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ORIGINAL RESEARCH

# No Difference in Clinical Outcomes for African American and White Patients Hospitalized with SARS-CoV-2 Pneumonia in Louisville, Kentucky

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## Abstract

**Introduction:** Current literature indicates that African American individuals are at increased risk of becoming infected with the SARS-CoV-2 virus and suffer higher SARS-CoV-2-related mortality rates. However, there is a lack of consensus as to how the clinical outcomes of African American patients differ from those of other groups. The objective of this study was to define the clinical outcomes of African American and White hospitalized patients with SARS-CoV-2 community-acquired pneumonia (CAP) in Louisville, Kentucky.

**Methods:** This was a retrospective cohort study of hospitalized patients with SARS-CoV-2 CAP at eight hospitals in Louisville, Kentucky. Severity of CAP at time of hospitalization was evaluated using the pneumonia severity index (PSI), CURB-65 score, SARS-CoV-2 viral load, and the World Health Organization severity score. The following thirteen clinical outcomes were compared: discharge alive to home, time to home discharge, admission to the ICU, length of ICU stay, need for invasive mechanical ventilation (IMV), duration of IMV, development of acute respiratory distress syndrome (ARDS), development of septic shock, need for vasopressors, development of cardiovascular events, time to cardiovascular events, in-hospital mortality, and time to death.

**Results:** A total of 541 patients were eligible for this study, 343 White (63%) and 198 African American (37%). None of the thirteen clinical outcomes were significantly different between the two groups.

**Conclusion:** This study indicates that African American and White patients do not have different clinical outcomes after the point of hospitalization due to SARS-CoV-2 CAP.

## Introduction

The disproportionate likelihood of SARS-CoV-2 infection for African American individuals is well documented; a recent systematic review of 15 cohort and cross-sectional studies found that the odds of testing positive for SARS-CoV-2 infection were 1.5–3.5 times greater for African American than White individuals.[1] A systematic review and meta-analysis of eight studies similarly found that the odds of infection were twice as high for African American individuals.[2] The disparity in infection odds may be explained by factors external to hospitalization.

The mortality data collected in several areas of the United States indicates that SARS-CoV-2-related mortality occurs more often in African American patients, relative to the percentage of SARS-CoV-2-related mortality in the local population.[3-5] Provisional age-adjusted mortality data show that non-Hispanic African Americans are more than twice as likely to have died from COVID-19 in 2020 compared to non-Hispanic White Americans (151.1 vs 72.5 per 100,000, respectively).[6] Little is known concerning the health outcomes of African American patients compared to White patients during hospitalization due to COVID-19. Previous studies have found no statistically significant association between African American identity and post-hospitalization mortality in patients with SARS-CoV-2.[7-12] Only three of the cited studies examined outcomes other than mortality, finding no statistically significant association between African American identity and ICU admission [7, 8], invasive mechanical ventilation [7, 8], or critical illness.[9] A more exhaustive evaluation of clinical outcomes has not yet been performed. To investigate the possibility of differences between African American and White patients for outcomes beyond mortality, we performed a study evaluating 13 clinical outcomes of hospitalized African American and White patients with SARS-CoV-2 community-acquired pneumonia (CAP) in the city of Louisville, KY. These 13 outcomes have been examined in the literature; however, to our knowledge, our study is the first to compare all of them for African American and White patients in a single study.[1, 2, 7, 12-15]

## Methods

This was a retrospective cohort study of hospitalized patients with SARS-CoV-2 CAP at eight hospitals in Louisville, Kentucky. Patients were eligible for inclusion if they were hospitalized from March 3, 2020 through July 1, 2020 with a provider diagnosis of CAP and were positive for SARS-CoV-2 by reverse transcription polymerase chain reaction test. Only patients indicated as 'Caucasian,' 'White,' or 'White or Caucasian' and patients indicated as 'African American' or 'Black or African American' in the electronic health record were included in the analysis. Hispanic patients were not excluded. Patients who developed pneumonia after admission to the hospital (e.g. nosocomial infection) were excluded from the study.

Patient demographic, medical history, exam findings and laboratory values, and severity of CAP were compared between groups. Severity of CAP at time of hospitalization was compared using the pneumonia severity index (PSI), CURB-65 score, WHO severity scale categories [16], and SARS-CoV-2 viral load, using cycle threshold (Ct) value of initial RT-PCR for SARS-CoV-2 as a surrogate marker.

The following 13 clinical outcomes were compared: (1) discharge alive to home, (2) time to home discharge, (3) admission to the ICU, (4) length of ICU stay, (5) need for invasive mechanical ventilation (IMV), (6) duration of IMV, (7) development of acute respiratory distress syndrome (ARDS), (8) development of septic shock, (9) need for vasopressors, (10) development of cardiovascular events, (11) time to cardiovascular events, (12) in-hospital mortality, and (13) time to death. Clinical outcomes were collected from the electronic health record. Time-to-event outcomes were continuous; all other outcomes were dichotomous.

