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Original Article

Racial and ethnic disparities in COVID-19 mortality in the United States

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Abstract

Background: Among COVID-19–associated deaths reported in the United States (U.S.), minority communities were disproportionately represented. The objective was to assess differences in mortality by race and ethnicity among patients with coronavirus disease 2019 (COVID-19) in the U.S.

Methods: This is a retrospective case series study with information extracted from the U.S. Centers for Disease Control and Prevention between January 20 and December 29, 2020. Clinical and sociodemographic data were analyzed by race and ethnicity from non-hospitalized and hospitalized patients with COVID-19. Binary logistic models were fitted to evaluate factors associated with COVID-19-related mortality.

Results: A total of 434,076 patients with COVID-19 were characterized; 284,574 cases were Non-Hispanic White, 10,468 cases were Non-Hispanic Asian, and 949,022 cases were Non-Hispanic Black, and 89,407 cases were Hispanic/Latino. For non-hospitalized patients, Hispanic/Latino with pneumonia (OR 3.34, 95%CI: 1.70-6.58) and Non-Hispanic Asian with comorbidities (OR 3.88, 95%CI: 0.99-15.2) had the highest odds for mortality. For hospitalized patients, Non-Hispanic Black with comorbidities (OR 3.02, 95%CI: 2.24-4.08) and Non-Hispanic Asian and Non-Hispanic Black with pneumonia (OR 2.98, 95%CI: 2.09-4.26; and OR 2.97, 95%CI: 2.60-3.38, respectively) had the highest odds for mortality.

Conclusion: Racial/ethnic disparities in mortality persist among patients with COVID-19 in the U.S. These findings support the assertion that racial and ethnic minorities are disproportionately affected by COVID-19 in the U.S.

Keywords: SARS-CoV 2, COVID-19, Race, Ethnicity, Health Disparity, Inequality

Background

The novel coronavirus, known as Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV2), was identified in Wuhan, China, in December 2019 and was considered a pandemic by the World Health Organization on March 11, 2020 [1]. The coronavirus disease (COVID-19) pandemic has had a devastating impact on Public Health and the global economy [2, 3]. Actually, the United States (U.S.) has the highest number of confirmed SARS-Cov-2 cases globally, with 26.5 million affected people and more than 440,000 deaths in the country from January 20, 2020, to February 2, 2021 [4]. Recent research has shown that low incomes and race are associated with the COVID-19 incidence [5, 6]. The pandemic could increase poverty and inequities [7–10], and it is well documented that income is correlated with COVID-19 severity [11, 12]. Pre-existing conditions could explain this situation. Asian, Black, and Hispanic Americans are more likely to be uninsured than non-Hispanic White Americans [13], resulting in more limited access to health. The combined effect of poverty and structural inequities among ethnic minorities makes them more exposed to the virus since these groups generally work in places where social distancing is impossible or live in crowded conditions [14, 15]. This study focused on four major groups: non-Hispanics Whites, non-Hispanics Asians, non-Hispanics Blacks, and Hispanics/Latinos. In this context, we evaluated racial and ethnic differences in mortality during the COVID-19 pandemic in the U.S.

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Methods

Study Design and Data Source

A secondary analysis of COVID-19 data collection and reporting in the U.S. was carried out. The Centers for Disease Control and Prevention (CDC) is the leading federal Public Health institute in the U.S. and releases daily updates on the number of total COVID-19 cases, new cases, total deaths, new deaths, and tests [16]. The information was extracted from the COVID-19 case surveillance restricted access dataset with 32 elements, including state and county of residence information from January 20 to December 29, 2020 (*https://data.cdc.gov/Case-Surveillance/COVID-19-Case-Surveillance-Public-Use-Data/vbim-akqf/data* ; Accessed on December 31, 2020) [17].

We excluded people without information on the variables of interest and/or who did not belong to any of the aforementioned population groups (n=12,981,757). Overall, 434,081 patients were included in the analysis (Figure 1).

