


# Healthcare Disparities Correlated with In-Hospital Mortality in COVID-19 Patients

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**Introduction:** Increasing age, male gender, African American race, and medical comorbidities have been reported as risk factors for COVID-19 mortality. We aimed to identify healthcare disparities associated with increased mortality in COVID-19 patients.

**Methods:** We performed an observational study of all hospitalized patients with SARS-CoV2 infection from within the largest multicenter healthcare system in Southeast Michigan, from February to December, 2020.

**Results:** From 11,304 hospitalized patients, 1295 died, representing an in-hospital mortality rate of 11.5%. The mean age of hospitalized patients was 63.77 years-old, with 49.96% being males. Older age (AOR = 1.05,  $p < 0.0001$ ), male gender (AOR = 1.43,  $p < 0.0001$ ), divorced status (AOR = 1.25,  $p = 0.0256$ ), disabled status (AOR = 1.42,  $p = 0.0091$ ), and homemakers (AOR = 1.96,  $p = 0.0216$ ) were significantly associated with in-hospital mortality.

**Conclusion:** Older age, male gender, divorced and disabled status and homemakers were significantly associated with in-hospital mortality if they developed COVID-19. Further research should aim to identify the underlying factors driving these disparities in COVID-19 in-hospital mortality.

**Keywords:** disparities, COVID-19, mortality, race, disability

## Introduction

The COVID-19 pandemic has overwhelmed health-care systems and led to significant morbidity and mortality. Four factors: older age, male gender, medical comorbidities, and African American race have been associated with higher risk of infection and mortality from COVID-19.<sup>1,2</sup> Furthermore, health-care disparities, including increased rates of comorbidities are seen disproportionately in marginalized populations including minorities and those with lower socioeconomic status.<sup>3</sup> While prior studies have shown an increased risk of COVID-19 infection in groups affected by health-care disparities, our study aims to identify if there is a similar increased risk in these groups that is associated with mortality among a large cohort of COVID-19 patients in Michigan.

## Methods

We performed an observational study of hospitalized patients with SARS-CoV2 infection diagnosed by RT-PCR nasopharyngeal swab from within the largest healthcare system in Southeast Michigan (8 hospitals), from February 25, 2020 through December 31, 2020. All patients admitted to

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a Beaumont hospital were included, with the exception of patients missing demographic data and patients who were not permanent Michigan residents. Zip-code-level data from the United States Census Bureau (USCB) such as rate of unemployment, use of public transportation, and percentage of food stamp usage were used as proxies for economic and employment status as this individual-level data was not available from the electronic health record (EHR). The zip-code-level data was eventually matched with the rest of the individual patient-level data that was available in the EHR. Disability was defined by USCB as serious difficulty with four basic areas of functioning – hearing, vision, cognition, and ambulation. Homemaker is any person that manages a home. Univariate and multivariate analysis were used to determine any hospitalization correlates. P values of less than 0.05 were considered statistically significant.

## Results

### Participants

As shown below in [Table 1](#), a total of 11,304 hospitalized patients were studied, of which 1295 patients died, representing an in-hospital mortality rate of 11.5%. The mean patient age of hospitalized patients was 63.77 years old and there was a nearly even split between males (49.96%) and females (50.04%). The median income of ZIP code was \$56,521. Half of all patients were married (45.99%) and a quarter were single (26.25%). The remaining were either widowed (15.45%), divorced (9.85%) or separated (1.10%).

### Outcome Data

For prediction of in-hospital mortality in the multivariate model, older age (AOR = 1.05,  $p < 0.0001$ ), male gender (AOR = 1.43,  $p < 0.0001$ ), divorced patients (AOR = 1.25,  $p = 0.0256$ ), disabled patients (AOR = 1.42,  $p = 0.0091$ ), and homemakers (AOR = 1.96,  $p = 0.0216$ ) were significantly associated with in-hospital mortality ([Table 2](#)). For each additional year of age, the odds of death increase by 5% ( $p < 0.0001$ ). For each additional \$1000 increase in median Income of zip code, the odds of death decrease by 1% ( $p = 0.0059$ ).

## Discussion

We found that in-hospital mortality in COVID-19 patients was significantly associated with older age,

male gender, divorced, disabled, and homemaker status. These findings are consistent with the current literature suggesting that elderly individuals and males tend to have higher risk of severe infection, hospitalizations and mortality related to COVID-19.<sup>1,4-6</sup> As reported in our study, higher mortality rates have also been demonstrated amongst disabled patients. Currently, our study is the first to report associations between mortality and marital status, as well as homemaker status, in patients with COVID-19.

Interestingly, our study found no significant association between race alone and in-hospital mortality in COVID-19 patients, which differs from previous report findings.<sup>7</sup> Many factors have been hypothesized to explain the racial disparity seen in COVID-19, including increased housing density, burden of chronic disease, poverty rate, likelihood of employment as essential workers as well as limited access to healthcare.<sup>8</sup> This lack of disparity in our study potentially highlights the true underlying driver of increased mortality, disproportionate rates of comorbidities and socioeconomic disadvantages in minority groups, rather than race itself.

This study is novel, as we are the first to report mortality disparities associated with marital and homemaker status. Our findings may lead to further research and guide future preventative care and management of COVID-19 in these populations. With the rapid distribution of COVID-19 vaccines in the United States, increased efforts should be taken to ensure vaccination of high-risk populations. Studies describing health disparities may be used to encourage vaccine administration through targeted campaigns, incentive programs, and vaccination clinics. Our research has implications for the long-term outcomes for individuals in the high-risk populations described in the study.

