


Racial and Ethnic Disparities in Hospital Admissions from COVID-19: Determining the Impact of Neighborhood Deprivation and Primary Language



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BACKGROUND: Despite past and ongoing efforts to achieve health equity in the USA, racial and ethnic disparities persist and appear to be exacerbated by COVID-19.

OBJECTIVE: Evaluate neighborhood-level deprivation and English language proficiency effect on disproportionate outcomes seen in racial and ethnic minorities diagnosed with COVID-19.

DESIGN: Retrospective cohort study

SETTING: Health records of 12 Midwest hospitals and 60 clinics in Minnesota between March 4, 2020, and August 19, 2020

PATIENTS: Polymerase chain reaction–positive COVID-19 patients

EXPOSURES: Area Deprivation Index (ADI) and primary language

MAIN MEASURES: The primary outcome was COVID-19 severity, using hospitalization within 45 days of diagnosis as a marker of severity. Logistic and competing-risk regression models assessed the effects of neighborhood-level deprivation (using the ADI) and primary language. Within race, effects of ADI and primary language were measured using logistic regression.

RESULTS: A total of 5577 individuals infected with SARS-CoV-2 were included; 866 ($n = 15.5\%$) were hospitalized within 45 days of diagnosis. Hospitalized patients were older (60.9 vs. 40.4 years, $p < 0.001$) and more likely to be male ($n = 425$ [49.1%] vs. 2049 [43.5%], $p = 0.002$). Of those requiring hospitalization, 43.9% ($n = 381$), 19.9% ($n = 172$), 18.6% ($n = 161$), and 11.8% ($n = 102$) were White, Black, Asian, and Hispanic, respectively. Independent of ADI, minority race/ethnicity was associated with COVID-19 severity: Hispanic patients (OR 3.8, 95% CI 2.72–5.30), Asians (OR 2.39, 95% CI 1.74–3.29), and Blacks (OR 1.50, 95% CI 1.15–1.94). ADI was not associated with hospitalization. Non-English-speaking (OR 1.91, 95% CI 1.51–2.43) significantly increased odds of hospital admission across and within minority groups.

CONCLUSIONS: Minority populations have increased odds of severe COVID-19 independent of neighborhood deprivation, a commonly suspected driver of disparate outcomes. Non-English-speaking accounts for differences across and within minority populations. These results support the ongoing need to determine the mechanisms that contribute to disparities during COVID-19 while also highlighting the underappreciated role primary language plays in COVID-19 severity among minority groups.

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Key Points

- **Question:** Do socioeconomic factors or primary language account for racial disparities in COVID-19 disease severity?
- **Findings:** In this observational study of 5577 adults, race, ethnicity, and non-English-speaking as a primary language are associated with increased risk of severe COVID-19 disease, independent of neighborhood-level deprivation.
- **Meaning:** Racial and ethnic disparities related to COVID-19 severity are not explained by socioeconomic factors, which supports further investigation into other confounders (e.g., testing, community outreach, racism) and highlights the need to focus on our non-English-speaking populations.

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INTRODUCTION

Health disparities linger in the USA, and their elimination remains an essential health and societal imperative.^{1,2} Concerns of racial health inequity worsening during COVID-19 were raised immediately,^{3–5} and first identified in a landmark study of New York City’s five boroughs.⁶ Additionally, community-level studies demonstrated lower socioeconomic

status (SES) was associated with the risk of SARS-CoV-2 infection.⁷

The etiology of health disparities is multifactorial and includes differences in sociocultural environment, behavior, biological profile, healthcare system, and clinical events.^{8–18} Specific to COVID-19, multiple explanations driving health disparities have been proposed, for example, higher rates of “essential workers,” multigenerational housing, increased rates of poverty, comorbidities, and uninsured status in minority populations.¹⁹ Early data regarding COVID-19’s impact on health disparities are emerging;^{20–29} studies rarely account for multiple socioeconomic variables and granular patient-level characteristics simultaneously. Previous studies used individual-level poverty (uninsured or Medicaid enrollment or homelessness) or neighborhood-level poverty (percent of low-income residents or median neighborhood income) with variable definitions.^{29–32} These poverty measures may inadequately evaluate disparate outcomes. Furthermore, another evolving confounder is English language proficiency (ELP). At the county level, ELP was one of the strongest predictors of poor outcomes in COVID-19.³³ Despite this association, language proficiency at the individual-level analysis remains unknown.