Patient characteristics were reported as median and interquartile range (IQR) for continuous variables and frequency and percentage for categorical variables. Continuous variables were compared using Mann-Whitney U tests, and categorical variables were compared using Chi-squared tests of independence. Multivariable logistic regression was used to compare ICU admission, need for IMV, development of cardiovascular events, and in-hospital mortality between groups, adjusting for CURB-65 score, sex, histories of congestive heart failure, obesity (Body Mass Index $\geq$ 30), diabetes, renal disease, neoplastic disease, coronary artery disease, cerebrovascular disease, hypertension, and hypoxemia (PaO2/FiO2 $<$ 200 or SpO2/FiO2 $<$ 141 if blood gasses were not obtained). CURB-65 score was chosen instead of age as it includes several laboratory values in addition to advanced age. Cluster robust standard errors, using hospitals as clusters, was performed to account for within-hospital variation. Adjusted odds ratios and 95% confidence intervals were reported. Time-to-event outcomes were compared using Log-rank tests, with Kaplan-Meier curves produced. Median survival time and 95% confidence limits were reported. All analysis was performed using R version 3.6. *P*-values of less than 0.05 were considered statistically significant.

## Results

A total of 700 hospitalized patients with a positive SARS-CoV-2 infection were identified between March

**Table 1.** Demographics, social, and medical history of the study population.

| | African American (*n*=198) | White (*n*=343) | *P*-value |
|---|---|---|---|
| Demographics and social history | | | |
| Age (median [IQR]) | 62 [51, 72] | 66 [52, 77] | 0.050 |
| Sex: Male (%) | 90 (45) | 159 (46) | 0.910 |
| Nursing home resident (%) | 32 (16) | 78 (23) | 0.085 |
| Former smoker (%) | 55 (28) | 105 (31) | 0.550 |
| Current smoker (%) | 21 (11) | 29 (8) | 0.498 |
| Alcohol or drug abuse (%) | 19 (10) | 33 (10) | >0.999 |
| Depression, anxiety or other mental health issues (%) | 26 (13) | 96 (28) | <0.001 |
| Medical history | | | |
| Obesity (%) | 121 (61) | 152 (44) | <0.001 |
| Diabetes (%) | 82 (41) | 115 (34) | 0.081 |
| Renal Disease (%) | 49 (25) | 68 (20) | 0.218 |
| Congestive heart failure (%) | 30 (15) | 46 (13) | 0.665 |
| Coronary artery disease (%) | 28 (14) | 65 (19) | 0.190 |
| Cerebrovascular disease (%) | 34 (17) | 47 (14) | 0.335 |
| Asthma (%) | 24 (12) | 34 (10) | 0.512 |
| Neoplastic disease (active or within the last year) (%) | 15 (8) | 28 (8) | 0.938 |
| COPD (%) | 31 (16) | 62 (18) | 0.548 |
| Liver disease (non-cirrhotic) (%) | 7 (4) | 15 (4) | 0.803 |
| Cirrhosis (%) | 3 (2) | 5 (1) | >0.999 |
| Essential arterial hypertension (%) | 133 (67) | 183 (53) | 0.002 |
| Hyperlipidemia (%) | 74 (37) | 133 (39) | 0.817 |
| Prior myocardial infarction (%) | 19 (10) | 36 (10) | 0.853 |
| Atrial fibrillation (%) | 11 (6) | 48 (14) | 0.004 |
| Prior deep vein thrombosis (%) | 15 (8) | 19 (6) | 0.449 |

**Abbreviations:** IQR, interquartile range; COPD, chronic obstructive pulmonary disease.

**Table 2.** Physical examination and laboratory findings of the study population.

| | African American (*n*=198) | White (*n*=343) | *P*-value |
|---|---|---|---|
| Heart Rate (beats/min) | 95 [84, 110] | 94 [78, 111] | 0.654 |
| Respiratory Rate (breaths/min) | 21 [18, 27] | 21 [18, 26] | 0.696 |
| Systolic Blood Pressure (mmHg) | 122 [107, 142] | 122.00 [105, 141] | 0.669 |
| Diastolic Blood Pressure (mmHg) | 68 [57, 83] | 67 [55, 78] | 0.145 |
| Temperature (degrees C) | 37.7 [37.1, 38.6] | 37.6 [36.9, 38.4] | 0.086 |
| $SpO_2/FiO_2$ | 429 [326, 452] | 394 [267, 448] | 0.005 |
| $PaO_2/FiO_2$ | 214 [130, 294] | 257 [136, 363] | 0.110 |
| WBC x 1000 per uL | 6.38 [4.77, 8.56] | 6.28 [4.44, 9.27] | 0.972 |
| Neutrophils x 1000 per uL | 4.39 [3.14, 6.82] | 4.82 [3.00, 8.11] | 0.164 |
| Lymphocytes x 1000 per uL | 1.10 [0.73, 1.46] | 0.94 [0.67, 1.46] | 0.222 |
| Neutrophil / Lymphocyte | 3.98 [2.63, 7.15] | 4.82 [2.79, 8.12] | 0.064 |
| Hematocrit (%) | 38.3 [34.3, 41.9] | 38.8 [35.1, 42.6] | 0.263 |
| Glucose (mg/dL) | 125 [105, 168] | 122 [103, 167] | 0.355 |
| Blood urea nitrogen (mg/dL) | 18 [12, 33] | 19 [12, 30] | 0.973 |
| Creatinine (mg/dL) | 1.22 [0.80, 1.90] | 1.00 [0.70, 1.40] | <0.001 |
| Ferritin (ng/dL) | 404 [209, 1041] | 377 [155, 836] | 0.183 |
| Procalcitonin (ug/L) | 0.19 [0.05, 0.59] | 0.11 [0.05, 0.36] | 0.074 |
| Lactate (mmol/L) | 1.40 [1.00, 1.95] | 1.40 [1.10, 1.80] | 0.816 |
| D-Dimer (ng/mL) | 851.00 [396.50, 1612.75] | 710.00 [410.00, 1589.00] | 0.360 |
| IL-6 (pg/mL) | 56.75 [29.85, 83.50] | 70.30 [32.70, 174.50] | 0.060 |
| C-reactive protein (mg/L) | 77.88 [35.37, 148.50] | 79.91 [42.00, 180.50] | 0.171 |