Limitations of this study include the retrospective nature as well as potential inaccuracies and missing data in the medical record. Further research should aim to understand the underlying factors driving these disparities in COVID-19 in-hospital mortality.

## Conclusion

In conclusion, we report disparities associated with COVID-19 mortality including older age, male gender, divorced patients, disabled patients, and homemakers. Further research should aim to identify the underlying factors driving these disparities in COVID-19 in-hospital mortality.

**Table I** Participant Characteristics, Stratified by Death

	<b>All Patients (N= 11,304)</b>	<b>Deceased (N= 1295)</b>	<b>Alive (N= 10,009)</b>	<b>p-value</b>
Age of Patient (Years) Mean (Standard Deviation)	63.77 (17.79)	73.15 (12.89)	62.52 (17.94)	<0.0001
Unemployment Rate of ZIP Code (%) Mean (Standard Deviation)	7.44% (4.78%)	7.29% (4.64%)	7.46% (4.80%)	0.2325
Percent of ZIP Code Working in White Collar Profession (%) Mean (Standard Deviation)	35.69% (13.87%)	36.51% (13.74%)	35.57% (13.88%)	0.0321
Percent of ZIP Code Working in Service Profession (%) Mean (Standard Deviation)	18.41% (5.59%)	18.09% (5.46%)	18.45% (5.60%)	0.0278
Median Income of ZIP Code (\$) Mean (Standard Deviation)	\$60,704.80 (\$25,539.92)	\$60,982.56 (\$25,155.67)	\$60,663.85 (\$25,595.32)	0.6734
Poverty Rate of ZIP Code (%) Mean (Standard Deviation)	13.41% (10.82%)	13.30% (10.75%)	13.43% (10.83%)	0.6889
Biological Sex of Patient Female Male	5657 (50.04%) 5647 (49.96%)	553 (42.70%) 742 (57.30%)	5095 (50.96%) 4903 (49.04%)	<0.0001
Race of Patient American Indian or Alaska Native Asian Black or African American Native Hawaiian or Pacific Islander Other White or Caucasian Unknown	34 (0.30%) 230 (2.03%) 3684 (32.59%) 5 (0.04%) 699 (6.18%) 6646 (58.79%) 6 (0.05%)	3 (0.23%) 26 (2.01%) 392 (30.27%) 0 (0.00%) 73 (5.64%) 800 (61.78%) 1 (0.08%)	31 (0.31%) 204 (2.04%) 3288 (32.89%) 5 (0.05%) 624 (6.24%) 5841 (58.42%) 5 (0.05%)	0.3875
Ethnicity of Patient Arabic or Middle Eastern Hispanic or Latino Not Hispanic or Latino Other Unknown	1139 (10.08%) 351 (3.11%) 9273 (82.03%) 440 (3.89%) 101 (0.89%)	123 (9.50%) 30 (2.32%) 1085 (83.78%) 44 (3.40%) 13 (1.00%)	1016 (10.16%) 321 (3.21%) 8180 (81.82%) 393 (3.93%) 88 (0.88%)	0.2844
Marital Status Divorced Married Separated Single Widowed Unknown	1114 (9.85%) 5199 (45.99%) 124 (1.10%) 2967 (26.25%) 1746 (15.45%) 154 (1.36%)	154 (11.89%) 589 (45.48%) 10 (0.77%) 260 (20.08%) 259 (20.00%) 23 (1.78%)	958 (9.58%) 4609 (46.10%) 114 (1.14%) 2707 (27.08%) 1480 (14.80%) 130 (1.30%)	<0.0001
Primary Payor Private Insurance Uninsured Medicaid Medicare Tricare/VA	6005 (53.12%) 132 (1.17%) 382 (3.38%) 4760 (42.11%) 25 (0.22%)	483 (37.30%) 8 (0.62%) 24 (1.85%) 777 (60.00%) 3 (0.23%)	5520 (55.21%) 124 (1.24%) 358 (3.58%) 3974 (39.75%) 22 (0.22%)	<0.0001

**Table 2** Multivariate Model to Predict Death

	<b>AOR (95% CI)</b>	<b>p-value</b>
Age of Patient (Years)	1.05 (1.04, 1.05)	<0.0001
Median Income of ZIP Code (\$1000 USD)	0.99 (0.99, 0.99)	0.0059
Biological Sex of Patient		
Male	1.43 (1.26, 1.63)	<0.0001
Female	Reference Group	
Marital Status		
Divorced	1.25 (1.03, 1.53)	0.0256
Separated	0.80 (0.42, 1.53)	0.4992
Single	1.06 (0.90, 1.25)	0.5139
Unknown	1.24 (0.76, 2.01)	0.3898
Widowed	0.78 (0.66, 0.94)	0.0074
Married	Reference Group	
Employment Status		
Disabled	1.42 (1.09, 1.85)	0.0091
Homemaker	1.96 (1.10, 3.47)	0.0216
Not Employed	1.19 (0.95, 1.50)	0.1291
Part Time	0.65 (0.36, 1.17)	0.1517
Retired	1.19 (0.95, 1.49)	0.1204
Self Employed	0.89 (0.49, 1.59)	0.6847
Student	1.94 (0.11, 35.5)	0.6555
Unknown	1.89 (1.31, 2.71)	0.0006
Full Time	Reference Group	

## Data Sharing Statement

The data used to support the findings of this study are available from the corresponding author upon request.

## Ethics Approval

The study was approved by the Beaumont Health Institutional Review Board. The study was approved under expedited review and the patient consent was

waived as the study design was retrospective. The data confidentiality and compliance with the Declaration of Helsinki were maintained.

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## Disclosure

The authors have no conflicts of interest regarding the publication of this paper.

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