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Variations in Presentation and Management of COVID-19 Inpatients by Race and Ethnicity in a Large Texas Metroplex

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Abstract

Objective: The aim of this study was to assess variations in presentation and outcomes of coronavirus disease 2019 (COVID-19) across race/ethnicity at a large Texas metroplex hospital.
Methods: A retrospective cohort study was performed.
Results: Although COVID-19 patients demonstrated significant socioeconomic disparities, race/ethnicity was not a significant predictor of intensive care unit (ICU) admission ($P = 0.067$) or case fatality ($P = 0.078$). Hospital admission varied by month, with incidence among Black/African-American and Hispanic/Latino patients peaking earlier in the pandemic timeline ($P < 0.001$). Patients reporting Spanish as their primary language were significantly more likely to be admitted to the ICU (odds ratio, 1.75; $P = 0.007$).
Conclusions: COVID-19 patients do not demonstrate significant racial/ethnic disparities in case fatality, suggesting that state-wide disparities in mortality rate are rooted in infection risk rather than hospital course. Variations in admission rates by race/ethnicity across the timeline and increased ICU admission among Spanish-speaking patients demonstrate the need to pursue tailored interventions on both a community and structural level to mitigate further health disparities throughout the pandemic and after.

In the United States, over 33 million individuals have been infected with the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), resulting in coronavirus disease 2019 (COVID-19) with over 594,000 associated deaths[1] at the time of this writing. Surveillance data indicate that marginalized populations have been facing a greater impact from, and carrying a greater burden of, COVID-19.[1–3] Health disparities among racial and ethnic minorities in the United States are historically well documented, but poorly understood.[4–7] These health disparities indicate an increased risk among minority populations in the face of comorbidity-associated COVID-19 outcomes.[8]

Black/African-American (Bl) and Hispanic/Latino (HsL) populations experience higher rates of SARS-CoV-2 infection, demonstrate higher risk for hospitalization, and are represented disproportionately in overall COVID-19 deaths as compared with non-Hispanic White (NHWh) populations.[2,8,9] APM Research Labs reports an age-adjusted mortality rate of 123.7 in Bl Americans, and 86.7 in HsL Americans, contrasted with 75.7 in NHWh Americans.[2] While the mechanisms of these racial and ethnic disparities remain under investigation, it has been suggested that contributing factors include susceptibility (such as comorbid conditions) and exposure-related factors (the social determinants of health).

Diabetes (DM), hypertension (HTN), cardiovascular disease, cerebrovascular disease, chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), chronic liver disease, and malignancy are associated with higher risk of severe disease and mortality among patients with COVID-19.[8–10] Bl and HsL populations generally bear a higher burden of chronic disease and multimorbidity than NHWh and Asian-American populations.[9–11]

Although there is strong evidence of disparity in mortality rate due to COVID-19 by race and ethnicity, there is little evidence supporting a disparity in case fatality rate in those who are hospitalized with COVID-19.[12,13] While mortality rates measure the deceased patients per *population*, case fatality rates measure the deceased per people *infected*. This distinction suggests that comorbidities alone do not account for racial/ethnic disparities, but rather that exposure-related factors and unequal infection risk might also play a significant role. Socioeconomic status (SES) is among the most frequently suggested contributors to health disparities in the United States,[13] but its use often depends on the availability of data. Several measures that might affect disparities in COVID-19 outcomes include insurance status, smoking status, zip code, primary language, education level, household income, and population density.

Texas has consistently ranked among states as 50th overall in health insurance coverage. This gap in coverage has only worsened during the pandemic, with 29% of adults under 65 uninsured as of May 2020.[14] County-level data in Texas indicate that locations with higher rates of HsL and Bl minority populations experience a higher COVID-19 fatality burden and a higher incidence of cases per 100,000.[15,16] These data indicate a need for multidimensional county-level analyses to monitor the waves of COVID-19 incidence across jurisdictions. The authors wished to determine the effects of racial/ethnic disparities across the presentations and outcomes of COVID-19 disease at a university hospital in a large Texas metroplex for the purpose of identifying potentially modifiable factors to optimize patient outcome.

Methods

Study Population

Adult patients (18 y of age and older) with a laboratory-confirmed diagnosis of COVID-19 admitted from the emergency department (ED) to inpatient status at the public/private Clements University Hospital (CUH) in Dallas, Texas, between March 17, 2020, and January 10, 2021, were included in this observational cohort study. Data were collected retrospectively from the electronic health record (EHR) and manual chart review to determine insurance status. The University of Texas Southwestern Institutional Review Board (IRB) activated IRB exemption (STU-2020-1330, Velois Study Number 32323) for this study on January 4, 2021.

Patient Categorization

Patients were categorized by race/ethnicity (NHWh, Bl, and HsL), sex (male and female), age range (18-39, 40-64, 65-84, and 85+), comorbidity profile, primary language (English and Spanish), insurance status (uninsured, Medicaid, Medicare, and private/employer-based), date of admission range by month (March 10, 2020, to January 10, 2021), and area-based socioeconomic measures (ABSMs).