**Abbreviations:** WBC, white blood cell count; IL-6, interleukin-6.

3, 2020 and July 1, 2020. Of these hospitalizations, 632 patients were identified as having SARS-CoV-2 CAP, including 541 patients who met the criteria for inclusion. Analyzed patients included 198 (37%) African American and 343 (63%) White patients. Patient demographics, social and medical histories are summarized in **Table 1**. Few differences were observed between groups. Most notably, higher rates of mental health issues (13% vs 28%; $P < 0.001$) and atrial fibrillation (6% vs 14%; $P = 0.001$) were prevalent among White patients. Higher prevalence of obesity (61% vs 44%; $P < 0.001$) and hypertension (67% vs 53%; $P = 0.002$) was observed in African American patients. Physical exam and laboratory values, summarized in **Table 2**, were also similar; African American patients had significantly increased creatinine and slightly higher SpO2/FiO2 ratios compared to White patients, but these increases were not considered clinically relevant.

Indices for pneumonia severity between groups are summarized in **Figure 1**. Severity between African American and White patients was not significantly different for PSI risk classifications ($P$=0.459), CURB-65 scores ($P$=0.387), initial viral load ($P$=0.186), and WHO severity score criteria ($P$=0.855).

Crude rates of the 13 clinical outcomes are summarized in **Table 3**. None of the thirteen clinical outcomes, including the rate of mortality at discharge (the least favorable outcome) were statistically significantly different. Time to event outcomes are visualized in **Figures 2–6**.

Adjusted analysis of need for ICU admission, need for IMV, development of cardiovascular events, and in-hospital mortality are visualized in **Figures 7–10**. After adjustment, African American patients did not have significantly different odds of experiencing any of these outcomes compared to White patients.

## Discussion

This study demonstrates that there are no statistically significant differences in clinical outcomes between African American and White patients hospitalized with SARS-CoV-2 CAP. To our knowledge, this is the first evaluation using 13 different clinical outcomes to determine whether African American patients fare worse after hospitalization for SARS-CoV-2 infection than White patients.

Our data support the concept that disparities between African American and White patients in relation to SARS-CoV-2 infection are caused by factors external to hospitalization. To our knowledge, there is no pathophysiologic medical mechanism that would cause African American and White patients to respond differently to medical treatment for SARS-CoV-2 infection, and our data support this hypothesis. The increased mortality documented in studies of African American individuals compared to White individuals with SARS-CoV-2 infection is most likely due to factors external to hospitalization.

Our data are consistent with the findings of other studies. The population of Louisville is approximately 22% African American and 72% White [17], yet we observed that 31% of SARS-CoV-2 pneumonia hospitalizations were African American patients and 54% were White patients, indicating that African American individuals are overrepresented among SARS-CoV-2 pneumonia hospitalizations compared to the general population of Louisville. Our study is also consistent with other studies that found no statistically significant association between African American identity and post-hospitalization mortality.[7-12] Likewise, African American identity was not associated with ICU admission or IMV in our study, consistent with two others.[7, 8] Our analysis further found no statistically significant association between African American identity and length of hospital stay, length of ICU stay, duration of IMV, development of ARDS, development of septic shock, need for vasopressors, development of cardiovascular events, time to cardiovascular events, or time to death.

One important strength of our study is that the demographic characteristics, socioeconomic characteristics, and health behaviors of the population of the city of Louisville are highly generalizable to the United States.[18] Consequently, our findings may be generalizable to hospitalized patients nationwide. The patients in our study were from all areas of Louisville, and thus represented a wide range of socioeconomic statuses. Additionally, the breadth of the clinical outcomes analyzed in this study makes our conclusions more reliable. By utilizing cluster robust standard errors, we can be certain that modifications of care did not affect our results.

One important limitation in scope is that we were unable to evaluate outcomes for patients that did not seek hospitalization. Differences in outcomes may still exist between African American and White individuals who are infected with SARS-CoV-2 but not hospitalized. Additionally, outcomes were only evaluated for hospitalized patients during the acute phase of infection; outcomes for non-hospitalized patients and patients in the post-acute phase of SARS-CoV-2 infection and recovery were not evaluated or characterized. Case and fatality rates for Louisville do not indicate the number of patients who were hospitalized, making immediate comparisons to available data a difficult endeavor. We obtained information on patients' identities from the electronic health record indication of 'Caucasian,' 'White,' or 'White or Caucasian' and 'African American' or 'Black or African American.' We

