

The Impact of Disparities in Social Determinants of Health on Hospitalization Rates for Patients with COVID-19 in Michigan (USA)

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Importance: The COVID-19 pandemic continues to impact the health-care system in the United States and has brought further light on health disparities within it. However, only a few studies have examined hospitalization risk with regard to social determinants of health.

Objective: We aimed to identify how health disparities affect hospitalization rates among patients with COVID-19.

Design: This observational study included all individuals diagnosed with COVID-19 from February 25, 2020 to December 31, 2020. Uni- and multivariate analyses were utilized to evaluate associations between demographic data and inpatient versus outpatient status for patients with COVID-19.

Setting: Multicenter (8 hospitals), largest size health system in Southeast Michigan, a region highly impacted by the pandemic.

Participants: All outpatients and inpatients with a positive RT-PCR for SARS-CoV-2 on nasopharyngeal swab were included. Exclusion criteria included missing demographic data or status as a non-permanent Michigan resident.

Exposure: Patients who met inclusion and exclusion criteria were divided in 2 groups: outpatients and inpatients.

Main Outcome and Measures: We described the comparative demographics and known disparities associated with hospitalization status.

Results: Of 30,292 individuals who tested positive for SARS-CoV-2, 34.01% were admitted to the hospital. White or Caucasian race was most prevalent (57.49%), and 23.35% were African-American. The most common ethnicity was non-Hispanic or Latino (70.48%). English was the primary language for the majority of patients (91.60%). Private insurance holders made up 71.11% of the sample. Within the hospitalized patients, lower socioeconomic status, African-American race and Hispanic and Latino ethnicity, non-English speaking status, and Medicare and Medicaid were more likely to be admitted to the hospital.

Conclusions and Relevance: Several health disparities were associated with greater rates of hospitalization due to COVID-19. Addressing these inequalities from an individual to system level may improve health-care outcomes for those with health disparities and COVID-19.

Keywords: COVID-19, hospitalization, social determinants of health, disparities

Key Points

Question: Which social determinants of health increase the risk of hospitalization in patients with COVID-19?

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Finding: Lower socioeconomic status as indexed by zip code, African-American race and Hispanic and Latino ethnicity, non-English speaking status, and Medicare and Medicaid patients were all at higher risk of hospitalization in patients with COVID-19.

Meanings: Individual- and population-level health disparities need to be addressed because they lead to serious and tangible consequences for patients as they increase the risk for inpatient admission, which could cause higher morbidity and mortality, due to more severe COVID-19 disease.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic, continues to impact health-care systems across the United States as it continues to require hospitalization for many.¹ Clinical predisposing factors for hospitalization including: older age, male gender, obesity, COVID-19 Risk of Complications Score have been reported in southeast Michigan, a region significantly impacted by the pandemic.^{2,3}

Ethnic and racial minorities, poverty, and low education levels,⁴ poverty and black race,⁵⁻⁹ non-Hispanic black race,⁷⁻¹⁰ public insurance use (ie, Medicare or Medicaid)^{5,6,11} have been reported as health-care disparities having high hospitalization rates.

Our study aimed to assess the impact of multiple social determinants of health on the rates of hospitalization for patients with COVID-19 in southeast Michigan specifically.

Methods

We conducted an observational study at the largest size healthcare system (8 hospitals) in southeast Michigan from February 25, 2020 to December 31, 2020. We included all outpatients and inpatients who were diagnosed with SARS-CoV2 infection by a positive RT-PCR on nasopharyngeal swab. Patients for whom demographic data were missing and patients who were not permanent Michigan residents were excluded from analysis. Zip-code-level data from the United States Census Bureau such as rate of unemployment/use of public transportation/percentage of food stamp use, were used as proxies for economic and employment status as individual-level data was not available from the electronic health record. The zip-code-level data was eventually matched with the individual patient-level data. Univariate and multivariate analysis were used to

determine any hospitalization correlates. Assumptions of all models were adequately met. P values of less than 0.05 were considered statistically significant. Given the large sample size and retrospective nature of the study, it was not feasible to obtain consent from individual patients. The protocol for the study was reviewed and approved by the Beaumont Health Institutional Review Board IRB (#2020-209).