Patients were categorized into ABSM categories by zip code tabulation area (ZCTA)-level data from the Public Health Disparities Geocoding Project,[17,18] linked to United States Census-derived data on neighborhood SES variables. Four zip code data categories were pulled for analysis: (1) Categorical poverty variable (apINDPOV): Proportion of households in a given zip code living below the Federal Poverty Level, by categories 0-4.9%, 5-9.9%, 10-19.9%, and 20-100%. (2) Quintiles of poverty (q_INDPOV): Proportion of households in a given zip code living in poverty, adjusted for geographical location and weighted by population size. (3) Quintiles of Index of Concentration at the Extremes (q_ICE) for racialized economic segregation: The difference between NHWh high-income persons and persons of color with low incomes, divided by population size. Thus, q_ICE measures disparity in racial and economic privilege, with values ranging from -1 (lower levels of privilege) to +1 (greater privilege).[19] (4) Quintiles of percent crowded households (q_crowding): Proportion of households in a given zip code living in crowded households, adjusted for geographical location and weighted by population size.

Statistical Analysis

We used chi-squared and Fisher exact test with Monte Carlo simulation to compare patient characteristics by 2 primary outcomes: admission to the intensive care unit (ICU) and death. Assessment of ICU admission included patients admitted directly from the ED to the ICU, and patients admitted from the ED to a less-acute unit that subsequently required ICU admission. Patient characteristics were also compared with age range and race/ethnicity. Multivariable binary logistic regression was used to reanalyze case fatality and ICU admission outcomes to assess for robustness of independent associations. Statistical tests were 2-sided, and a P value of < 0.05 was considered significant. All analyses were performed using IBM SPSS Statistics©, Version 24.0 (IBM Corporation, Armonk, NY).

Table 1. Demographics

		N	%
RaceEthn	AIAN	4	0.32
	As	30	2.41
	Bl	341	27.41
	HsL	391	31.43
	NHPI	2	0.16
	NHWh	407	32.72
	Other	69	5.55
Sex	Male	651	52.33
	Female	593	47.67
Age range	18-39	183	14.71
	40-64	531	42.68
	65-84	456	36.66
	85+	74	5.95

RaceEthn = Race/ethnicity, AIAN = American Indian or Alaskan Native, As = Asian, Bl = Black or African American, HsL = Hispanic or Latino, NHPI = Native Hawaiian or Pacific Islander, NHWh = Non-Hispanic White.

Results

From March 3, 2020, to January 10, 2020, a total of 1244 patients who tested positive for COVID-19 were admitted to CUH from the ED. Overall median age was 61 y, and overall mean age was 59.42 y (standard deviation [SD], 17.124), with 47.7% of patients being female, 32.7% NHWh, 27.4% Bl, and 31.4% HsL (Table 1).

Race and Ethnicity

Distribution of age was higher among NHWh patients (mean, 64.12; SD, 16.5), compared with Bl (57.65, 16.99) and HsL (55.68, 16.8) patients. NHWh patients were more likely to be over 65 than Bl and HsL patients ($P < 0.001$) (Table 2). A total of 105 patients lacked race/ethnicity documentation in their charts.

Bl and HsL patients were more likely to live in zip codes associated with lower SES. 18.2% of NHWh patients lived in a zip code where 0-4.9% live below the poverty line, while 2.9% of Bl patients and 2.8% of HsL patients lived in these zip codes. In contrast, 11.6% of NHWh patients lived in a zip code where 20-100% live under the poverty line, while 49.9% of Bl patients and 40.9% of HsL patients lived in these zip codes ($P < 0.001$). Adjusted for geography and population size, the differences between lowest quintile of poverty (29.5% of NHWh, 6.7% of Bl, and 5.4% of HsL patients) and highest quintile of poverty (10.4% of NHWh, 45.5% of Bl, and 37.8% of HsL patients) were still significant ($P < 0.001$).

NHWh patients were also more likely to live in the quintile of zip codes with the lowest proportion of crowded households (25.4%) compared with Bl (8.5%) and HsL (4.3%) patients. Bl (52.5%) and HsL (74.9%) patients were also more likely to live in the quintile with the highest proportion of crowded households, compared with NHWh patients (27.3%) ($P < 0.001$). NHWh

Table 2. Associations in comorbidity profiles and socioeconomic factors by race/ethnicity in COVID-19 patients at CUH