We hypothesized that neighborhood-level deprivation and non-English as a primary language (at the individual level) might account for the disproportionate outcomes seen in racial and ethnic minorities. Understanding these complex relationships is critical to guiding the ongoing prevention, policy, and intervention efforts to fight this global pandemic equitably.³⁴ The purpose of this study was to evaluate the impact of neighborhood-level deprivation and primary language on disproportionate outcomes seen in racial and ethnic minorities diagnosed with COVID-19.

METHODS

Design and Data

A retrospective analysis of 12 Minnesotan hospitals and 60 primary care clinics between March 4 and August 19, 2020, was performed. We pooled data across different electronic health records (EHRs) utilizing a unique patient identifier to account for healthcare encounters across systems. The University of Minnesota institutional review board (STUDY00001489) approved and provided a waiver of consent for this study.

POPULATION

Individuals with polymerase chain reaction (PCR)–confirmed COVID-19 that did not opt out of research were included in the study. Less than 2.5% of patients opt out of research, a decision made when they establish care. Patients with missing race or ethnicity data were excluded (1225 patients, 17.9%) or

those developing new-onset COVID-19 following hospital admission (13 patients).

Outcomes

Our primary outcome was the need for hospitalization within 45 days of PCR-confirmed COVID-19 disease. By August 24, 2020, individuals not hospitalized were censored in the competing-risk regression model and treated as not requiring hospitalization in the logistic regression model.

Independent Variables/Covariates

The independent variables for this study included race (White/Black/Asian/Other) or ethnicity (Hispanic/non-Hispanic), English versus non-English-speaking, and the national Area Deprivation Index (ADI) categorized into quintiles (first quintile: lowest neighborhood-level deprivation, fifth quintile: highest neighborhood-level deprivation). Race and ethnicity were self-reported and collected for administrative purposes, and quality was not verified. To perform the analysis, we made a categorical variable including both race and ethnicity. We categorized patients identifying as non-Hispanic into White, Black, Asian, or Other with the understanding that race is a social construct and distinctly different from ethnicity; however, when assessing minority populations, it is prudent to include all communities that may be affected.

The ADI’s development has been described previously.³⁵ The ADI is a measure of the socioeconomic disadvantage of a neighborhood (United States Census Block Groups) calculated from 17 different indicators that include education, housing (e.g., occupancy rates, household value), poverty (e.g., median income, number of dependents, % with complete plumbing), and employment status. ADI³⁶ and other indices^{37–39} are utilized to estimate these socioeconomic variables’ effects on aggregate outcomes, including in COVID-19.

All models were adjusted for age, gender, Elixhauser Comorbidity Index,⁴⁰ relationship status, and rurality/urbanity. Urban was defined as living in a zip code with a population density > 200 people per square mile.⁴¹ Marital status was characterized as single, married (domestic partner, life partner), divorced, or widowed.

Statistical Analysis

Median and interquartile range (IQR) expressed the central tendency for continuous variables with a skewed distribution. Categorical variables’ frequencies were described as percentages. The bivariate analysis compared those requiring and not requiring hospital admission. The association of race and ethnicity on mortality, hospital admission severity (laboratory values/vitals), in-hospital complications, intensive care unit (ICU) and mechanical ventilation utilization, and in-hospital mortality was evaluated for patients requiring hospital admission. Overall missingness was low (0–2.06%) and imputation was deemed unnecessary.⁴²

Logistic and competing-risk regression models (censored at 45 days while accounting for the competing risk of death before hospitalization) were used to assess the independent association of race/ethnicity, ADI, and primary language (English vs. other) on the primary outcome. Comorbidities were determined using a random forest variable importance analysis. Models were compared using comorbidities selected by variable importance analysis (Appendix Table 1) to aggregate indices of comorbidities commonly used to adjust for baseline conditions (Elixhauser Comorbidity Index) given the limited experience of adjusting for comorbid conditions in COVID-19. We used the best Bayesian Information Criterion (BIC) to determine the final model.