Results

Of 30,292 individuals who tested positive for SARS-CoV-2, 10,303 (34.01%) were admitted to the hospital at least once. Approximately half of the patients (57.49%) were white or Caucasian and one-quarter (23.35%) were Black or African-American. The most common ethnicity was non-Hispanic or Latino representing 70.48% of the total patients. The majority of patients (91.60%) spoke English as their primary language. Of the total patients included, 71.11% had private insurance. These demographics are reflective of the local total population. The remaining descriptive results can be found in [Table 1](#).

In the univariate analysis, Black or African American patients had 64% greater odds of admission than White or Caucasian patients (OR: 1.64; CI: 1.55, 1.74). Arabic or Middle Eastern patients had 25% lower odds of admission than non-Hispanic or Latino patients (OR: 0.75; CI: 0.69-0.81). Non-English speakers had 61% greater odds of admission than English speakers (OR: 1.61; CI: 1.47, 1.74). Medicaid patients had 2.05-fold greater odds of admission than private insurance patients (OR: 2.05; CI: 1.78, 2.36), and Medicare patients had 4.16-fold greater odds of admission than private insurance patients (OR: 4.16; CI: 3.93, 4.40). On average, patients who lived in zip codes with higher unemployment rates, usage of public transportation, higher percentage of service workers, rates of poverty, and lower rates of white collar professions and median income, were more likely to be hospitalized (all $p < 0.0001$).

In the multivariate analysis, independent hospitalization correlates were: Black or African American patients (AOR: 1.83; CI: 1.70, 1.93), Hispanic or Latino patients (AOR: 1.49; CI: 1.27, 1.75), non-English speaking patients (AOR: 1.53; CI: 1.36, 1.71), Medicaid patients (AOR: 1.49; CI: 1.27, 1.74), Medicare patients (AOR: 1.41; 1.31, 1.53), disabled patients (AOR: 2.23; CI: 1.97, 2.51), unemployed patients (AOR: 1.46, CI: 1.35, 1.59). For all reported AOR above, the p value was <0.0001 . The remaining multivariate results can be found in [Table 2](#).

Table I Demographic Characteristics of Patients Testing Positive for SARS-CoV2 Infection from February to December 2020 (N = 30,292) (p values Were Resulted Through a Chi-Square Test)

Demographic Characteristics	Total Patients	Admitted	Not Admitted	P-value
	N = 30,292	N = 10,303	N = 19,989	
Age of Patient (Years) (n = 30,291) Mean (Standard Deviation)	53.52 (20.11)	63.54 (17.77)	48.31 (19.15)	<0.0001
Body Mass Index (BMI) (n = 15,680) Mean (Standard Deviation)	31.35 (8.49)	31.65 (8.65)	30.78 (7.68)	<0.0001
Unemployment Rate of ZIP Code (%) (n = 29,930) Mean (Standard Deviation)	6.73% (4.43%)	7.43% (4.79%)	6.36% (4.19%)	<0.0001
Percent of ZIP Code Taking Public Transportation to Work (%) (n = 29,930) Mean (Standard Deviation)	1.48% (2.43%)	1.80% (2.71%)	1.32% (2.26%)	<0.0001
Percent of ZIP Code Working in White Collar Profession (%) (n = 29,930) Mean (Standard Deviation)	37.89% (14.32%)	35.70% (13.85%)	39.03% (14.43%)	<0.0001
Percent of ZIP Code Working in Service Profession (%) (n = 29,930) Mean (Standard Deviation)	17.51% (5.50%)	18.40% (5.59%)	17.04% (5.40%)	<0.0001
Median Income of ZIP Code (\$) (n = 29,929) Mean (Standard Deviation)	\$65,360.97 (\$27,067.02)	\$60,764.35 (\$25,592.06)	\$67,745.13 (\$27,502.70)	<0.0001
Percent of ZIP Code on Food Stamps/SNAP (%) (n = 29,929) Mean (Standard Deviation)	15.12% (12.71%)	17.28% (13.28%)	14.00% (12.25%)	<0.0001
Poverty Rate of ZIP Code (%) (n = 29,929) Mean (Standard Deviation)	11.85% (10.39%)	13.39% (10.84%)	11.05% (10.06%)	<0.0001
Biological Sex of Patient (n = 30,292)				
Female	16,454 (54.32%)	5184 (50.38%)	11,250 (56.32%)	<0.0001
Male	13,831 (45.66%)	5106 (49.62%)	8717 (43.64%)	
Unknown	7 (0.02%)	0 (0.00%)	7 (0.04%)	N/A ¹
Race of Patient (n = 30,292)				
American Indian or Alaska Native	74 (0.24%)	33 (0.32%)	41 (0.21%)	<0.0001
Asian	599 (1.98%)	208 (2.02%)	390 (1.95%)	
Black or African American	7072 (23.35%)	3308 (32.15%)	3758 (18.82%)	
Native American or Pacific Islander	29 (0.10%)	5 (0.05%)	24 (0.12%)	
Other	2434 (8.04%)	659 (6.40%)	1773 (8.88%)	
White or Caucasian	17,416 (57.49%)	6071 (59.00%)	11,328 (56.73%)	
Unknown	2668 (8.81%)	6 (0.06%)	2653 (13.29%)	
Ethnicity of Patient (n = 30,292)				
Arabic or Middle Eastern	3180 (10.50%)	1042 (10.13%)	2138 (10.71%)	<0.0001
Hispanic or Latino	882 (2.91%)	338 (3.28%)	543 (2.72%)	
Not Hispanic or Latino	21,349 (70.48%)	8404 (81.67%)	12,923 (64.72%)	
Other	1395 (4.61%)	406 (3.95%)	986 (4.94%)	
Unknown	3486 (11.51%)	100 (0.97%)	3377 (16.91%)	