		Total		NHWh Total N = 407 (32.7%)		Bl Total N = 341 (27.4%)		HsL Total N = 391 (31.4%)		
		N	%	N	%	N	%	N	%	p-value
Age range (% within age range)	18-39	183	14.7	37	22.3	55	33.1	74	44.6	<0.001
	40-64	531	42.7	153	31.2	159	32.4	178	36.3	
	65-84	456	36.7	175	42.4	112	27.1	126	30.5	
	85+	74	5.9	42	60	15	21.4	13	18.6	
Comorbidities (% of RaceEth)	DM	536	43.1	139	34.2	156	45.7	198	50.6	<0.001
	HTN	777	62.5	246	60.4	254	74.5	211	54.0	<0.001
	CAD	186	15.0	90	22.1	44	12.9	36	9.2	<0.001
	CHF	174	14.0	70	17.2	61	17.9	34	8.7	<0.001
	Afib	134	10.8	71	17.4	27	7.9	21	5.4	<0.001
	COPD	96	7.7	57	14.0	26	7.6	9	2.3	<0.001
	Asthma	181	14.5	67	16.5	61	17.9	36	9.2	0.001
	ILD	45	3.6	22	5.4	10	2.9	11	2.8	0.098
	OSA	102	8.2	42	10.3	31	9.1	17	4.3	0.005
	PH	41	3.3	18	4.4	13	3.8	9	2.3	0.249
	ChrLung	140	11.3	73	17.9	37	10.9	22	5.6	<0.001
	CKD	231	18.6	70	17.2	97	28.4	50	12.8	<0.001
	ESRD	81	6.5	6	1.5	41	12.0	29	7.4	<0.001
	ChrLiver	62	5.0	16	3.9	10	2.9	28	7.2	0.017
	HIV	15	1.2	4	1.0	7	2.1	4	1.0	0.4 (0.387,0.413)
	Malignancy	243	19.5	118	29.0	58	17.0	44	11.3	<0.001
	SolidOrgTx	97	7.8	38	9.3	25	7.3	25	6.4	0.282
	ImmSupr	94	7.6	36	8.8	25	7.3	26	6.6	0.49
Smoking status (% within RaceEth)	Never smoker	807	64.9	228	59.1	235	69.5	276	73	<0.001
	Former smoker	352	28.3	146	37.8	86	25.4	87	23	
	Current some day smoker	23	1.8	4	1	6	1.8	11	2.9	
	Current everyday smoker	24	1.9	8	2.1	11	3.3	4	1.1	
Zip categories (% within RaceEthn)										
apINDPOV	0-4.9%	107	8.6	72	18.2	10	2.9	11	2.8	<0.001
	5-9.9%	238	19.1	108	27.3	54	15.8	48	12.3	
	10-19.9%	487	39.1	170	42.9	107	31.4	171	44	
	20-100%	397	31.9	46	11.6	170	49.9	159	40.9	
q_INDPOV	[0,0.0656]	185	14.9	117	29.5	23	6.7	21	5.4	<0.001
	(0.0656,0.146]	172	13.8	68	17.2	42	12.3	43	11.1	
	(0.102,0.146]	211	17	79	19.9	66	19.4	47	12.1	
	(0.146,0.21]	297	23.9	91	23.0	55	16.1	131	33.7	
	(0.21,1]	364	29.3	41	10.4	155	45.5	147	37.8	
q_ICE	(0.294,1]	184	14.8	111	28	26	7.6	20	5.1	<0.001
	(0.176,0.294]	151	12.1	89	22.5	22	6.5	25	6.4	
	(0.0865,0.176]	127	10.2	62	15.7	24	7	32	8.2	
	(-0.0535,0.0865]	242	19.5	76	19.2	49	14.4	102	26.2	
	[-1,-0.0535]	525	42.2	58	14.6	220	64.5	210	54.0	
q_crowding	[0,0.0176]	173	13.9	103	25.4	29	8.5	17	4.3	<0.001
	(0.0176,0.0283]	171	13.7	87	21.4	48	14.1	22	5.6	
	(0.0283,0.0516]	274	22	105	25.9	85	24.9	59	15.1	
	(0.0516,1]	625	50.2	111	27.3	179	52.5	293	74.9	
Insurance status (% within RaceEthn)	Uninsured	128	10.3	24	6	16	4.7	82	21.2	<0.001
	Medicaid	71	5.7	13	3.2	31	9.1	25	6.5	
	Medicare	578	46.5	215	53.5	180	53.1	136	35.1	
	Private/employer-based	456	36.7	150	37.3	112	33	144	37.2	

(*Continued*)

Table 2. (*Continued*)

		Total		NHWh Total N = 407 (32.7%)		Bl Total N = 341 (27.4%)		HsL Total N = 391 (31.4%)		p-value
		N	%	N	%	N	%	N	%	
Date of admission range (% within date range)	March	28	2.3	8	30.8	10	38.5	8	30.8	<0.001
	April	37	3	13	39.4	8	24.2	12	36.4	
	May	37	3	4	11.1	12	33.3	20	55.6	
	June	72	5.8	10	14.7	22	32.4	36	52.9	
	July	173	13.9	42	25.8	48	29.4	73	44.8	
	August	79	6.4	24	34.3	20	28.6	26	37.1	
	September	66	5.3	20	33.3	18	30	22	36.7	
	October	131	10.5	41	35	34	29.1	42	35.9	
	November	210	16.9	79	41.8	56	29.6	54	28.6	
	December	290	23.3	116	44.8	78	30.1	65	25.1	
	January	*121*	*9.7*	50	42.4	35	29.7	33	28	

NHWh = Non-Hispanic White, Bl = Black/African-Americaan, HsL = Hispanic/Latino. DM = diabetes mellitus, HTN = hypertension, CAD = coronary artery disease, CHF = congestive heart failure, Afib = atrial fibrillation, COPD = chronic obstructive pulmonary disease, ILD = interstitial lung disease, OSA = obstructive sleep apnea, PH = pulmonary hypertension, ChrLung = chronic lung disease, CKD = chronic kidney disease, ESRD = end-stage renal disease, ChrLiver = chronic liver disease, HIV = human immunodeficiency virus, SolidOrgTx = solid organ transplant patient, ImmSupr = immunosuppressed. apINDPOV = categorical poverty variable, q_INDPOV = quintiles of poverty, q_ICE = quintiles of Index of Concentration at the Extremes, q_crowding = quintiles of percent crowded households.

patients were more likely to live in zip codes with the highest concentration of better-off social extremes (28% vs 7.6% for Bl and 5.1% for HsL), and were least likely to live in zip codes with the highest concentration of worst social extremes (14.6% vs 64.5% for Bl and 26.2% for HsL) ($P < 0.001$).

NHWh patients were more likely to be former smokers than Bl and HsL patients, who were more likely to have never smoked ($P < 0.001$). HsL patients were more likely to be uninsured (21.2%) than NHWh (6.0%) or Bl (4.7%) patients; on the other hand, NHWh (37.3%) and HsL (37.2%) patients were more likely to have private or employer-based insurance than Bl (33.0%) patients ($P < 0.001$).