We investigated ADI and primary language effects, across and between race/ethnic groups, on the risk for admission. By plotting the cumulative incidence of hospital admission, it was clear there were consistent and sequential increases across and within groups in relation to both ADI and primary language. To determine significance within racial and ethnic groups, logistic regression analyses (using the same covariates as the primary model) were performed by stratifying either ADI or primary language by race and ethnicity. Each model used the race and ethnicity of interest as the base to determine if ADI or language differed. For ADI models, we report the comparison between the fifth to the first ADI quintile.

Statistical analyses were performed using Stata MP, version 16 (StataCorp, College Station, TX). Statistical significance was defined as a two-tailed p value < 0.05 .

RESULTS

Of the 5577 individuals infected with SARS-CoV-2 meeting inclusion criteria for this study, 866 ($n = 15.5\%$) patients were admitted to the hospital within 45 days of COVID-19 diagnosis (Appendix Figure 1). Overall, the median age was 43.7 years (IQR: 27.4–62.3) and 44.4% ($n = 2474$) were male. Patients were predominantly White ($n = 2931$, 52.6%), followed by Black ($n = 1225$, 22.0%), Asian ($n = 677$, 12.2%), and Hispanic ($n = 416$, 7.5%). The median national ADI was 37% (IQR: 22–48%).

Patients who required hospitalization were older (60.9 years [IQR: 45.7–75.9] vs. 40.4 year [IQR: 25.6–58.3], $p < 0.001$) and a greater proportion were male ($n = 425$, 49.1% vs. $n = 2049$, 43.5%, $p = 0.002$) (Table 1). A higher proportion of non-English-speaking patients required admission ($n = 301$, 34.8% vs. $n = 785$, 16.7%, $p < 0.001$). Admitted patients had higher median Elixhauser Comorbidity Index (5.0, IQR: 3.0–9.0 vs. 1.0, IQR: 0.0–2.0, $p < 0.001$) and mortality ($n = 108$, 12.5% vs. $n = 68$, 1.4%, $p < 0.001$) than those not requiring admission.

Of those requiring hospitalization, 43.9% ($n = 381$), 19.9% ($n = 172$), 18.6% ($n = 161$), and 11.8% ($n = 102$) were White, Black, Asian, and Hispanic, respectively (Appendix Table 2). White patients (69.6 years) were significantly older than their Black (55.4 years), Asian (58.9 years), and Hispanic (48.5 years) counterparts ($p < 0.001$). Approximately half of White and

Hispanic patients lived in the first and second quintile ADI neighborhoods. In contrast, nearly the same proportion of Asian patients lived in the fourth quintile, and Black patients were evenly distributed over all ADI quintiles. Admission labs, including those associated with mortality, were not significantly different between racial/ethnic groups (Appendix Table 2).^{43,44}

Logistic regression models with Elixhauser Comorbidity Index performed better (BIC 3686) compared to using selected comorbidities (BIC 4008) as described above. Thus, the final model included Elixhauser Comorbidity Index in attempts to adjust for comorbidities.

Table 1 Univariate Analysis of Individuals Infected with SARS-CoV-2 Not Admitted Compared to Those Admitted to the Hospital

