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National Disparities in COVID-19 Outcomes between Black and White Americans

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Abstract: Background: There is very limited comprehensive information on disparate outcomes of black and white patients with COVID-19 infection. Reports from cities and states have suggested a discordant impact on black Americans, but no nationwide study has yet been performed. We sought to understand the differential outcomes for black and white Americans infected with COVID-19.

Methods: We obtained case-level data from the Centers for Disease Control and Prevention on 76,442 white and 48,338 non-Hispanic Black patients diagnosed with COVID-19, ages 0 to >80+, outlining information on hospitalization, ICU admission, ventilation, and death outcomes. Multivariate Poisson regressions were used to estimate the association of race, treating white as the reference group, controlling for sex, age group, and the presence of comorbidities.

Results: Black patients were generally younger than white, were more often female, and had larger numbers of comorbidities. Compared to white patients with COVID-19, black patients had 1.4 times the risk of hospitalization (RR 1.42, $p < 0.001$), and almost twice the risk of requiring ICU care (RR 1.68, $p < 0.001$) or ventilatory support (RR 1.81, $p < 0.001$) after adjusting for covariates. Black patients saw a 1.36 times increased risk of death (RR 1.36, $p < 0.001$) compared to white. Disparities between black and white outcomes increased with advanced age.

Conclusion: Despite the initial descriptions of COVID-19 being a disease that affects all individuals, regardless of station, our data demonstrate the differential racial effects in the United States. This current pandemic reinforces the need to assess the unequal effects of crises on disadvantaged populations to promote population health.

Keywords: COVID-19 ■ Disparities ■ Built environment ■ Black health ■ Structural inequities ■ United States

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INTRODUCTION

At the writing of this manuscript, the United States has over 1.5 million confirmed cases and over 90,000 deaths related to the novel coronavirus 2019 (COVID-19).¹ This pandemic has brought deep-seated inequities in the US health care system to the forefront of

public consciousness.^{2,3} In the first month of the outbreak, evidence appeared that there would be a higher burden of COVID-19 infection, hospitalization, and mortality in black patients as compared to white patients.⁴ In New York City, the case rate was 1.6 times higher in black and 1.4 times higher in Latinx residents than white residents.⁵ Further, the death rate for each group is twice as high as in their white counterparts. While this is a stark example, we continue to see similar trends in communities throughout the country.^{6,7}

The full magnitude of this disparity is just now coming into perspective. Millett et al. showed that at the time of their article, over half of national COVID-19 diagnoses and deaths could be attributed to twenty-two percent of US counties which also happen to house a disproportionate share of black residents.⁸ There is also emerging evidence that of the states publicly reporting race/ethnicity data, black patients had a significantly higher risk of death than whites.⁶

At the time of this writing, there is still no available dataset that links race/ethnicity related COVID-19 outcomes to patient location at the individual level. However, the Centers for Disease Control and Prevention (CDC) has recently made a limited individual-level dataset for the United States available by request. Using these data, we seek to describe the black-white racial disparities in COVID-19 outcomes to further our collective understanding on this topic.

METHODS

Data sources

Data on COVID-19 cases were obtained from the CDC Surveillance Review and Response Group (SRRG)⁹ which manages data collection for COVID-19 cases within the United States and affiliated territories. The dataset has a limited scope of variables and does not provide the full breadth of information reportable to the CDC, including geographic information. Patient data are continuously added as cases are reported via passive surveillance, and completeness is reliant on independent state and local authorities. The vast majority of patients included are

laboratory-confirmed cases (99.9%). Patient-specific variables include sex, age group, race, ethnicity, date of disease onset, need for hospitalization, need for intensive care unit (ICU), ventilation, and death, among other variables around symptomatology. The dataset provides a binary variable (yes/no) if a patient has comorbid conditions, but does not specify number or types of conditions. Missing information and low counts of variables that may identify individuals are listed as unknown.