The rates of comorbidities significantly varied by race/ethnicity. Bl patients had significantly higher rates of HTN (74.5%; $P < 0.001$), CKD (28.4%; $P < 0.001$), and end-stage renal disease (ESRD) (12.0%; $P < 0.001$) when compared with NHWh and HsL patients. HsL patients were significantly more likely to have a diagnosis of DM (50.6%; $P < 0.001$) or chronic liver disease (7.2%; $P = 0.017$) and had the lowest rates of congestive heart failure (CHF) (8.7%; $P < 0.001$), asthma (9.2%; $P = 0.001$), or obstructive sleep apnea (OSA) (4.3%; $P = 0.005$). NHWh patients had significantly higher rates of cardiovascular complications, such as coronary artery disease (CAD) (22.1%, $P < 0.001$) and atrial fibrillation (Afib) (17.4%; $P < 0.001$), as well as the pulmonary comorbidities of COPD (14.0%; $P < 0.001$) and chronic lung disease (17.9%; $P < 0.001$). Additionally, NHWh patients had significantly higher rates of malignancy history (29.0%; $P < 0.001$) than any other racial group.

Of note, the number of patients in each racial/ethnic group that was admitted to the hospital with COVID-19 varied significantly by month ($P < 0.001$). The highest proportion of Bl patients were admitted at the beginning of the pandemic in March (38.5%), while admission of HsL patients peaked in May and June (55.6% and 52.9%). The proportion of NHWh patients has been highest in the most recent months of this dataset: November (41.8%), December (44.8%), and January (42.4%) (Figures 1, 2).

Outcomes

Length of stay in the hospital averaged 8.4 d, with a median of 5 d. Of those who were dispositioned, 658 (57.3%) were discharged to home on self-care only; 234 (20.1%) were discharged to home with home health; 130 (11.4%) were discharged to a skilled nursing facility, to long-term acute care, or to a rehabilitation facility; and 10 (0.9%) left against medical advice.

In this cohort, 261 patients (21.0%) were admitted to the ICU, and 133 died (11.4%). Of the 133 deceased, 51 were NHWh (38.3%), 26 were Bl (19.5%), and 43 were HsL (32.3%). Of those admitted to the ICU, 79 were NHWh (30.3%), 63 were Bl (24.1%), and 98 were HsL (37.5%). Race/ethnicity did not achieve statistical significance as a predictor of ICU admission ($P = 0.067$) or death ($P = 0.078$) but trended toward higher ICU admission rates for HsL patients and higher case fatality rates for NHWh patients. There was no statistical difference in ICU admission or case fatality when comparing among apINDPOV ($P = 0.245$ for ICU admit, $P = 0.364$ for death), q_INDPOV ($P = 0.328$, $P = 0.362$), q_ICE ($P = 0.984$, $P = 0.73$), or q_crowding ($P = 0.514$, $P = 0.893$).

Patients reporting Spanish as their primary language were more likely to be admitted to the ICU than those who spoke English (32.6% vs 20.5%, $P = 0.001$). Similarly, 26.2% of HsL patients were admitted to the ICU compared with 20.6% of NHWh patients ($P = 0.069$). Patients admitted to the ICU were more likely to have been admitted to the hospital earlier in the pandemic ($P < 0.001$). Comorbidities associated with ICU admission were DM ($P = 0.016$), HTN ($P = 0.04$), Afib ($P = 0.028$), CKD ($P = 0.001$), and ESRD ($P = 0.003$) (Table 3).

On multivariable logistic regression, the associations between ICU admission and having a primary language of Spanish (odds ratio [OR]: 1.75; $P = 0.007$, reference English-speaking) remained significant. Moreover, admission to the ICU was significantly less likely in each successive month of the epidemic (OR: 0.88/mo; $P < 0.001$). The association with CKD (OR = 1.43; $P = 0.095$) did not maintain statistical significance on multivariable analysis but trended toward predicting ICU admission (Table 4A).

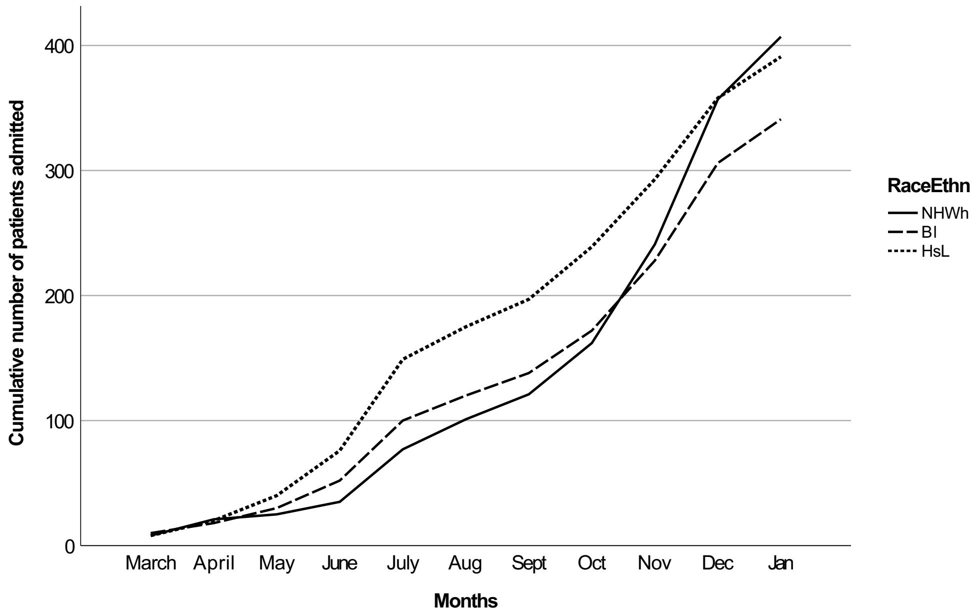

Figure 1. Timeline of admitted patients by race and ethnicity.