	Not admitted ($n = 4711$, 84.5%)	Admitted ($n =$ 866, 15.5%)	p value
Age (years): median (IQR)	40.4 (25.6–58.3)	60.9 (45.7–75.9)	<0.001
Male sex: n (%)	2049 (43.5)	425 (49.1)	0.002
Race/ethnicity: n (%)			
White	2550 (54.1)	381 (44.0)	<0.001
Black	1053 (22.4)	172 (19.9)	
Asian	516 (11.0)	161 (18.6)	
Hispanic	314 (6.7)	102 (11.8)	
Declined	219 (4.6)	32 (3.7)	
Other	59 (1.3)	18 (2.1)	
Non-English-speaking: n (%)	785 (16.7)	301 (34.8)	<0.001
Area deprivation quintiles: n (%)			
First: 0–20%	1005 (21.3)	169 (19.5)	<0.001
Second: 21–40%	1559 (33.1)	237 (27.4)	
Third: 41–60%	1155 (24.5)	220 (25.4)	
Fourth: 61–80%	657 (13.9)	142 (16.4)	
Fifth: 81–100%	335 (7.1)	98 (11.3)	
Urban: n (%)	3416 (85.8)	728 (93.7)	<0.001
Marital status: n (%)			
Single	2428 (51.5)	324 (37.4)	<0.001
Married	1837 (39.0)	381 (44.0)	
Separated/divorced	236 (5.0)	73 (8.4)	
Widowed	210 (4.5)	88 (10.2)	
Comorbidities: n (%)			
Hypercoagulable state	39 (0.8)	33 (3.8)	<0.001
Hypocoagulable state	211 (4.5)	242 (27.9)	<0.001
Type 1 diabetes mellitus	95 (2.0)	84 (9.7)	<0.001
Type 2 diabetes mellitus	578 (12.4)	338 (39.0)	<0.001
Atrial fibrillation or atrial flutter	220 (4.7)	163 (18.8)	<0.001
Hypertension	1,333 (28.6)	574 (66.3)	<0.001
Chronic kidney disease	334 (7.2)	241 (27.8)	<0.001
Chronic obstructive pulmonary disease	169 (3.6)	123 (14.2)	<0.001
Liver disease	237 (5.1)	131 (15.1)	<0.001
Cerebral vascular disease	279 (6.0)	151 (17.4)	<0.001
Sleep apnea	308 (6.6)	154 (17.8)	<0.001
Congestive heart failure	246 (5.3)	174 (20.1)	<0.001
Obesity	849 (18.2)	294 (33.9)	<0.001
Mortality: n (%)	68 (1.4)	108 (12.5)	<0.001

Univariate analysis comparing PCR+ individuals infected with SARS-CoV-2 who were admitted within 45 days of testing vs. those without hospital admission. ADI quintiles represent lowest areas of deprivation (1st quintile) to the highest areas of deprivation (5th quintile)

Primary Analysis

On logistic regression analysis, minority race and ethnicity were independent predictors for hospital admission (Table 2). Hispanic patients (OR 3.8, 95% CI 2.72–5.30), Asians (OR 2.39, 95% CI 1.74–3.29), and Blacks (OR 1.50, 95% CI 1.15–1.94) had higher odds of hospital admission within 45 days compared to White patients. ADI was not independently associated at any quintile, while being non-English-speaking (OR 1.91, 95% CI 1.51–2.43) was independently associated with increased odds of hospitalization compared to English-speaking patients. These associations remained significant in the competing-risk model (Table 2).

Race/Ethnicity~Area Deprivation Index

Cumulative incidence plots were generated to visualize the disparity by race and ethnicity and ADI quintile (Fig. 1a). On logistic regression, compared to White patients living in the first ADI quintile, there was no statistical difference in hospitalization of White patients living in the fifth ADI quintile. In contrast, there was a sequential increase in odds of needing hospitalization of first ADI quintile Black (OR 1.75, 95% CI 1.05–2.93) and fifth ADI quintile Black (OR 1.90, 95% CI 1.13–3.19), first quintile Asian (OR 2.31, 95% CI 1.02–5.26) and fifth ADI quintile Asian (OR 4.85, 95% CI 1.86–12.60), and first ADI quintile Hispanic (OR 3.68, 95% CI 1.97–6.88) and fifth ADI quintile Hispanic patients (OR 10.14, 95% CI 3.85–26.74) when compared to White patients in the first ADI quintile (Appendix Table 3). On subgroup analysis comparing the fifth vs. first quintile within each racial and ethnic group, there was no significant difference in the odds of hospitalization (Fig. 2a).