Exposure and outcomes of interest

The primary exposure of interest was reported race of either black or non-Hispanic white. We sought to obtain a better understanding of the social construct of race, thus we excluded Hispanic whites in this analysis to minimize confounding. We included all patients from the first date of reporting (April 5, 2020) through the download of the data (May 18, 2020). Covariates included sex, age group (ten year increments, beginning with 0-9 years of age and ending with 80+), and comorbidity indicator (yes/no). Outcomes of interest included hospitalization, ICU level of care, ventilatory support, and death.

Statistical analysis

We composed multivariate Poisson regression models with robust error variance for each of the outcomes of interest in a stepwise fashion. Model 1 provides a crude association between black race and the outcome of interest. Models 2-4 then control for sex, age group, and comorbidities respectively. Predicted margins for the outcome of interest from the final regression model (Model 4) were plotted by race across age groups in order to understand the disparities between black and white patients across age groups.

There was a large amount of missing data for most of the variables of interest (ranging from 37 to 87%), which is likely a result of underreporting. Missing data were excluded from the primary analysis, limiting analyses only to those with complete data for each particular outcome of interest. However, we further characterized those with unknown data and ran multinomial logit regression models on the unknown values to compare to the previously constructed regression models of known data. We present this analysis in full in the Online Only [Supplementary Material](#) (Section A).

Baseline patient characteristics were compared using Chi square tests. All analyses were performed in Stata 16.¹⁰ The Boston University Institutional Review Board deemed this study exempt given the deidentified nature of the data.

RESULTS

Baseline patient characteristics are provided in [Table 1](#). A total of 124,780 cases were analyzed with black individuals making up 38.7% of these cases. Black patients were generally younger than white patients with the highest proportion in the 50-59 age group (20.8% vs 17.7%) and were predominantly female (54.8% vs 49.1%). They have significantly higher comorbidities compared to their white counterparts (31.6% vs 26.2%). Overall, black patients had higher numbers of hospital admissions (37.7% vs 26.2%), ICU admissions (5.7% vs 4.2%), and need for ventilator support (4.1% vs 3.1%) compared to their white counterparts.

In the unadjusted model ([Table 2A](#), Model 1), black patients had a relative risk for hospitalization of 1.53 (95% CI 1.50, 1.55, $p < 0.001$). After adjusting for sex, age group, and comorbidities, black patients had a 1.42 times increased risk (95% CI 1.40, 1.44, $p < 0.001$) of hospitalization for COVID-19 compared to white patients. In plotting predicted margins for proportion hospitalized ([Figure 1](#)), black-white disparities in hospitalization for COVID-19 persist across all age groups.

When assessing ICU admission for COVID-19 infection, black patients had 1.81 increased unadjusted risk (95% CI 1.73, 1.89, $p < 0.001$) of requiring ICU care compared to their white counterparts ([Table 2B](#), Model 1). After adjustment for confounding, black patients had 1.68 times increased adjusted risk of ICU admission (95% CI 1.60, 1.77, $p < 0.001$) compared to white patients. Predictive margins ([Figure 2](#)) show a widening gap in proportion of ICU admissions between black and white patients with advanced age.

Black patients had a 1.81 times increased risk of requiring ventilatory support (95% CI 1.71, 1.91, $p < 0.001$) compared to white patients in the unadjusted model ([Table 2C](#), Model 1). This was similar after controlling for sex, age group, and comorbidities with black patients seeing a increased adjusted risk of 1.81 (95% CI 1.71, 1.91, $p < 0.001$) of ventilatory support compared to their white counterparts. In plotting predicted margins, there are larger disparities between the proportion of white and black patients requiring ventilation with increasing age ([Figure 3](#)).

Black patients had 1.29 higher risk of death (95% CI 1.25, 1.33, $p < 0.001$) compared to white patients ([Table 2D](#), Model 1) in the unadjusted model. This effect was potentiated after controlling for sex, age, and comorbidities with black patients seeing 1.36 higher risk of death (95% CI 1.32, 1.39, $p < 0.001$) from COVID-19 compared to their white counterparts. There was no

Table 1. Baseline characteristics of black and non-Hispanic white patients infected with COVID-19.