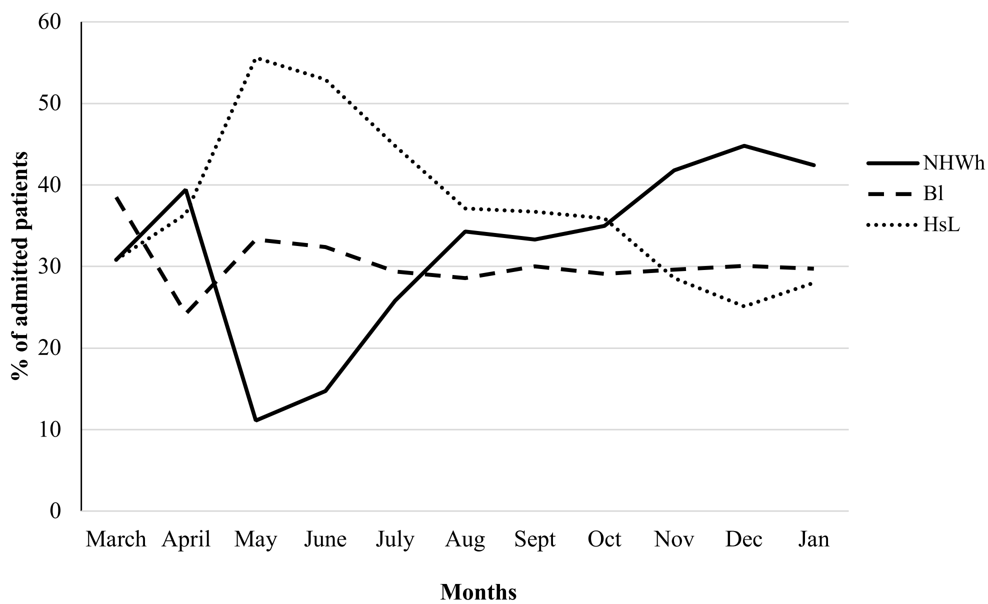

Figure 2. Percentage of patients admitted per month by race and ethnicity.

Deceased patients were more likely to be older (15.6% deceased among patients 65-84, contrasted with 3.5% among patients 18-39, $P < 0.001$), more likely to be former smokers compared with never smokers (16.4% vs 8.3%, $P < 0.001$), and less likely to have private insurance (6.6%) than Medicare (16.0%), Medicaid (10.1%), or no insurance (9.8%) ($P < 0.001$). Case fatality was also associated with HTN ($P < 0.001$), CAD ($P < 0.001$), CHF ($P = 0.001$), Afib ($P < 0.001$), COPD ($P < 0.001$), interstitial lung disease (ILD) ($P < 0.001$), pulmonary hypertension (PH) ($P = 0.002$), chronic lung disease ($P < 0.001$), CKD ($P < 0.001$), ESRD ($P < 0.001$), malignancy ($P < 0.001$), and solid organ transplants ($P = 0.012$) (Table 3).

On multivariable logistic regression, the case fatality associations in the age groups of 65-84 (OR: 4.48; $P = 0.007$) and 85+ (OR: 10.96; $P < 0.001$) were significant (reference category 18-39). PH (OR: 2.41; $P = 0.043$) and ESRD (OR: 3.28; $P = 0.003$) remained a significant predictor of case fatality. The association with ILD (OR: 2.64, $P = 0.088$) and malignancy (OR: 1.55; $P = 0.072$) did not achieve statistical significance but demonstrated a trend toward predicting case fatality (Table 4B).

Discussion

The Centers for Disease Control and Prevention (CDC) reports that Bl Americans are 2.9 times more likely to be hospitalized with and 1.9 times more likely to die of COVID-19 than NHWh persons. HsL persons are 3.1 times more likely than NHWh persons to be hospitalized and 2.3 times more likely to die.[20]

Table 3. Univariable analysis for predictors of ICU admission and death across comorbidity profile and socioeconomic factors in COVID-19 patients at CUH