Race/Ethnicity~Primary Language

Cumulative incidence plots were generated to visualize the disparity by race and ethnicity and primary language (English vs. non-English) (Fig. 1b). Similar to above, the odds of hospitalization increased across racial and ethnicity groups when stratified by primary language (English or other) and compared to English-speaking White patients. In contrast to the ADI models, on subgroup analysis, comparing those who speak English as their primary language vs. non-English-speaking within each minority group, there was a significant difference in the odds of hospitalization: Black (OR 1.72, 95% CI 1.14–2.59), Asian (OR 1.61, 95% CI 1.0–2.6), and Hispanic (3.74, 95% CI 2.14–6.52) (Fig. 2b).

DISCUSSION

We assessed outcomes of patients diagnosed with COVID-19 in the outpatient setting. Specifically, we evaluated the association of (1) neighborhood-level deprivation (using the area deprivation index [ADI]) and (2) non-English as a primary language with the need for hospital admission within 45 days (COVID-19 severity surrogate). Race and ethnicity were

associated with COVID-19 severity. Furthermore, non-English-speaking was associated with increased odds of admission while neighborhood-level deprivation was not. Despite our hypothesis that neighborhood deprivation and/or primary language may account for racial differences in outcomes, race and ethnicity remained statistically significant. The disparate findings by race and ethnicity in our study are not novel in isolation; however, the persistence despite controlling for proposed inequity drivers highlights a concerning and enduring healthcare crisis. Furthermore, it supports concerns^{12,25,45} that other unidentified confounders (i.e., structural racism, testing, etc.) drive the association.

Race/Ethnicity

Like prior reports, we identified persisting associations between minority communities and COVID-19 outcomes despite accounting for different socioeconomic variables.^{30,31,37,38,46} Hispanic patients had the highest odds of hospitalization, followed by Asian, Black, and White patients. The increased risk among Hispanic and Black patients is well documented.^{30,31} Similarly, in UK studies, Asian patients had higher odds of hospitalization despite controlling for deprivation areas.^{37,38} Our surrounding community includes large Hmong and Somali populations which provided an opportunity to evaluate multiple minority populations. While we acknowledge that administrative data with self-reported race and ethnicity data is an oversimplification of the unique populations, it highlights the concerning degree in which multiple populations under each cohort are disproportionately affected by this pandemic. The persistence of race and ethnic effects on COVID-19 outcomes contrasts disparities in other disease processes and chronic conditions.^{47–50} For example, racial disparities in cancer patient outcomes can be explained by treatment received and socioeconomic status.^{47–49} Alternatively, with COVID-19, these persisting disparities may illuminate contributing mechanisms. For example, cancer-related factors (i.e., diagnosis, treatment) occur at different points during their care. In contrast to chronic conditions or treatment plans, the pandemic provides a raw healthcare snapshot with a less confounded arena to study disparities. Furthermore, disparate outcomes appear limited to out-of-hospital care given race, ethnicity, and socioeconomic factors were not associated with in-hospital mortality in multiple studies.^{32,51} This suggests pre-hospitalization solutions are likely this highest yield targets to mitigate disparities.

Neighborhood-Level Deprivation

Socioeconomic status is a driver of health disparities.^{47,49,52,53} ADI was used, to account for socioeconomic status, because it includes key neighborhood-level characteristics, such as poverty, housing, education, and employment factors at the neighborhood level. While it is not interchangeable with individual SES, it does incorporate a portion of a patient's socioeconomic factors and may even account for racial disparities to a greater

Table 2 Multivariable Logistic Regression and Competing-Risk Models for Hospital Admission in Individuals Infected with SARS-CoV-2