	Non-hispanic white (n = 76,442)	Black (n = 48,338)
Laboratory-confirmed case	76,426 (99.9)	48,334 (99.9)
Female, n (%)	37,458 (49.1)	26,450 (54.8)
Age, n (%)		
0-9	415 (0.5)	198 (0.4)
10-19	1231 (1.6)	528 (1.1)
20-29	8239 (10.8)	3959 (8.2)
30-39	9931 (13.0)	6885 (14.2)
40-49	10,246 (13.4)	8083 (16.7)
50-59	13,521 (17.7)	10,071 (20.8)
60-69	13,161 (17.2)	9104 (18.8)
70-79	9470 (12.4)	5972 (12.4)
80+	10,228 (13.4)	3538 (7.3)
Comorbidities Present, n (%)		
Yes	20,034 (26.2)	15,247 (31.6)
No	8286 (10.8)	2290 (4.74)
Unknown	48,122 (63.0)	30,801 (63.7)
Hospitalization, n (%)		
Yes	19,990 (26.2)	18,209 (37.7)
No	28,060 (36.7)	10,823 (22.4)
Unknown	28,392 (37.1)	19,306 (39.9)
ICU admission, n (%)		
Yes	3225 (4.2)	2771 (5.7)
No	12,748 (16.7)	4650 (9.6)
Unknown	60,469 (79.1)	40,917 (84.7)
Ventilator support, n (%)		
Yes	2351 (3.1)	1979 (4.1)
No	11,504 (15.1)	4181 (8.7)
Unknown	62,587 (81.9)	42,178 (87.3)
Death, n (%)		
Yes	9141 (12.0)	6282 (13.0)
No	25,023 (32.7)	11,851 (24.45)
Unknown	42,278 (55.3)	30,205 (62.5)

observed difference in mortality between black and white patients under the age of 19 (Figure 4), but the gap between black and white deaths widens with increasing age.

DISCUSSION

Our study provides first glances into the differential effects of COVID-19 infection on black and white

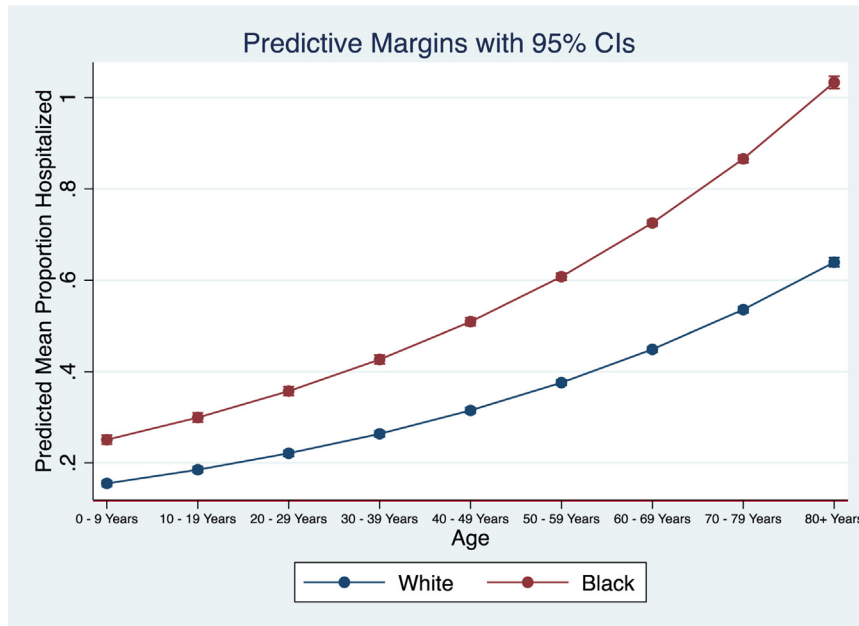
Americans at a national level. Overall, among confirmed COVID-19 positive cases, black patients have significantly higher risk of hospitalization, ICU admission, ventilatory support, and death when controlling for confounders. These figures reinforce previously reported literature in different localities across the United States that too have shown higher rates of hospitalization and deaths among minorities.⁵

Table 2. Relative Risk Ratio (RR) of outcomes of interest in black vs white patients infected with COVID-19.