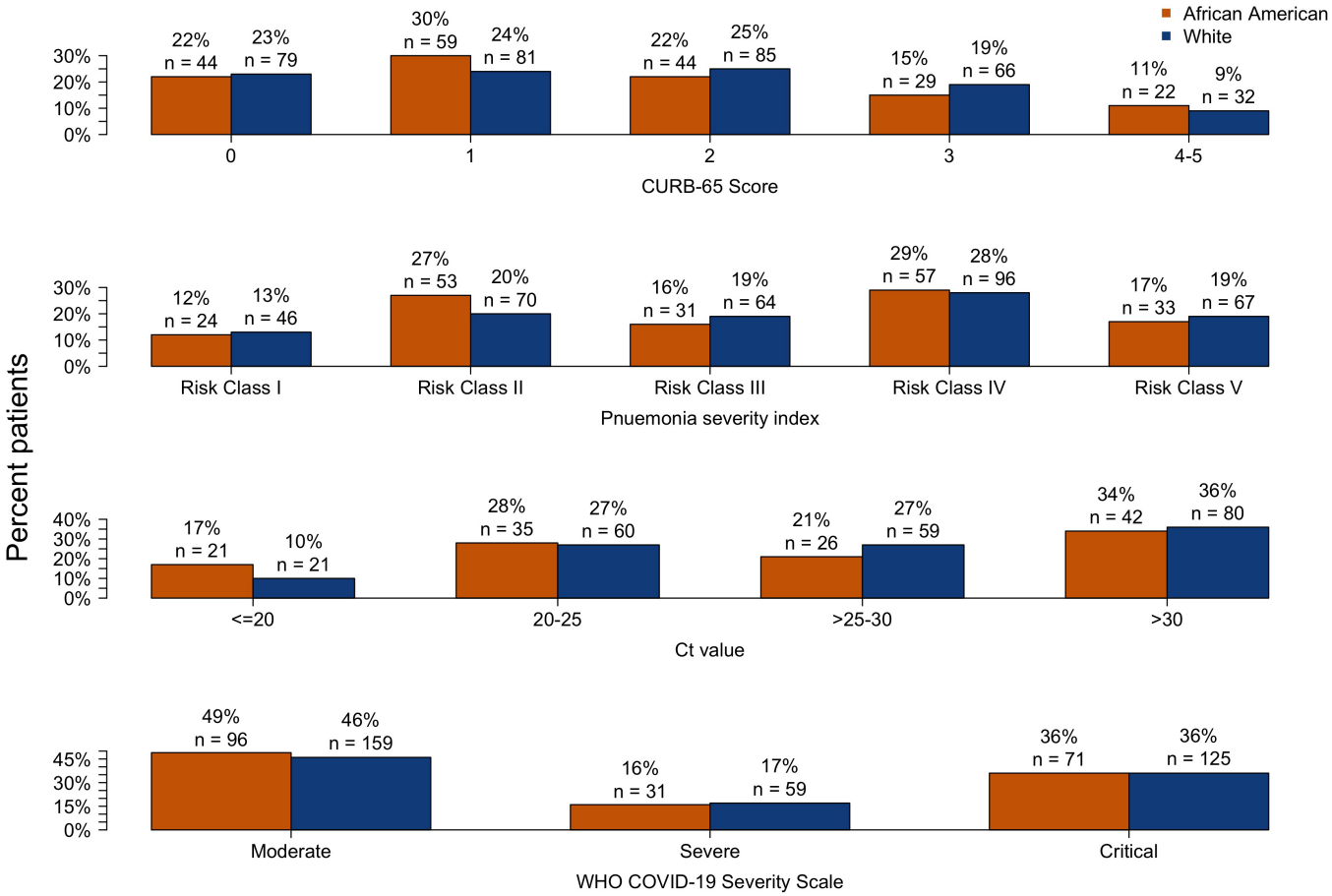


**Figure 1.** Severity of disease at time of hospital admission based on CURB-65 score, pneumonia severity index, and viral load for African American and White patients.

**Table 3.** Crude outcomes for African American and White patients.

| | African American (*n*=198) | White (*n*=343) | *P*-value |
|---|---|---|---|
| Discharged home (%) | 129 (65) | 215 (63) | 0.269 |
| Days to home discharge* | 5.00 [4.19-6.33] | 5.29 [4.58-6.55] | 0.684 |
| ICU admission (%) | 80 (40) | 139 (41) | >0.999 |
| Days in ICU* | 15.80 [10.01-25.80] | 10.80 [8.96-15.10] | 0.115 |
| Mechanically ventilated (%) | 53 (27) | 86 (25) | 0.740 |
| Days ventilated* | 16.10 [13.00-30.00] | 12.10 [10.10-29.10] | 0.315 |
| ARDS (%) | 48 (24) | 77 (22) | 0.711 |
| Septic shock (%) | 28 (14) | 44 (13) | 0.763 |
| Vasopressor use (%) | 41 (21) | 63 (18) | 0.581 |
| Cardiovascular event (%) | | | |
| Days to cardiovascular event* | 0.82 [0.37-3.20] | 2.32 [0.96-5.26] | 0.432 |
| In-hospital mortality/Hospice care (%) | 35 (18) | 76 (22) | 0.257 |
| Days to mortality/hospice care* | 7.76 [5.17, 11.60] | 9.72 [8.25-11.30] | 0.684 |

**Abbreviations:** ICU, intensive care unit; ARDS, acute respiratory distress syndome.
* Data represented as median survival times with 95% confidence limits. Comparisons between estimates were made using log-rank tests.