	Odds ratio*	95% CI	p value	Standardized hazard ratio	95% CI	p value
Age	1.02	1.01–1.02	<0.001	1.01	1.01–1.02	<0.001
Male sex	1.28	1.07–1.53	0.006	1.25	1.08–1.46	<0.001
Race/ethnicity						
White	Ref	—	—			
Black	1.50	1.15–1.94	0.002	1.31	1.04–1.65	0.02
Asian	2.39	1.74–3.29	<0.001	1.78	1.33–2.38	<0.001
Hispanic	3.80	2.72–5.30	<0.001	3.02	2.31–3.95	<0.001
Decline	1.82	1.16–2.87	0.009	1.64	1.11–2.44	0.01
Other	2.04	1.04–4.00	0.04	1.89	1.18–3.03	0.01
Area deprivation quintiles						
First: 0–20%	Ref	—	—			
Second: 21–40%	0.83	0.65–1.07	0.2	0.85	0.69–1.04	0.12
Third: 41–60%	0.87	0.67–1.13	0.3	0.88	0.71–1.1	0.26
Fourth: 61–80%	0.88	0.65–1.19	0.4	0.87	0.67–1.13	0.29
Fifth: 81–100%	1.31	0.93–1.85	0.1	1.14	0.84–1.54	0.39
Rural/urban	1.34	0.97–1.85	0.07	1.29	0.97–1.7	0.08
Marital status						
Single	Ref	—	—			
Married	0.92	0.75–1.13	0.4	0.98	0.82–1.17	0.82
Separated	0.68	0.47–0.98	0.04	0.81	0.59–1.11	0.19
Widowed	0.60	0.42–0.88	0.008	0.75	0.56–1.02	0.07
Non-English-speaking	1.91	1.51–2.43	<0.001	1.52	1.24–1.88	<0.001
Elixhauser Comorbidity Index	1.36	1.32–1.40	<0.001	1.2	1.18–1.22	<0.001

Multivariable logistic regression (left) with odds of hospital admission in patients with PCR+ COVID-19 diagnosis within 45 days of testing. Competing-risk model (right) with standardized hazard ratio of hospital admission in patients with PCR+ COVID-19 censored at 45 days from testing while accounting for death prior the primary endpoint. ADI quintiles represent lowest areas of deprivation (1st quintile) to the highest areas of deprivation (5th quintile)

*AUROC: 0.854

degree than individual-level SES estimates.⁵⁴ Surprisingly, neighborhood-level deprivation was not associated with severe COVID-19.

Prior studies found areas of deprivation were associated with higher SARS-CoV-2 infection rates, but limited data with robust SES adjustment exists for other outcomes.^{15,37–39,55,56} Price-Haywood et al. found Black patients with COVID-19

(vs. White) had higher odds of hospital admission (OR 1.96, 95% CI 1.62–2.37) after controlling for neighborhood-level income (OR 1.22, 95% CI 1.04–1.43).³² Similarly, other studies found non-White populations had an increased risk of poor outcomes after adjusting for insurance and poverty.^{30,31} In contrast to our findings and others, Ogedegbe et al. found no difference in hospitalization between Black