		Total		Deceased			ICU admit		
				Total N = 133 (11.4%)			Total N = 261 (21.0%)		
		N	%	N	%	p-value	N	%	p-value
Race/Ethnicity	NHWh	407	32.7	51	13.5	0.078	79	20.6	0.069
	Bl	341	27.4	26	8.2		63	19.6	
	HsL	391	31.4	43	11.7		98	26.2	
Sex	Male	651	52.3	75	12.4	0.275	150	24.4	0.052
	Female	593	47.7	58	10.4		111	19.6	
Age range	18-39	183	14.7	6	3.5	<0.001	28	16.1	0.162
	40-64	531	42.7	41	8.2		112	22.0	
	65-84	456	36.7	66	15.6		103	24.1	
	85+	74	5.9	20	29.0		18	25.7	
Comorbidities	DM	536	43.1	65	13.3	0.094	128	25.5	0.016
	HTN	777	62.5	100	13.9	<0.001	176	24.0	0.04
	CAD	186	15	37	21.6	<0.001	41	23.6	0.614
	CHF	174	14	31	18.9	0.001	42	25.3	0.284
	Afib	134	10.8	28	23.5	<0.001	37	29.8	0.028
	COPD	96	7.7	22	24.2	<0.001	21	23.1	0.815
	Asthma	181	14.5	18	10.5	0.659	39	22.5	0.879
	ILD	45	3.6	13	32.5	<0.001	12	28.6	0.303
	OSA	102	8.2	13	13.1	0.584	23	23.0	0.821
	Pulm HTN	41	3.3	11	28.9	0.002	13	33.3	0.086
	ChrLung	140	11.3	32	24.6	<0.001	34	25.4	0.332
	CKD	231	18.6	46	20.8	<0.001	68	30.2	0.001
	ESRD	81	6.5	19	24.4	<0.001	28	35.4	0.003
	ChrLiver	62	5	10	16.7	0.193	19	31.7	0.067
	HIV	15	1.2	0	0.0	0.161	2	13.3	0.41
	Malignancy	243	19.5	41	17.9	<0.001	46	20.0	0.392
	SolidOrgTx	97	7.8	17	19.8	0.012	22	24.7	0.536
	ImmSupr	94	7.6	14	16.3	0.144	22	25.0	0.496
Language	English	1088	87.5	112	11.0	0.875	212	20.5	0.001
	Spanish	142	11.4	15	11.5		44	32.6	
Smoking status	Never smoker	807	64.9	63	8.3	<0.001	155	20.2	0.524
	Former smoker	352	28.3	53	16.4		79	23.9	
	Current some day smoker	23	1.8	3	13.6		4	18.2	
	Current everyday smoker	24	1.9	1	4.3		4	16.7	
Zip categories									
apINDPOV	0-4.9%	107	8.6	8	7.9	0.364	15	14.6	0.245
	5-9.9%	238	19.1	28	12.7		52	23.2	
	10-19.9%	487	39.1	59	12.9		109	23.4	
	20-100%	397	31.9	37	16.4		80	21.4	
q_INDPOV	[0,0.0656]	185	14.9	18	10.3	0.362	32	18.2	0.328
	(0.0656,0.146]	172	13.8	20	12.6		38	23.5	
	(0.102,0.146]	211	17	23	11.8		41	20.8	
	(0.146,0.21]	297	23.9	40	14.2		74	25.8	
	(0.21,1]	364	29.3	31	9.1		71	20.6	
q_ICE	(0.294,1]	184	14.8	20	11.6	0.343	36	20.7	0.962
	(0.176,0.294]	151	12.1	19	13.9		29	20.6	
	(0.0865,0.176]	127	10.2	11	9.2		28	22.6	
	(-0.0535,0.0865]	242	19.5	33	14.5		49	21.5	
	[-1,-0.0535]	525	42.2	49	10.0		114	22.8	
q_crowding	[0,0.0176]	173	13.9	20	12.8	0.893	36	22.4	0.514
	(0.0176,0.0283]	171	13.7	17	10.9		36	22.5	
	(0.0283,0.0516]	274	22	27	10.5		49	18.8	
	(0.0516,1]	625	50.2	69	11.7		140	23.4	

(*Continued*)

Table 3. (*Continued*)

		Total		Deceased			ICU admit		
				Total N = 133 (11.4%)			Total N = 261 (21.0%)		
		N	%	N	%	p-value	N	%	p-value
Insurance status	Uninsured	128	10.3	12	9.8	<0.001	31	24.8	0.277
	Medicaid	71	5.7	7	10.1		16	22.9	
	Medicare	578	46.5	85	16.0		129	23.8	
	Private/employer-based	456	36.7	28	6.6		82	19.0	
Date of admission range	March	28	2.3	3	10.7	0.062 (0.055, 0.068)	13	46.6	<0.001
	April	37	3	8	21.6		19	51.4	
	May	37	3	4	10.8		8	21.6	
	June	72	5.8	11	15.3		26	36.1	
	July	173	13.9	22	12.7		44	25.4	
	August	79	6.4	6	7.6		10	12.7	
	September	66	5.3	6	9.1		14	21.2	
	October	131	10.5	13	9.9		18	13.7	
	November	210	16.9	25	12.2		51	24.3	
	December	290	23.3	21.0	7.7		47	16.7	
	January	*121*	*9.7*	14.0	22.6		11	16.4	

RaceEthn=Race/ethnicity, NHWh=Non-Hispanic White, Bl=Black/African-Americaan, HsL=Hispanic/Latino. DM=diabetes mellitus, HTN=hypertension, CAD=coronary artery disease, CHF=congestive heart failure, Afib=atrial fibrillation, COPD=chronic obstructive pulmonary disease, ILD=interstitial lung disease, OSA=obstructive sleep apnea, PH=pulmonary hypertension, ChrLung=chronic lung disease, CKD=chronic kidney disease, ESRD=end-stage renal disease, ChrLiver=chronic liver disease, HIV=human immunodeficiency virus, SolidOrgTx=solid organ transplant patient, ImmSupr=immunosuppressed. apINDPOV=categorical poverty variable, q_INDPOV=quintiles of poverty, q_ICE=quintiles of Index of Concentration at the Extremes, q_crowding=quintiles of percent crowded households.