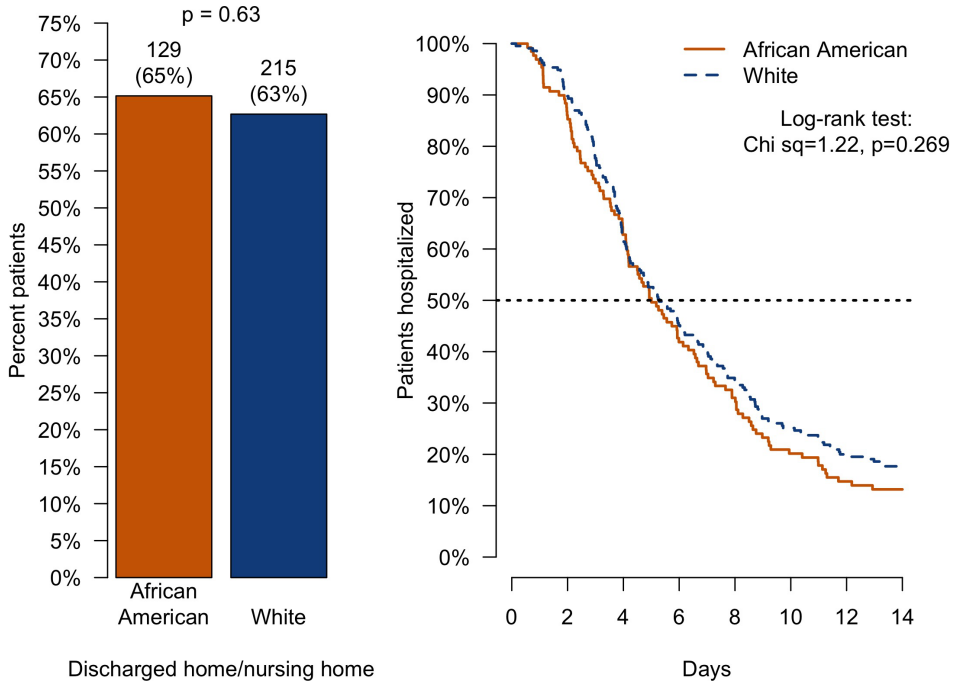


**Figure 2.** Patients discharged home and time to discharge home for African American and White patients. *P*-values represent chi-squared and log-rank tests.

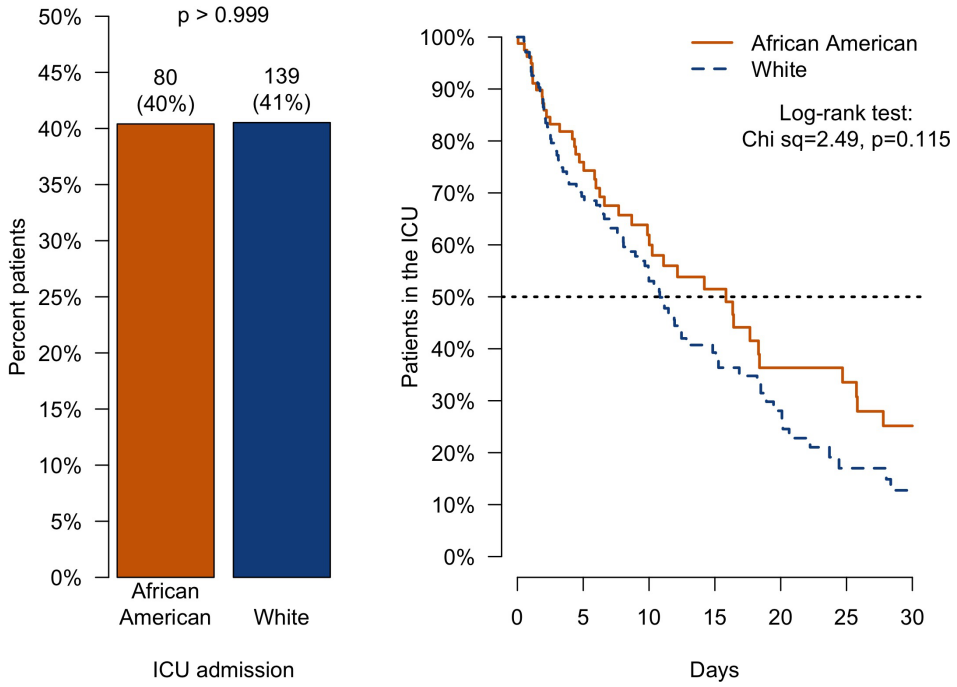


**Figure 3.** Patients admitted to the ICU and time spent in the ICU by African American and White patients. *P*-values represent chi-squared and log-rank tests.