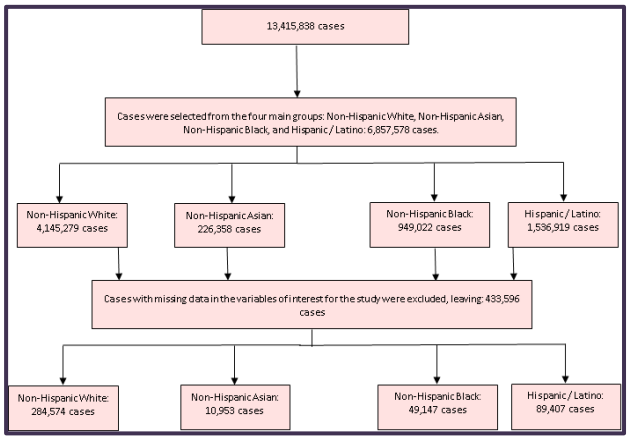

Figure 1: Flowchart of Patients selection

Variables

The dependent variable was death in patients with COVID-19. We considered as individual-level covariates: age categorized into six age groups, 0–29, 30–49, 50–59, 60–69, 70–79, and 80+ years, using the oldest age group as the reference category in the model specifications; sex that compared men (= 0) with women (= 1); comorbidities (No = 0 / Yes = 1); hospitalization (No = 0 / Yes = 1); pneumonia (No = 0 / Yes = 1); and admission to the intensive care unit (ICU) (No = 0 / Yes = 1).

We calculated weights to make statistics computed from the data more representative of the population. Stratification was used to calculate weights so that the weighted case distribution was as close as possible to that of the target population. The information was extracted from the COVID-19 case surveillance public-use data on May 8, 2021, and we stratified it by race, sex, age group, and if the patient had died.

Statistical analysis

Firstly, the variables of interest were presented as frequencies and percentages for the categorical variables stratified by race/ethnicity. Secondly, we performed binary logistic regression models to test the effect of sex, age, and clinical factors on mortality. For each race/ethnicity, a model with sex, age group, comorbidities, hospitalization, pneumonia, and admission to the ICU was fitted. Models were then fitted for hospitalized and non-hospitalized patients. The results were expressed in terms of odds ratios (O.R.s) with 95% confidence intervals (C.I.s) for each model. Statistical tests were two-tailed and considered significant under a 0.05 alpha. All analyses were conducted using the SVY module for complex samples of the statistical software STATA, version 14 (Stata Corp, Stata Statistical Software, Release 14, 2015).

Results

Table 1 summarizes the characteristics of 15,102 deceased patients with COVID-19 by race/ethnicity. Overall, Non-Hispanic White patients were the oldest, and Hispanic/Latino patients were the youngest (e.g., 80+ years: 54.23% Non-Hispanic White patients vs. 28.30% Hispanic/Latino patients). Hispanic/Latino patients had a higher proportion of young patients than other groups. Non-Hispanic Black and Non-Hispanic White patients had a higher proportion of women patients (47.27% and 47.39%, respectively) than the other groups (Non-Hispanic Asian: 42.55%; and Hispanic/Latino: 38.18%). Non-Hispanic Black patients had a higher proportion of comorbidities (97.76% vs. range, 92.58%-95.63%). Non-Hispanic White patients had the lowest prevalence of hospitalization (74.13%), pneumonia (53.07%), and admission to the ICU (40.20%).