In Texas, from March 11 through December 8, 2020, APM Research Labs reports a mortality rate of 102 deaths per 100,000 in HsL, 69.4 per 100,000 in Bl, and 62.6 per 100,000 in NHWh.[2] Although HsL and Bl individuals consistently experienced a higher incidence of and worse outcomes due to COVID-19 throughout 2020, the mortality rate among NHWh persons in Texas surpassed that of Bl persons in early January 2021 (81.2 per 100,000 NHWh vs 78.5 per 100,000 Bl).[2]

Between March 17, 2020, and January 10, 2021, 1244 laboratory-confirmed COVID-19 patients were admitted to CUH from the ED. On average, NHWh patients were older than Bl and HsL patients. Bl and HsL were more likely to live in zip codes with a higher proportion of crowded households, associated with lower levels of economic and racial privilege, and with a higher proportion of poverty. NHWh patients were more likely to be former smokers than Bl and HsL patients, who were more likely to have never smoked. Overall, 3.9% of the study population reported that they are current smokers. These findings contrast with the general population in Texas, with 14.9% of adults reporting current tobacco use.[21]

Overall, 21.0% of patients in the present study had a stay in the ICU during their hospitalization, and 11.4% of patients who were dispositioned in this study died. The comorbidity-associated outcomes of these patients are consistent with prior literature, indicating a trend toward higher risk of severe disease with DM, HTN, Afib, CKD, and ESRD.[8] Deceased patients were more likely to be older, more likely to be former smokers compared with never smokers, and less likely to have private insurance than Medicare, Medicaid, or no insurance. On multivariable analysis, older age, and ESRD remained significant predictors of death even after accounting for potential confounders.

Upon both univariable and multivariable analysis, patients reporting Spanish as their primary language were more likely to be admitted to the ICU than those who spoke English. These findings are consistent with previous studies,[22–24] although the reasons for the association are unclear. It has been suggested that limited English proficiency restricts patients from accessing health care or understanding health information.[23] The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020, and, since then, public health messaging has been rapidly evolving. In Texas in particular, where 35.5% of households speak a language other than English at home,[25] state mask mandates and social distancing guidelines have been variable in messaging.[26–30] We postulate several mechanisms behind this disparity: rapidly evolving public health messaging was more easily lost in translation, directly or indirectly affecting disease incidence rates; additionally, barriers in translation and health literacy in the hospital could have affected outcomes once admitted.

Each successive month during the pandemic was associated with an overall diminishing likelihood of ICU admission (OR: 0.877; 95% confidence interval [CI]: 0.833-0.924). These findings are consistent with other ICU admission trends[31] and might suggest an improvement in the medical management of COVID-19. However, the same study indicates that, despite the decrease in ICU admission rates, the prognosis of ICU patients remains unchanged, pointing toward the importance of managing COVID-19 before infection.

This study suggests that admission from the ED to the hospital due to COVID-19 varies significantly by race and ethnicity depending upon timeline. Bl and HsL patients were more likely than NHWh patients to be admitted earlier in the pandemic timeline (March, April, May, June 2020), while NHWh patients were more likely to be admitted in the more recent months of data collection (December 2020, January 2021). Throughout the initial week of the COVID-19 U.S. outbreak, it was found that individuals who were Bl or living below the poverty level were less worried about COVID-19, less likely to believe they would become infected, and felt less prepared for an outbreak.[32] Additionally, knowledge about COVID-19 was shown to influence risk and behavior, such as purchasing more goods than usual or attending large

Tables 4A and 4B. Multivariable regression for predictors of ICU admission (A) and death (B) in COVID-19 patients at CUH

4A. Predictors of ICU admission

	Odds Ratio (95% Confidence Interval)	p-value
DM	1.24 (0.91 - 1.69)	*0.166*
HTN	1.15 (0.82 - 1.61)	*0.408*
Afib	1.40 (0.90 - 2.19)	*0.136*
PH	1.78 (0.88 - 3.62)	*0.109*
CKD	1.42 (0.93 - 2.17)	*0.104*
ESRD	1.33 (0.73 - 2.42)	*0.35*
Spanish-Speaking (ref: English)	1.78 (1.18 - 2.68)	***0.006***
Successive month (X - X)	0.88/later month (0.83 - 0.92)	*<**0.001***

4B. Predictors of case fatality

		Odds Ratio (95% Confidence Interval)	p-value
Age Range	*18-39 (ref)*	*reference*	–
	40-64	1.66 (0.6 - 4.58)	*0.329*
	65-84	4.48 (1.5 - 13.22)	***0.007***
	85+	10.96 (3.19 - 37.62)	*<**0.001***
Comorbidities	HTN	1.16 (0.67 - 2.01)	*0.599*
	CAD	1.47 (0.86 - 2.5)	*0.156*
	CHF	1.01 (0.57 - 1.8)	*0.969*
	Afib	1.43 (0.8 - 2.53)	*0.225*
	COPD	1.17 (0.4 - 3.44)	*0.782*
	ILD	2.64 (0.87 - 8.05)	*0.088*
	PH	2.41 (1.03 - 5.66)	***0.043***
	ChrLung	1.62 (0.53 - 4.94)	*0.397*
	CKD	1.49 (0.85 - 2.63)	*0.165*
	ESRD	3.28 (1.49 - 7.2)	***0.003***
	Malignancy	1.55 (0.96 - 2.51)	*0.072*
	SolidOrgTx	0.97 (0.48 - 1.94)	*0.925*
Smoking status	*Never*	*reference*	–
	Former smoker	1.22 (0.77 - 1.93)	*0.407*
	Current some day smoker	1.49 (0.26 - 8.58)	*0.656*
	Current everyday smoker	0.58 (0.07 - 4.52)	*0.601*
Insurance Status	*Private*	*reference*	
	Uninsured	1.46 (0.58 - 3.67)	*0.423*
	Medicaid	1.51 (0.55 - 4.13)	*0.424*
	Medicare	0.77 (0.41 - 1.45)	*0.415*

