.49
Diabetes mellitus, n (%)	118 (20.7)	30 (37.0)	74 (20.8)	6 (10.9)	8 (10.0)	< 0.001	27 (26.7)	91 (19.4)	0.127
Elixhauser comorbidity score, mean (SD)	7.00 (10.94)	8.74 (9.66)	7.97 (12.04)	3.55 (5.75)	3.30 (8.23)	< 0.001	6.32 (10.58)	7.14 (11.02)	0.492
Prior myocardial infarction or heart failure, n (%)	79 (13.8)	15 (18.5)	60 (16.9)	1 (1.8)	3 (3.8)	< 0.001	10 (9.9)	69 (14.7)	0.27
Prior COPD or asthma, n (%)	91 (15.9)	19 (23.5)	59 (16.6)	4 (7.3)	9 (11.2)	0.047	12 (11.9)	79 (16.8)	0.281
Ordinal Outcomes									
No need for admission	262 (45.9)	22 (27.2)	150 (42.3)	37 (67.3)	53 (66.2)	< 0.001	42 (41.6)	220 (46.8)	0.398
Admission, No ICU	202 (35.4)	32 (39.5)	141 (39.7)	13 (23.6)	16 (20.0)	0.002	38 (37.6)	164 (34.9)	0.685
ICU, No intubation	43 (7.5)	11 (13.6)	27 (7.6)	3 (5.5)	2 (5)	0.057	6 (5.9)	37 (7.9)	0.646
Required intubation	64 (11.2)	16 (19.8)	37 (10.4)	2 (3.6)	9 (11.2)	0.025	15 (14.9)	49 (10.4)	0.269

Values are presented as mean (SD) for continuous variables and n (%) for categorical variables.

P values are for groupwise comparisons, using One-way ANOVA for normal distributed data, Kruskal-Wallis Rank Sum Test for non-normal distributed data, and Chi-square Test for categorical data by default. Outcome of Covid-19 illness severity score in hospitalized patients was defined as an ordinal variable wherein: 0 = No need for admission, 1 = required admission but never ICU level care, 2 = required ICU level care but never intubate, 3 = required intubation. Odds ratios (OR) are from one multivariable adjusted ordinal logistic regression models adjusted for age, sex, obesity, hypertension, diabetes mellitus, Elixhauser comorbidity score, prior myocardial infarction or heart failure, and prior COPD or asthma.

		Race			Ethnicity		
Multivariable Adjusted OR	-	2.33 (1.44,3.78)	Reference = Non-African American	< 0.001	1.96 (1.24,3.12)	Reference	0.004
for Increased Severity							
Values are presented as mean (SD) for continuous variables and n (%) for categorical variables.							
P values are for groupwise comparisons, using One-way ANOVA for normal distributed data, Kruskal-Wallis Rank Sum Test for non-normal distributed data, and Chi-square Test for categorical data by default. Outcome of Covid-19 illness severity score in hospitalized patients was defined as an ordinal variable wherein: 0 = No need for admission, 1 = required admission but never ICU level care, 2 = required ICU level care but never intubate, 3 = required intubation. Odds ratios (OR) are from one multivariable adjusted ordinal logistic regression models adjusted for age, sex, obesity, hypertension, diabetes mellitus, Elixhauser comorbidity score, prior myocardial infarction or heart failure, and prior COPD or asthma.							

Discussion

In summary, we found that among patients cared for Covid-19 in a U.S. metropolitan healthcare system, African American race and Hispanic ethnicity were both associated with greater illness severity irrespective of age, sex, and overall burden of comorbid conditions. Our findings are consistent with recent reports of marked susceptibility to Covid-19 among African Americans, and we now confirm that this trend exists even after accounting for concomitant risk factors.(7) We further observed a similar trend among Hispanics, notwithstanding a paradoxical lower risk seen in the presence of diabetes. Racial and ethnic differences in Covid-19 illness severity could be due in part to socioeconomic and healthcare access disparities that preferentially impact African American and Hispanic communities; however, host-viral susceptibility factors should also be considered and warrant further investigation.(2)

Conclusions

Racial and ethnic health disparities in severity of illness and outcomes persist despite controlling for preexisting clinical conditions. Understanding the etiology of these differences is crucial to reducing the burden of Covid-19 disproportionately experienced by African American and Hispanic patients.