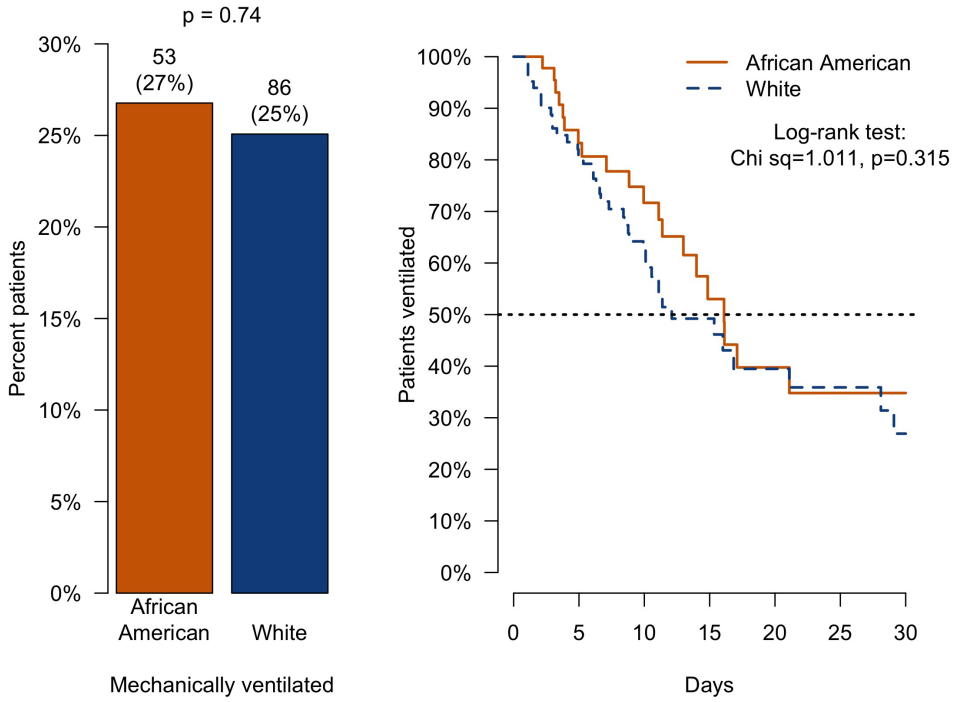


**Figure 4.** Patients requiring mechanical ventilation and time spent ventilated by African American and White patients. *P*-values represent chi-squared and log-rank tests.

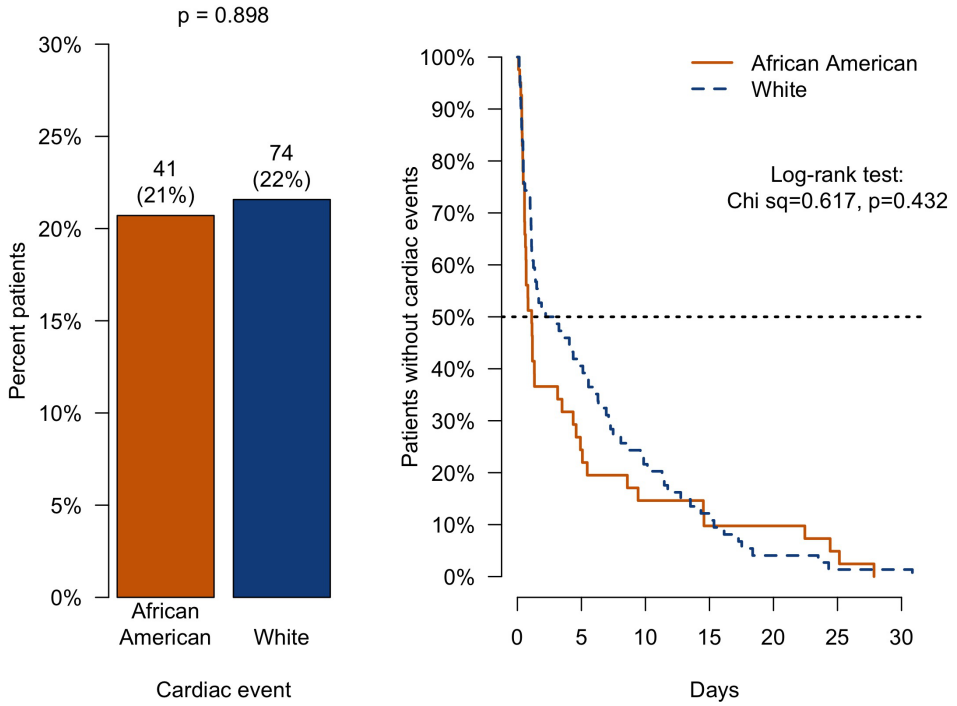


**Figure 5.** Patients experiencing cardiovascular events and time to first cardiovascular event for African American and White patients. *P*-values represent chi-squared and log-rank tests.