	Model 1	Model 2	Model 3	Model 4
A. Relative risk of hospitalization RR (95% CI)				
Black (vs non-Hispanic white)	1.53 [□] (1.50, 1.55)	1.54 [□] (1.52, 1.57)	1.58 [□] (1.56, 1.60)	1.42 [□] (1.40, 1.44)
Sex (female vs male)		0.78 [□] (0.77, 0.79)	0.81 [□] (0.80, 0.82)	0.85 [□] (0.83, 0.86)
Age			1.31 [□] (1.30, 1.31)	1.19 [□] (1.19, 1.20)
Comorbidities				3.83 [□] (3.61, 4.07)
B. Relative risk of ICU admission RR (95% CI)				
Black (vs non-Hispanic white)	1.81 [□] (1.73, 1.89)	1.83 [□] (1.76, 1.92)	1.88 [□] (1.80, 1.96)	1.68 [□] (1.60, 1.77)
Sex (female vs male)		0.69 [□] (0.66, 0.72)	0.71 [□] (0.68, 0.74)	0.71 [□] (0.67, 0.75)
Age			1.27 [□] (1.25, 1.28)	1.15 [□] (1.14, 1.17)
Comorbidities				3.65 [□] (3.21, 4.15)
C. Relative risk of ventilatory support RR (95% CI)				
Black (vs non-Hispanic white)	1.81 [□] (1.71, 1.91)	1.83 [□] (1.73, 1.93)	1.87 [□] (1.78, 1.97)	1.81 [□] (1.71, 1.91)
Sex (female vs male)		0.66 [□] (0.63, 0.70)	0.69 [□] (0.65, 0.72)	0.72 [□] (0.68, 0.76)
Age			1.33 [□] (1.31, 1.35)	1.17 [□] (1.15, 1.20)
Comorbidities				5.50 [□] (4.66, 6.50)
D. Relative risk of death RR, 95% CI				
Black (vs non-Hispanic white)	1.29 [□] (1.25, 1.33)	1.31 [□] (1.27, 1.34)	1.48 [□] (1.44, 1.51)	1.36 [□] (1.32, 1.39)
Sex (female vs male)		0.73 [□] (0.71, 0.75)	0.76 [□] (0.75, 0.78)	0.79 [□] (0.78, 0.82)
Age			1.79 [□] (1.77, 1.81)	1.52 [□] (1.50, 1.54)
Comorbidities				10.8 [□] (8.89, 13.2)

CI, Confidence Interval.
[□]p < 0.001.

Figure 1. Predicted proportion of hospitalizations for black and white patients infected with COVID-19 across age groups.



These findings also support studies showing higher rates of COVID-19 infections and deaths in areas with large minority share.^{8,11} Prior to this pandemic, there were predictions that racial and ethnic minorities would have a greater burden of disease in the event of a respiratory viral pandemic.^{11,12} Black patients were found to be over-represented among U.S. deaths from infectious causes,¹²

and specifically respiratory infections like pneumonia¹³ which may be attributable to hospital differences.¹⁴

The current study adds to a growing body of literature demonstrating the depth of racial disparities in outcomes for patients with COVID-19. It is important to note that our study focuses on the social construct of race and we would caution against genetic theories¹⁵ as contributing

Figure 2. Predicted proportion of ICU admissions for black and white patients infected with COVID-19 across age groups.