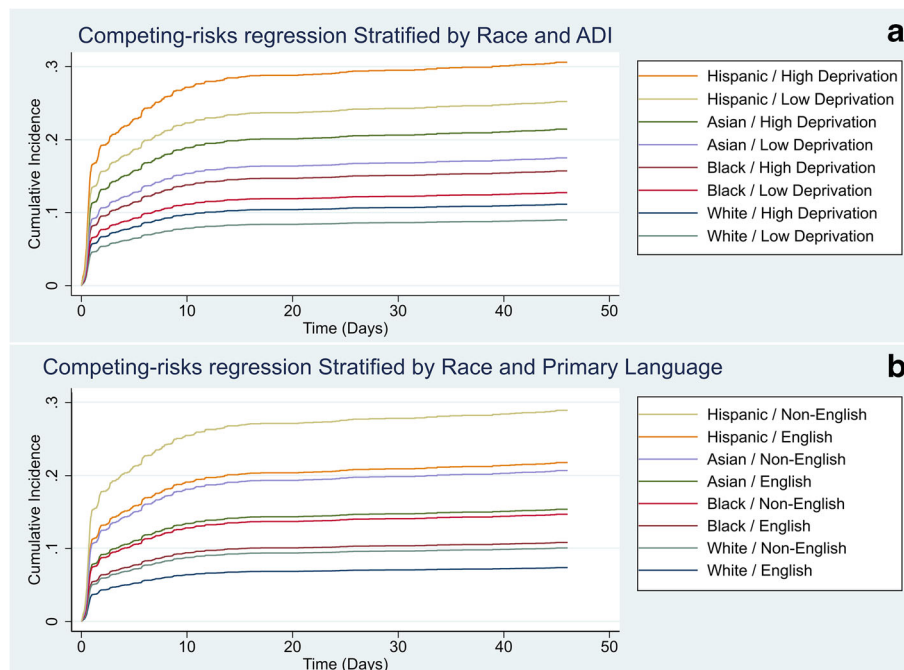


Fig. 1 Competing-risk regression cumulative incidence of hospital admission over time by ADI (a) and primary language (b) stratified by race/ethnicity. Models were censored at 45 days and accounted for death occurring prior to the primary endpoint (hospital admission).

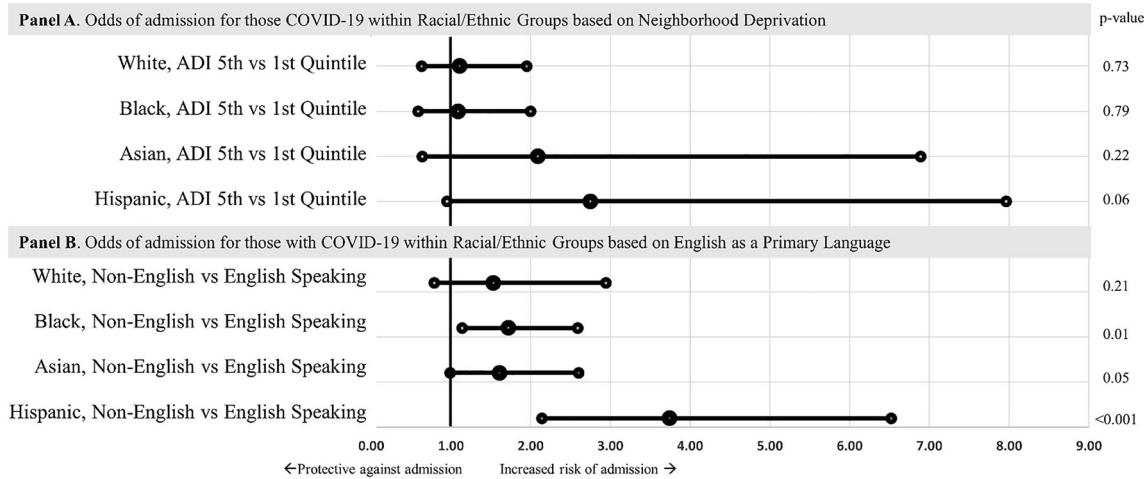


Fig. 2 Forest plots of multiple logistic regression models using each race/ethnicity as a baseline to compare ADI and primary language stratified by race/ethnicity. Multivariable logistic regression models using each race/ethnicity as a baseline within its respective model to compare within each race/ethnicity high vs. low neighborhood deprivation (top) and primary language (bottom) after adjusting (top) for age, sex, marital status, urbanity, and comorbidities of the odds of hospital admission in patients with PCR+ COVID-19 diagnosis within 45 days of testing.

vs. White patients; however, the proportion of Black patients with insurance was significantly higher than the surrounding community rate limiting the generalizability.⁵⁶ Overall, these findings highlight and support the alarming fact that minorities have a higher risk of severe infection and severe disease that is not attributable solely to baseline health conditions or socioeconomic factors. Furthermore, these data suggest COVID-19 is threatening to widen the health equity gap.⁵⁷