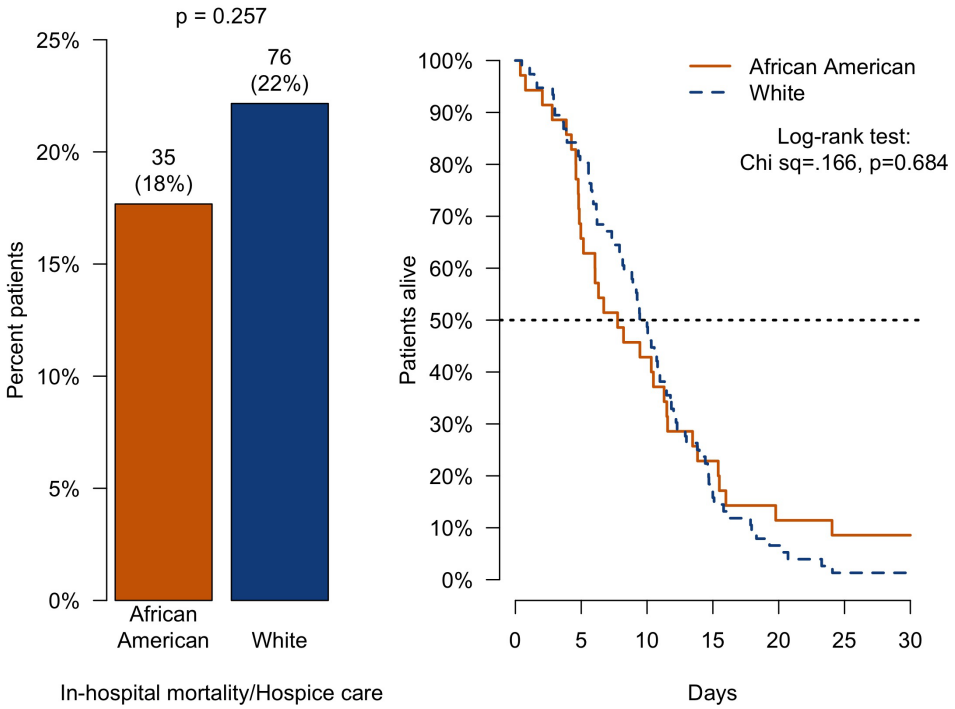


**Figure 6.** Patients experiencing in-hospital mortality and time to in-hospital mortality for African American and White patients. *P*-values represent chi-squared and log-rank tests.

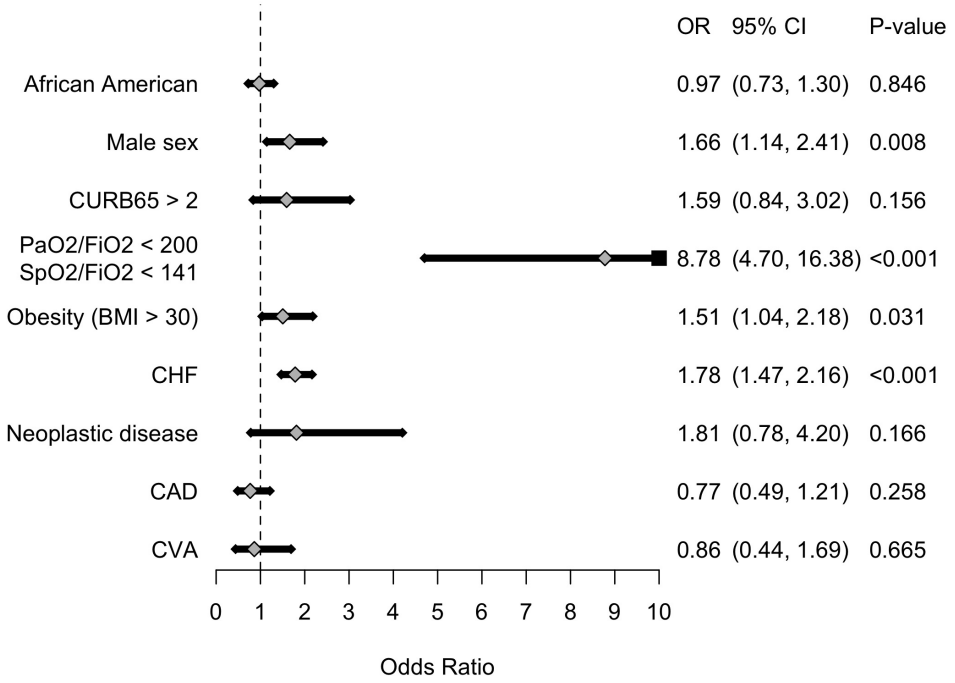


**Figure 7.** Multivariable logistic regression for admission to the ICU. African American patients were compared to White patients. All variables shown were independent predictors.

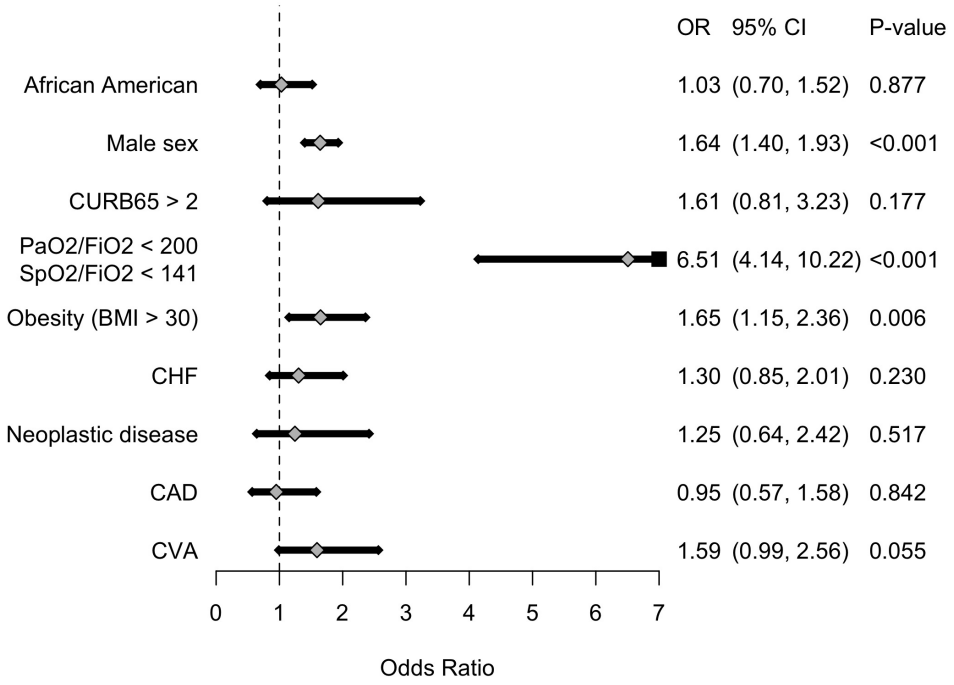


**Figure 8.** Multivariable logistic regression for mechanical ventilation. African American patients were compared to White patients. All variables shown were independent predictors.