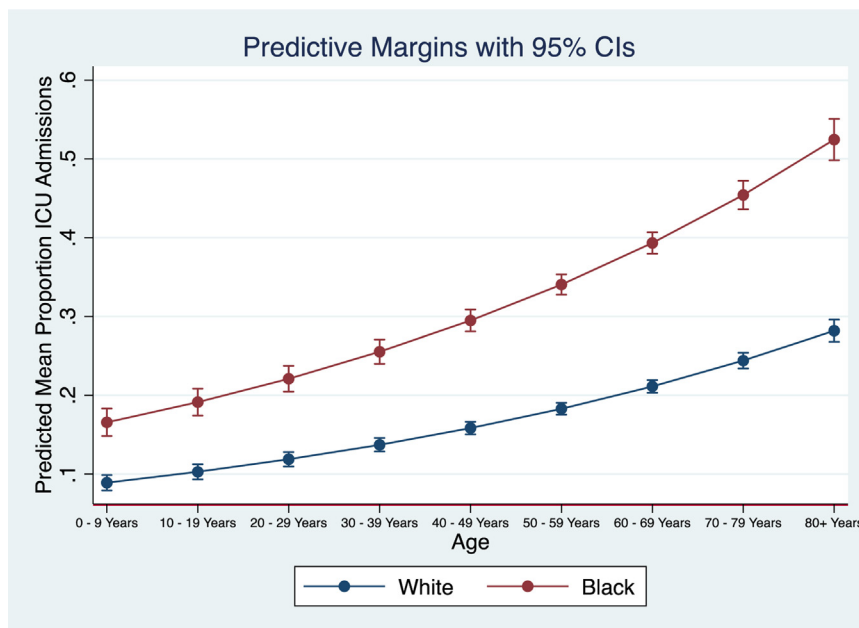
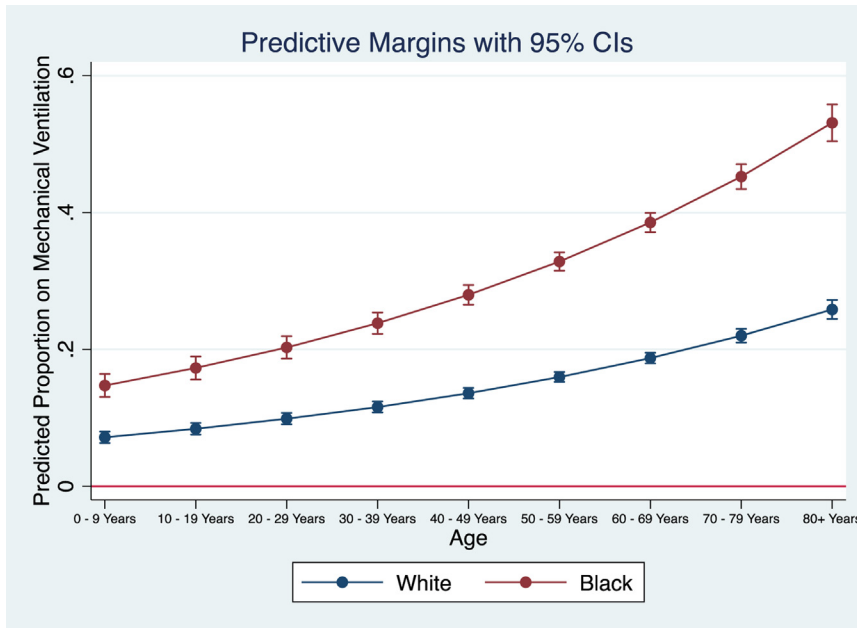