Significant predictors from univariable analysis were re-analyzed in multivariable regression models to assess for independent associations with ICU admission and death. DM = diabetes mellitus, HTN = hypertension, Afib = atrial fibrillation, CKD = chronic kidney disease, ESRD = end-stage renal disease. CAD = coronary artery disease, CHF = congestive heart failure, COPD = chronic obstructive pulmonary disease, ILD = interstitial lung disease, PH = pulmonary hypertension.

gatherings.[33] These social determinants of health might partially explain the disparities in COVID-19 infection and outcome seen among minority populations earlier in the pandemic timeline. It has also been suggested that reopening the economy in Texas on May 1, 2020, corresponded with spikes in daily new cases.[34] Another possible explanation might be tied to disparities in employment status, with Bl persons overrepresented in the health care and public safety sectors, HsL persons overrepresented in the food sector, and NHWh individuals more likely to work from home.[35]

Case fatality rates measure the deceased patients per confirmed cases, while mortality rates measure the deceased per population. It is more accurate to say that this study assesses case fatality rate, although it is unclear if the patient population presenting to CUH ED is broadly representative of infection trends in the Dallas-Fort Worth community. While data indicate that consistent racial/ethnic disparities exist in mortality rates, disparities in case fatality rates vary from state to state.[12,13,35–37]

In this study, race and ethnicity did not achieve statistical significance as a predictor of death or ICU admission, but trended toward higher ICU admission rates for HsL patients and higher case fatality rates for NHWh patients. Additionally, there was no statistical significance in ICU admission or case fatality when comparing categories of poverty, ICE, and household crowding. These findings indicate that racial/ethnic disparities in mortality rate may be attributed more to unequal infection risk than to hospital course upon admission.

Nuanced evaluation of specific subpopulations and settings on a community level is important in tailoring interventions to the specific community when addressing observed racial and ethnic disparities in pandemic outcomes. Several barriers to adopting pandemic interventions were identified during the 2009 influenza pandemic, including fewer financial resources, limited access to health care, and lack of tailored and culturally/linguistically sensitive education and communications.[38]

In light of the findings of this study, the lifting of business occupancy limits and mask mandates in Texas on March 11, 2021 (Texas Executive Order GA-34)[29] presents concern regarding its potential impact on all groups, especially those at increased risk of disease exposure. Thus, it is important to better understand the mechanisms of differential impacts of COVID-19 on a community- and state-wide level to mitigate the disease impact seen earlier in the pandemic. As incidence rates rise, local policy-makers and public health professionals must keep vulnerable populations in mind to minimize the racial and ethnic disparities of disease incidence. Addressing disparities on a community level will prove to be especially important as states move forward in vaccine rollout and distribution, which has already demonstrated significant racial/ethnic inequities.[39]

Health inequity is not caused by a single factor and likewise requires a multifactorial intervention strategy addressing root causes on both short- and long-term time frames.[4–6,40] Immediate recommendations to improve outcomes among Spanish-speaking individuals include culturally appropriate public health messaging in Spanish, improvement of translation services in hospitals, and health-care workforce communication skills education.[41] To prevent further disparities in disease incidence and mortality rates, it is important to pursue active engagement with and foster trust among minority communities, while improving access to health care and displaying cultural sensitivity both in mitigation interventions and vaccination efforts. In the long-term, it is recommended that local and national policy-makers pursue social and structural change addressing minority health extending through the COVID-19 pandemic and beyond.

Conclusions

The COVID-19 pandemic has revealed substantial variations in incidence and outcome across race and ethnicity. This study of the patients presenting with COVID-19 to a university hospital in a major metropolitan area indicates the need for culturally/linguistically sensitive interventions on a community level and policy addressing structural determinants of health on a national level. It is imperative that attention be given to mitigating disease incidence through effective public health messaging, fair and just health-care access, and far-reaching vaccination efforts.

Limitations

This study is limited by its retrospective nature and has a potential for selection bias. Several data points were inconsistently documented in patient records and were, therefore, not captured in our analysis. It is possible that patients admitted to the ICU may have had more robust work-ups, revealing underlying conditions that patients discharged directly to home may not have had, leading to an overrepresentation of comorbidities in the ICU group. Our cohort's proportion of uninsured patients (10.3%) and proportion of current smokers (3.9%) was much lower than the state average (29% uninsured, 14.9% current tobacco smokers), possibly due to a selection bias in our cohort, because our study only included patients who tested positive for COVID-19 from the public/private university hospital-associated ED. The presence of a large county hospital (Parkland Memorial Hospital) adjacent to the facility in this study may have caused influence in the patient population, leading to a patient sample less representative of the broader population in this metroplex. Thus, we suggest future studies span multiple centers in an effort to capture potential inequities in community-based settings such as were demonstrated in this study. Because decreased English proficiency was a significant indicator for ICU admission, it is recommended that further studies assess risk among patients speaking other primary languages common in Dallas, such as Chinese (Mandarin, Cantonese), Vietnamese, and Afro-Asiatic languages (Amharic, Somali). A comparison study comparing cohorts at the county hospital to the university hospital would be useful to address any demographic variability between the 2 institutions, including the surveillance of potential disparities in vaccine distribution and potential mitigation strategies.

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