Table 2 shows the factors associated with COVID-19 mortality. Non-Hispanic White females (OR 0.90, 95%CI: 0.86-095) had a higher odd of mortality than Non-Hispanic Black (OR 0.77, 95%CI: 0.68-0.86) and Hispanic/Latino females (OR 0.70, 95%CI: 0.61-–0.81). Overall, the odds by age group were lower in Non-Hispanic White patients (e.g., 70-79 years: Non-Hispanic White patients: OR 0.24, 95%CI: 0.22-0.26 vs. Hispanic/Latino patients: OR 0.41, 95%CI: 0.31-0.54). Hispanic/Latino patients with hospitalization (OR 8.72, 95%CI: 6.47-11.77) and ICU (OR 9.75, 95%CI: 8.29-11.48) had a higher risk of mortality compared with other groups (Non-Hispanic White patients: $OR_{hospitalization}$ 3.37, 95%CI: 3.14-3.63, ORICU 6.16, 95%CI: 5.70-6.65; Non-Hispanic Asian patients: $OR_{hospitalization}$ 7.42, 95%CI: 4.10-13.41, ORICU 6.81, 95%CI: 4.76-9.75; and Non-Hispanic Black patients: $OR_{hospitalization}$ 5.03, 95%CI: 4.10-6.16, ORICU 7.94, 95%CI: 7.00-9.01). Finally, Non-Hispanic Black patients with pneumonia (OR 2.90, 95%CI: 2.54-3.30) had a higher risk of mortality compared with other groups (Non-Hispanic White patients: OR 2.30, 95%CI: 2.15-2.46; Non-Hispanic Asian patients: OR 2.83, 95%CI: 1.95-4.10; and Hispanic/Latino: OR 2.73, 95%CI: 2.29-3.25).

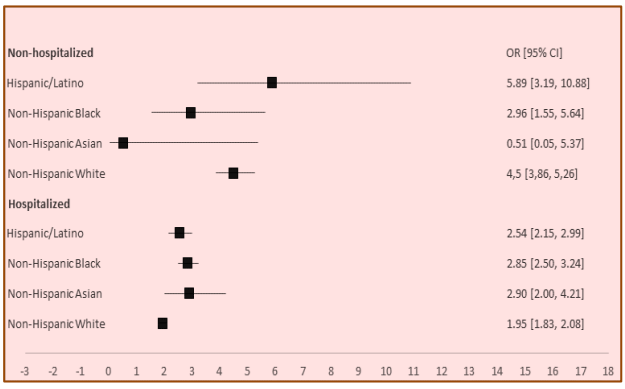

Figure 2. Results of logistic regression model for non-hospitalized patients versus hospitalized patients considering pneumonia. Odd Ratio (OR). 95% Confidence interval (CI

Figure 2 presents the association between pneumonia and mortality in hospitalized and non-hospitalized patients with COVID-19. For non-hospitalized patients, Hispanic/Latino with pneumonia (OR 5.89, 95%CI: 3.19-10.88) had a higher risk of mortality compared with other groups (Non-Hispanic White patients: OR 4.50, 95%CI: 3.86-5.26; and Non-Hispanic Black patients: OR 2.96, 95%CI: 1.55-5.64-3.40). For hospitalized patients, Non-Hispanic Asian and Non-Hispanic Black with pneumonia (OR 2.90, 95%CI: 2.00-4.21; and OR 2.85, 95%CI: 2.50-3.24, respectively) had a higher risk of mortality compared with other groups (Hispanic/Latino patients: OR 2.54, 95%CI: 2.15-2.99; and Non-Hispanic White patients: OR 1.95, 95%CI: 1.83-2.08). Associations of comorbidities and mortality in hospitalized and non-hospitalized patients with COVID-19 are presented in Figure 3. For non-hospitalized patients, Non-Hispanic Asian with comorbidities (OR 5.47, 95%CI: 1.18-25.31) had a higher risk of mortality compared with other groups (Non-Hispanic White patients: OR 2.48, 95%CI: 2.18-2.83; Non-Hispanic Black patients: OR 3.55, 95%CI: 1.93-6.53; and Hispanic/Latino patients: OR 2.44, 95%CI: 1.45-4.10). For hospitalized patients, Non-Hispanic Black with comorbidities (OR 3.71, 95%CI: 2.70-4.08) had a higher risk of mortality compared with other groups (Non-Hispanic White patients: OR 2.38, 95%CI: 2.11-2.69; Non-Hispanic Asian patients: OR 2.15, 95%CI: 1.29-3.57; and Hispanic/Latino patients: OR 2.80, 95%CI: 2.27-3.45).