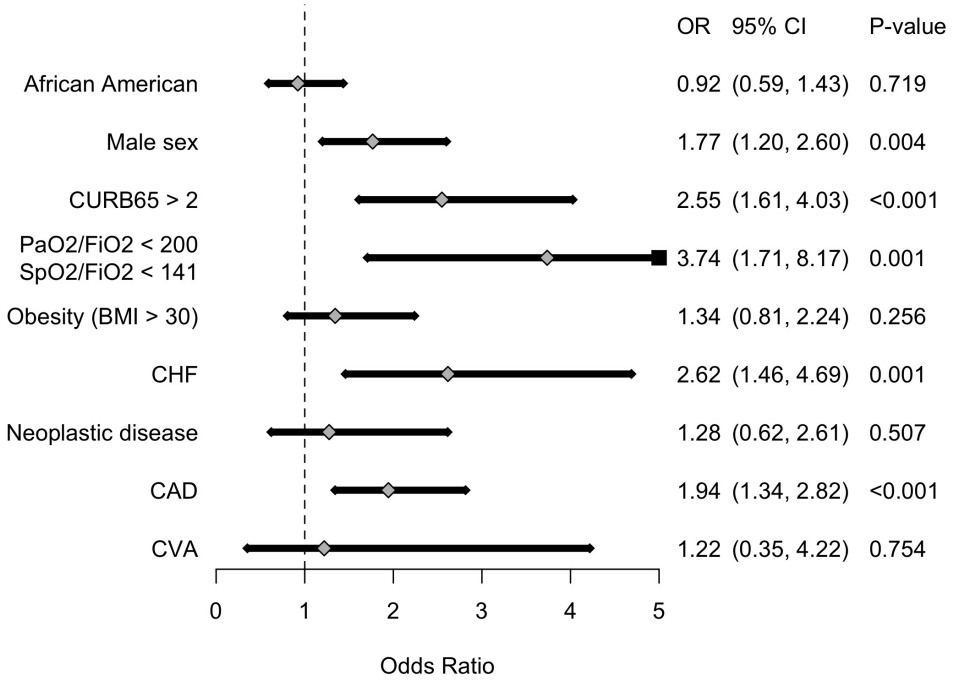


**Figure 9.** Multivariable logistic regression for development of cardiovascular events. African American patients were compared to White patients. All variables shown were independent predictors.

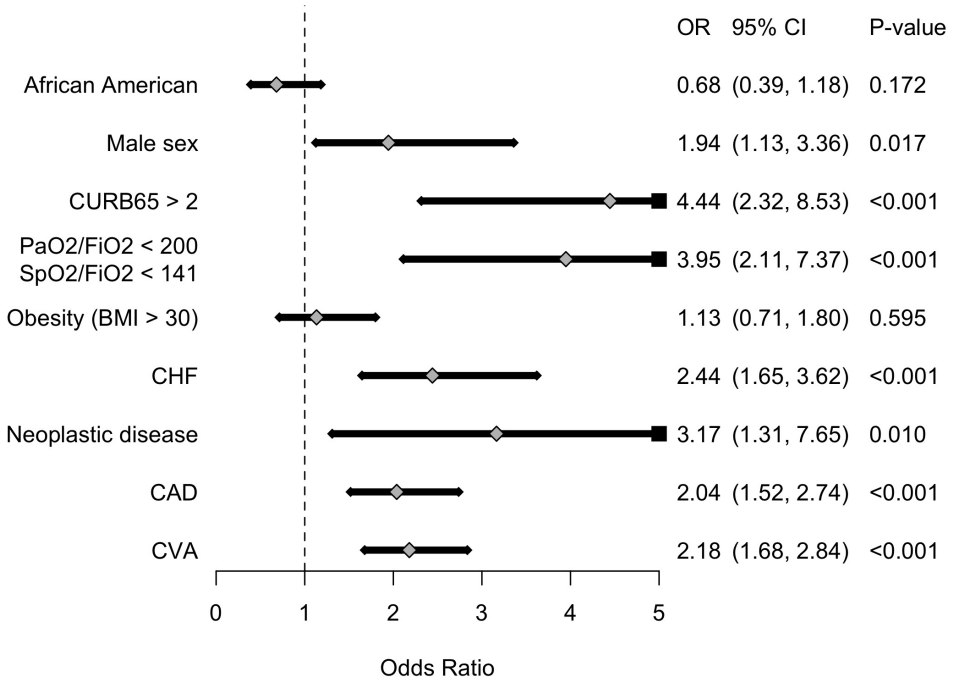


**Figure 10.** Multivariable logistic regression for in-hospital mortality. African American patients were compared to White patients. All variables shown were independent predictors.

were not able to verify that this information was consistently self-reported or concurred with the patients' self-identified race, which is considered the gold standard.[19] Patients of other identities were not evaluated, as we did not have enough patients to justify analysis. Future studies are needed to evaluate the clinical outcomes of non-White and non–African American groups, as well as outcomes in non-hospital settings.

Once patients are hospitalized, there is no statistically significant difference in clinical outcomes between African American and White patients. Future research on racial disparities in SARS-CoV-2 outcomes should therefore focus primarily on social causes and preventive measures prior to hospitalization.

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