Abbreviations

Covid-19: Coronavirus Disease 2019

Declarations

Ethics approval and consent to participate:

The Cedars-Sinai Medical Center Institutional Review Board approved all protocols relating to human subject participation. Informed consent was waived by the IRB.

Consent for publication:

Not applicable.

Availability of data and materials:

The data that support the findings of this study are available from Cedars-Sinai Medical Center, upon reasonable request. The data are not publicly available due to the contents including information that could compromise research participant privacy/consent.

Competing interests:

Not applicable.

Funding:

Not applicable.

Authors' contributions:

HJ, SC, and JEE took part in the conception, design, acquisition, analysis, interpretation and drafting of the manuscript. NA, NS, and PB took part in acquisition and drafting of the manuscript. PC was involved in the analysis, interpretation and drafting of the manuscript. All authors read and approved the final manuscript.

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Figures

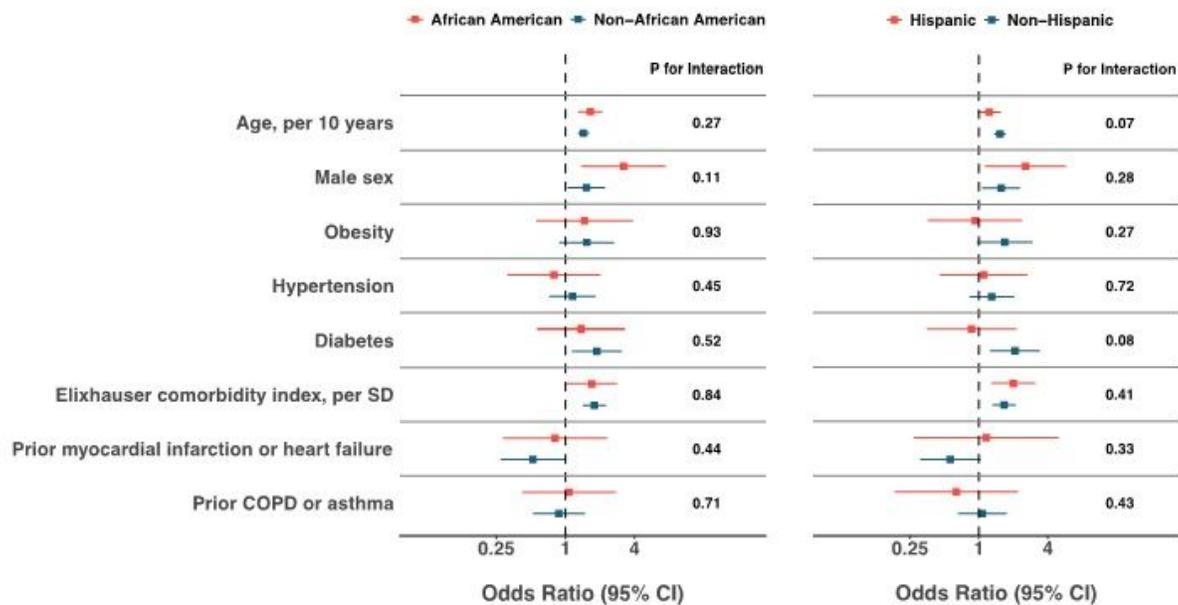


Figure 1

Characteristics Associated with Overall Covid-19 Illness Severity by Race and Ethnicity. *P for interaction values were calculated from likelihood ratio test between models with and without the interaction term. For each variable in the list, race and ethnicity interaction terms are implemented in multivariable adjusted models, with other covariates representative of the entire cohort. Outcome of Covid-19 illness severity score in hospitalized patients was defined as an ordinal variable wherein: 0 = No need for admission, 1 = required admission but never ICU level care, 2 = required ICU level care but never intubate, 3 = required intubation.