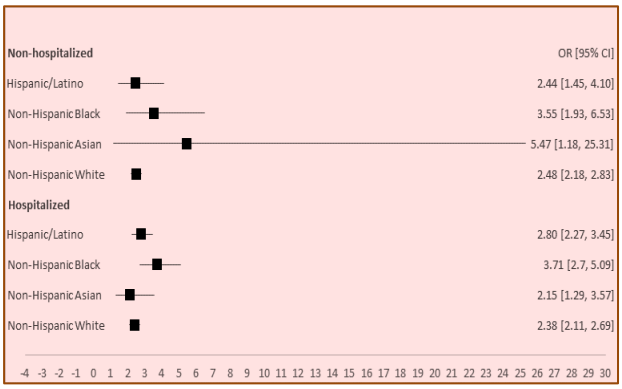

Figure 3. Results of logistic regression model for non-hospitalized patients versus hospitalized patients considering comorbidities. Odd Ratio (OR). 95% Confidence interval (CI).

Table 1: COVID-19 deaths by sociodemographic characteristics, comorbidities, and clinical outcomes

Variables	Categories	Non-Hispanic White	Non-Hispanic Asian	Non-Hispanic Black	Hispanic/Latino
Unweighted cases, n		284,574	10,953	49,147	89,407
Weighted cases, n		7,706,610	510,112	1,709,849	4,578,528
Unweighted deaths, n (%)		10,001 (3.51%)	485 (4.43%)	2,690 (5.47%)	1,931 (2.16%)
Weighted deaths, n (%)		222,176 (2.88%)	15,038 (2.95%)	51,526 (3.01%)	71,145 (1.55%)
Gender, % (95% CI)	Male	52.61 (51.62 - 53.59)	57.45 (52.6 - 62.17)	52.73 (50.82 - 54.63)	61.82 (59.41 - 64.17)
	Female	47.39 (46.41 - 48.38)	42.55 (37.83 - 47.4)	47.27 (45.37 - 49.18)	38.18 (35.83 - 40.59)
Age groups, % (95% CI)	0 - 29 Years	0.31 (0.24 - 0.39)	0.49 (0.17 - 1.46)	1.03 (0.71 - 1.5)	1.19 (0.87 - 1.64)
	30 - 49 Years	1.88 (1.67 - 2.12)	3.94 (2.58 - 5.96)	6.24 (5.42 - 7.17)	9.37 (8.35 - 10.51)
	50 - 59 Years	4.57 (4.22 - 4.95)	7.35 (5.61 - 9.57)	11.27 (10.19 - 12.45)	14.57 (13.25 - 15.99)
	60 - 69 Years	13.15 (12.53 - 13.8)	17.87 (14.89 - 21.31)	23.51 (21.97 - 25.13)	22.63 (20.83 - 24.54)
	70 - 79 Years	25.86 (25.01 - 26.73)	25.16 (21.58 - 29.1)	27.01 (25.37 - 28.71)	23.94 (21.94 - 26.06)
	80+ Years	54.23 (53.25 - 55.2)	45.19 (40.38 - 50.1)	30.94 (29.13 - 32.81)	28.30 (25.91 - 30.83)
Comorbidity, % (95% CI)	No	6.50 (6.03 - 6.99)	4.37 (2.94 - 6.46)	2.24 (1.75 - 2.86)	7.42 (6.36 - 8.64)
	Yes	93.5 (93.01 - 93.97)	95.63 (93.54 - 97.06)	97.76 (97.14 - 98.25)	92.58 (91.36 - 93.64)
Hospitalization, % (95% CI)	No	25.87 (25.01 - 26.76)	5.15 (3.31 - 7.92)	6.75 (5.85 - 7.79)	5.63 (4.58 - 6.9)
	Yes	74.13 (73.24 - 74.99)	94.85 (92.08 - 96.69)	93.25 (92.21 - 94.15)	94.37 (93.1 - 95.42)
Pneumonia, % (95% CI)	No	46.93 (45.94 - 47.92)	20.59 (16.95 - 24.78)	26.77 (25.11 - 28.5)	21.12 (19.21 - 23.16)
	Yes	53.07 (52.08 - 54.06)	79.41 (75.22 - 83.05)	73.23 (71.5 - 74.89)	78.88 (76.84 - 80.79)
ICU, % (95% CI)	No	59.80 (58.83 - 60.76)	33.95 (29.46 - 38.75)	34.69 (32.89 - 36.54)	26.98 (24.85 - 29.22)
	Yes	40.20 (39.24 - 41.17)	66.05 (61.25 - 70.54)	65.31 (63.46 - 67.11)	73.02 (70.78 - 75.15)