(Continued)

Table 1 (Continued).

Demographic Characteristics	Total Patients	Admitted	Not Admitted	P-value
	N = 30,292	N = 10,303	N = 19,989	
Marital Status (n = 30,292)				
Divorced	2247 (7.42%)	986 (9.58%)	1259 (6.31%)	<0.0001
Married	13,182 (43.52%)	4767 (46.33%)	8411 (42.12%)	
Separated	245 (0.81%)	114 (1.11%)	131 (0.66%)	
Single	9522 (31.43%)	2711 (26.35%)	6810 (34.11%)	
Widowed	2608 (8.61%)	1565 (15.21%)	1025 (5.13%)	
Unknown	2488 (8.21%)	147 (1.43%)	2331 (11.67%)	
English Language Speaker (n = 30,292)				
Yes	27,746 (91.60%)	9165 (89.07%)	18,548 (92.89%)	<0.0001
No	2546 (8.40%)	1125 (10.93%)	1419 (7.11%)	
Primary Payor (n = 30,292)				
Private Insurance	21,541 (71.11%)	5547 (53.91%)	15,977 (80.02%)	<0.0001
Uninsured	640 (2.11%)	122 (1.19%)	517 (2.59%)	
Medicaid	821 (2.71%)	341 (3.31%)	480 (2.40%)	
Medicare	7214 (23.81%)	4253 (41.33%)	2944 (14.74%)	
Tricare/VA	76 (0.25%)	27 (0.26%)	49 (0.25%)	
Has Primary Care Physician (PCP) (n = 30,292)				
Yes	21,327 (70.40%)	7746 (75.28%)	13,560 (67.91%)	<0.0001
No	8965 (29.60%)	2544 (24.72%)	6407 (32.09%)	

Note: ¹Unknown gender was not further analyzed due to no unknown gender patients being admitted.

Discussion

Our study found that several social determinants of health put patients at risk for hospitalization during COVID-19 infection, including lower socioeconomic status, indexed by zip code and employment status, race, ethnicity, English as a second language, and public insurance. Prior studies have associated similar disparities – such as ethnic and racial minority groups,^{7–11} poverty,⁵ lower education levels,⁴ public insurance coverage^{5,6,11} – with higher hospitalization rates in those infected with COVID-19, yet the topic remains understudied,^{7–11} and only few have focused on the risk of inpatient admission as a primary outcome^{4,6,9–11} or addressed the breadths of social determinants, as our study has.

These findings using data from Southeastern Michigan's largest size healthcare system suggest that social determinants of health impact what level of care is required for individuals who contract COVID-19. Inpatient care for those of lower socioeconomic status, minority groups, and public insurance users calls not only for greater health-care expense and physical and mental distress of hospitalization to such individuals but shines light on the necessity to address these disparities.

Efforts towards public health education for patients and physicians, acknowledgement of biases and disparities spanning from an individual to public policy level, and further research to better understand social determinants of health may all help to begin to alleviate this gap.