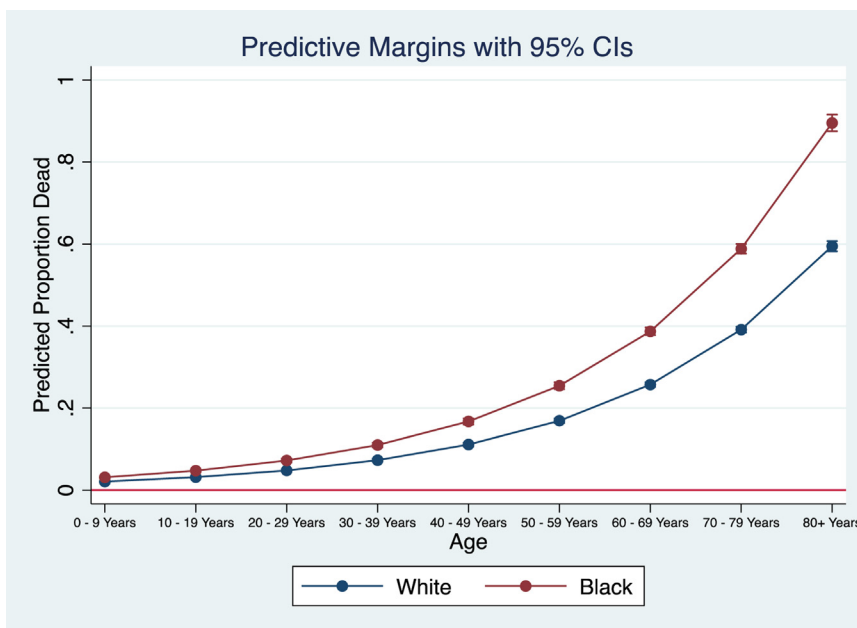
Figure 3. Predicted proportion requiring mechanical ventilation for black and white patients infected with COVID-19 across age groups.



factors to these differential outcomes. Black race in the United States is made up of a multitude of genetic ancestries; however, this group as a whole has seen racial discrimination and seclusion into neighborhoods with poor housing, high crime, air and water pollution, and low access to healthy foods which have significant effects on

health outcomes.¹⁶⁻²⁰ Black Americans are also over-represented in the low-wage essential workforce²¹⁻²⁴ and may be less able to practice social distancing due to living in increased density housing situations.^{21,25,26} Despite this, resource allocation plans developed during this time have failed to account for these issues.²⁷ Further data linking

Figure 4. Predicted proportion of deaths for black and white patients infected with COVID-19 across age groups.



patients and their location of residence will be important in understanding how neighborhood factors and the built environment shape these disparities.

We further show that at younger age (under 19), there are no differences in deaths between black and white patients. However, this disparity in death between black and white Americans increases with advancing age. Similar increases in disparities at older age are seen in the other outcomes of interest, although these disparities exist across all age groups. This worsening of disparities with age could represent a compounding of the social determinants over time that could lead to worsened health and susceptibility to poor outcomes related to COVID-19.

There are many limitations to this study that stem from the retrospective nature of data that relies on passive reporting from states and local authorities. The proportion of missing data in the outcomes variables and comorbidities is high and were slightly more prevalent among black individuals than white. Further characterization of unknown cases is provided in the [supplementary material](#) (Supplement Section A). We hypothesize that we are underestimating the true effect of black on race on COVID-19 outcomes given their overrepresentation of unknown values and findings that demonstrate a higher likelihood of worse outcomes in black patients. It is also possible that these patients with unknown values were not sick enough to require hospitalization and thus these fields were not recorded. We were limited to categorical (age group) and binary (comorbidities) variables for many of the covariates of interest, which loses granularity and further characterization of disease. Given the lack of available testing for large areas of the country, these absolute numbers likely represent higher numbers of hospitalizations, ICU admissions, and deaths than the general population because many of these confirmed positive cases likely were symptomatic and sought care, thus obtaining testing. These data are also likely undercounting the asymptomatic individuals that were not tested and never presented for care.

CONCLUSIONS

To our knowledge, by using CDC data, the current study represents the largest national investigation of racial disparities of COVID-19 infection related outcomes in the United States and reinforces the need for more granular information to drive policy decisions. In this work, we show that black patients represent a larger proportion of patients infected with COVID-19 requiring hospitalizations, ICU admission, ventilatory support, and death in the United States. Based on the data available, our work is descriptive by necessity. We hope that this work will serve as a call to

action for the medical and broader community to better understand why certain populations are impacted more significantly when facing a global infectious threat. By understanding the racial disparities of the COVID-19 pandemic and future medical crises, we will be better positioned to identify and address the root causes.

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DISCLOSURE

The authors have no financial nor personal disclosures or conflicts of interests.

DECLARATION OF INTEREST

The authors have no financial nor personal disclosures or conflicts of interests.

APPENDIX A. SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jnma.2020.07.009>.

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