All variables have significant values ($p<0.05$); ICU: Intensive Care Units.

Discussion

In In this study, we observed racial and ethnic disparities associated with deaths related to COVID-19 among a sample of patients in the U.S. between January 20 and December 29, 2020. We found overall mortality disparities by race/ethnicity: Non-Hispanic Asian, non-Hispanic Black, and Hispanic/Latino populations were associated with higher mortality than the non-Hispanic White population after controlling for comorbidities, sex, and age groups. Furthermore, the black population presented the highest risk of dying from comorbidities, followed by Non-Hispanic White, Hispanic-Latino, and non-Hispanic Asian. Our findings reinforce that racial and ethnic disparities are also of utmost importance for people at increased risk of severe illness from the virus that causes COVID-19 [18,19]. Disadvantaged social groups are at greater risk of becoming ill and dying since, due to the characteristics of their environment, they have greater exposure to risk factors while having fewer protective factors or resources to deal with diseases [18, 19]. The Ogedegbe et al. [20] study found Black populations are more likely to be uninsured and underinsured than White populations and thus more likely to die at home than in hospitals due to poorer access to care. COVID-19–related mortality relative to their representation in the population affects disproportionately Black and Hispanic/Latino people in major cities in the United States [15, 21].

Table 2: Factors associated to COVID-19 mortality according to race/ethnicity (Results from logistic regression model)

Predictors		Non-Hispanic White		Non-Hispanic Asian		Non-Hispanic Black		Hispanic/Latino	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex, female	Male	1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)	
	Female	0.903*	0.856 - 0.952	0.809	0.589 - 1.110	0.766*	0.684 - 0.858	0.702*	0.608 - 0.810
Age groups,	80+ Years	1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)	
	0 - 29 years	0.003*	0.002 - 0.004	0.001*	0.001 - 0.008	0.019*	0.012 - 0.028	0.018*	0.012 - 0.027
	30 - 39 years	0.014*	0.013 - 0.016	0.035*	0.019 - 0.064	0.046*	0.037 - 0.057	0.051*	0.039 - 0.067
	40 - 59 years	0.004*	0.036 - 0.0436	0.065*	0.039 - 0.108	0.082*	0.067 - 0.099	0.110*	0.085 - 0.143
	60 - 69 years	0.100*	0.093 - 0.107	0.129*	0.081 - 0.206	0.166*	0.139 - 0.200	0.219*	0.168 - 0.286
	70 - 79 years	0.240*	0.224 - 0.257	0.225*	0.139 - 0.365	0.333*	0.277 - 0.401	0.411*	0.311 - 0.543
Comorbidities	No	1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)	
	Yes	2.677*	2.446 - 2.929	2.575*	1.591 - 4.168	3.967*	2.991 - 5.261	2.894*	2.373 - 3.530
Hospitalization	No	1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)	
	Yes	3.374*	3.142 - 3.625	7.417*	4.102 - 13.410	5.029*	4.104 - 6.162	8.724*	6.467 - 11.770
Pneumonia	No	1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)	
	Yes	2.298*	2.145 - 2.461	2.830*	1.952 - 4.101	2.895*	2.541 - 3.298	2.730*	2.294 - 3.249
ICU	No	1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)	
	Yes	6.156*	5.697 - 6.653	6.810*	4.756 - 9.752	7.939*	7.000 - 9.005	9.754*	8.289 - 11.480

In a cross-sectional study in the United States, Karmakar et al. [22] found that racial/ethnic minority status was significantly associated with COVID-19 incidence and mortality. The highest likelihood of dying among Black and Hispanic patients found in this study is consistent with previous findings. The racial differences observed in the study population are probably the result of interactions among multiple factors. Several studies found that where people live and work could increase disease risk because of difficulty engaging in social distancing [21, 23].