Limitations of this study include relying on a single healthcare system in one geographical region and the inherent limitations of retrospective study design, like unknown confounders and the risk of type 1 error. A small number of patients included in the study had already been admitted to the hospital for non-COVID-related reasons and tested positive during the course of their hospitalization; they were not removed from the dataset because it is unclear whether or not the severity of their COVID-19 infection would or would not have resulted in hospital admission. Lastly, another possible limitation is confounding comorbidities associated with social determinants of health that increase the likelihood for necessitating inpatient status. This study aims to broadly identify whether social determinants of health impact risk of hospitalization for patients with COVID-19 infection, such as socioeconomic status, race, ethnicity, and gender. If so, further research is needed to better define and establish

Table 2 Multivariate Analysis of Patients Testing Positive for SARS-CoV2 Infection from February to December 2020 (N = 30,292)

	AOR (95% CI)	P-value
Age of Patient (Years)	1.03 (1.03, 1.03)	<0.0001
Percent of ZIP Code Working in White Collar Jobs	0.99 (0.99, 0.99)	0.0014
Median Income of ZIP Code (\$1000 USD)	0.99 (0.99, 0.99)	0.0054
Biological Sex of Patient		
Male	1.49 (1.40, 1.57)	<0.0001
Female	Reference Group	
Race of Patient		
American Indian or Alaska Native	2.12 (1.26, 3.57)	0.0045
Asian	1.28 (1.05, 1.54)	0.0127
Black or African American	1.83 (1.70, 1.97)	<0.0001
Native American or Pacific Islander	0.70 (0.26, 1.89)	0.4835
Other	0.79 (0.70, 0.88)	<0.0001
Unknown	0.04 (0.02, 0.09)	<0.0001
White or Caucasian	Reference Group	
Ethnicity of Patient		
Arabic or Middle Eastern	0.92 (0.82, 1.02)	0.1199
Hispanic or Latino	1.49 (1.27, 1.75)	<0.0001
Other	1.03 (0.89, 1.18)	0.7134
Unknown	0.30 (0.24, 0.38)	<0.0001
Not Hispanic or Latino	Reference Group	
Marital Status		
Divorced	0.98 (0.88, 1.08)	0.6851
Separated	1.14 (0.86, 1.51)	0.3499
Single	0.98 (0.91, 1.05)	0.5993
Unknown	0.92 (0.73, 1.14)	0.4340
Widowed	1.03 (0.93, 1.14)	0.6180
Married	Reference Group	
English Speaker		
No	1.53 (1.36, 1.71)	<0.0001
Yes	Reference Group	
Employment Status		
Disabled	2.23 (1.97, 2.51)	<0.0001
Homemaker	1.65 (1.22, 2.22)	0.0010
Not Employed	1.46 (1.35, 1.59)	<0.0001
Part Time	0.92 (0.80, 1.06)	0.2297
Retired	1.61 (1.46, 1.76)	<.0001
Self Employed	1.12 (0.92, 1.37)	0.2623
Student	0.38 (0.23, 0.62)	0.0001
Unknown	0.47 (0.41, 0.54)	<0.0001
Full Time	Reference Group	

(Continued)

Table 2 (Continued).

	AOR (95% CI)	P-value
Insurance Status		
Medicaid	1.49 (1.27, 1.74)	<0.0001
Medicare	1.41 (1.31, 1.53)	<0.0001
Tricare/VA	1.46 (0.84, 2.53)	0.1752
Uninsured	0.81 (0.65, 1.02)	0.0712
Private Insurance	Reference Group	
Primary Care Physician (PCP)		
No	1.20 (1.13, 1.28)	<0.0001
Yes	Reference Group	

the etiology for these disparities and why individual populations face more serious health outcomes.

Conclusion

Our study demonstrates that several social determinants of health may put patients at increased risk of hospitalization during COVID-19 infection, including lower socioeconomic status, indexed by zip code and employment status, race, ethnicity, English as a second language, and public insurance. Further research, public health education, and acknowledgment of biases among patients, physicians, policy makers, and health-care systems is necessary to address these disparities in order to decrease risk of hospitalization for patients with COVID-19 who are affected by them.

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

Megan McCrohan and Linnea Nierenberg are co-first authors for this study. The authors have no conflicts of interest regarding the publication of this paper.

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