Primary Language

Unfortunately, the pandemic disproportionately affects the most vulnerable. Similar to our study, other studies found an increased risk of poor COVID-19 outcomes in non- or limited-English speakers using different measures.^{20,22,33} Rozenfeld et al. found primary language other than English was associated with infection risk to a greater degree than race.²² Karmakar et al. recently found ELP was the most significant predictor of incidence and mortality for COVID-19 when measured at the county level.³³ Strikingly, we also found non-English-speaking patients within each minority racial/ethnic group had a higher odds of hospitalization than those who primarily spoke English. To our knowledge, this is one of the first times primary language, at the individual level within and across minority populations, was identified as a risk factor for hospitalization from COVID-19. The underappreciation of primary language as a risk factor for severe COVID-19 is likely to further these associations. English proficiency can be closely associated with socioeconomic status as it affects their daily interactions, employment opportunities, and level of discrimination.⁵⁸ During the pandemic, much of the information (and misinformation) regarding public health is derived from multiple modes of media, primarily in English.^{59,60} While multi-lingual versions of guidelines from the CDC attempt to mitigate this shortcoming, the rapidly changing COVID-19 information makes media a more convenient

avenue to consume information. Community efforts are necessary in assessing and alleviating the disparate outcomes influenced by language proficiency across and within racial and ethnic communities.

Limitations

Multiple limitations must be considered when interpreting our results. First, hospital admission criteria may vary by site. Testing deficiencies in low-risk minorities (creating the perception of higher risk) can bias the results away from the null; however, the significantly younger minority populations by > 10 years (vs. White) across hospitalized patients ([Appendix Table 2](#)) suggests against the presence of this bias. Generalizability is limited beyond this population. While Minnesota has a predominantly White population, it does include the understudied Hmong and Somali populations. The analysis does not include patients who opt out of research (< 1.5% of patients) and those with missing race/ethnicity data (18%), which may result in selection bias. Notably, these patients were missing numerous other data which limited the ability to perform multiple imputations. Insurance status (a common surrogate for SES) was not included in our analysis; however, adjustment for race, primary language, and multiple neighborhood socioeconomic attributes likely would attenuate the effects from insurance. Finally, neighborhood-level SES (ADI) and individual-level SES are sometimes discordant and attributing group-level measures to individuals may limit interpretation.⁶¹ However, in the absence of individual-level socioeconomic attributes, reliance on aggregate measures is necessary to examine these racial disparities.

Next Steps

Health equity, specifically for racial and ethnic minorities, remains an aspiration in the USA. However, failure to widely

study^{62,63} and acknowledge disparate minority outcomes⁶⁴ and implement evidence-based interventions makes health equity impossible.⁶⁵ Improving access to testing is a clear first step for those communities at the highest risk. Moreover, community engagement led by trusted community representatives, from strategy to implementation, should be a universal priority.¹³ Minority communities, specifically non-English-speaking and those with lower literacy rates, are more likely to be unaware of public health recommendations and are more susceptible to misinformation, which compounds a deep-seated distrust in healthcare due to historical discrimination and personal injustices.^{60,66–68} To combat this, we must ensure all forms of communication are available in different languages and with a robust community dissemination strategy. Urgently, we address healthcare providers' implicit bias, including trainees, to ensure healthcare provision equitably by creating a healthcare community filled with cultural humility.⁶⁹ Lastly, as vaccinations remain the ultimate endpoint for the pandemic, the disparate outcomes warrant our emergent attention during the vaccination prioritization process.^{65,70} Minority and non-English-speaking populations are clearly at high risk from multiple aspects of this health crisis, and early data already shows the maldistribution of the COVID-19 vaccine.^{71,72}

CONCLUSION

Our findings highlight areas of neighborhood-level deprivation may contribute to racial disparities but to a lesser degree when controlling individual-level factors. Strikingly, racial and ethnic disparities in COVID-19 illness severity exist, independent of socioeconomic characteristics, which supports the need to investigate the different levels of racism contributing to health inequity.⁷³ Furthermore, non-ELP is associated with COVID-19 severity across and within racial and ethnic groups. We must address underlying causes of social inequalities and incorporate such actions into the national COVID-19 response in the presence of the global attention, resources, and focus in hopes of ending this pandemic closer to public health equity.⁴

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11606-021-06790-w>.

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