Additional analysis by hospitalization led us to evaluate differences in COVID-19 mortality among ethnic groups, considering hospitalized versus non-hospitalized patients. Previous reports pointed out the existence of disparities in hospitalization rates due to COVID-19 [24]. We found differences in the factors associated with COVID-19 deaths according to hospitalization. Black patients presented more risk of death associated with comorbidities in both groups (hospitalized and non-hospitalized patients). Previous reports in the U.S. suggested the presence of more comorbidities in Black patients. Price et al. found disparities in comorbidities (obesity, diabetes, hypertension, and chronic kidney disease) among ethnic groups that could explain these findings [25]. Another New York City Community Health Survey analysis found similar results [26]. The apparition of pneumonia was associated with COVID-19 fatality in Hispanic/Latino non-hospitalized patients. Ogedegbe et al. [20] showed disparities in out-of-hospital deaths in Black and Hispanic communities.

This study has strengths and limitations. The data analyzed were of a secondary nature, and the accuracy of the data, therefore, cannot be guaranteed. This study is based on complete information on the factors studied; thus, the proportion of severe and critical patients and fatality rate might be different for the whole infected population. Finally, minority communities are more likely to experience living and working conditions that could predispose them to worse outcomes [19, 27, 28]. However, we do not have data on work occupation, household size, and the number and type of comorbidities. The strength of this study is the analysis of COVID-19 epidemiologic data based on a large population of patients differentiated by race or ethnicity, adjusting by comorbidities, sex, and age groups.

Conclusion and Policy Implications

Health inequities are not new. COVID-19 has emphasized disparities in disease outcomes by racial/ethnic status. In this sample of patients in the U.S., non-Hispanic Black and non-Hispanic Asian patients with comorbidities were more likely, and Hispanic/Latino patients less likely, than non-Hispanic White patients to die after adjustment for sex, age, and the state-level random effects. Furthermore, non-Hispanic Black, Hispanic/Latino, and non-Hispanic Asian patients were more likely to die than non-Hispanic white patients. These findings support the assertion that racial and ethnic minorities are disproportionately affected by COVID-19 in the U.S., even though the underlying causes of ethnic disparities in COVID-19 outcomes remain established.

Abbreviation

CDC: Centers for Disease Control and Prevention; COVID19: Coronavirus Disease 2019; U.S.: The United States; Severe SARS-CoV2: Acute Respiratory Syndrome Coronavirus-2

Declaration

We would like to declare that the article has a pre-print version published in “The Lancet” on 1st November 2021. Available at SSRN: https://ssrn.com/abstract=3954100 or https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3954100. http://dx.doi.org/10.2139/ssrn.3954100

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Availability of data and materials

Data will be available by emailing carlos.sanchez@isciii.es

Authors' contributions
CSP and FJPG conceptualized the analysis. CSP and FJPG accessed and verified the data, completed the formal analysis, and drafted the original manuscript. All authors had access to all data and contributed to study design, data collection, and manuscript editing. All authors had final responsibility for the decision to submit for publication. All authors have read and approved the final manuscript.

Ethics approval and consent to participate
We conducted the research following the Declaration of Helsinki. This study was analysis of secondary data collected from: https://data.cdc.gov/Case-Surveillance/COVID-19-Case-Surveillance-Public-Use-Data/vbim-akqf/data. The approval of an institutional ethics committee was not required. There was no restriction to accessing the data.

Consent for publication
Not applicable

Competing interest
The authors declare that they have no competing interests.

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