Factors Associated with COVID-Related Mortality: The Case of Texas

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Abstract

Background. Texas ranks 3rd in the count of COVID cases. Pre-existing disparities in healthcare may be intersecting with COVID-19 outcomes.

Objectives. To explore the relationship between county-level race/ethnic composition and COVID-19 mortality in the state of Texas and determine whether county-level health factors, healthcare access measures, and other demographic characteristics explain this relationship.

Methods. This retrospective study uses county-level case and fatality data obtained from the Texas Department of State Health Services and merged with the 2020 Robert Wood Johnson foundation (RWJF) county health rankings data. The outcome variables were fatalities per 100,000 population. A two-part/hurdle model examined 1) the probability of having a COVID-19 fatality and 2) fatalities per 100,000 population in counties with 1+ fatalities. For both parts of the hurdle model, we examined the impacts of racial and ethnic composition, adjusting for county characteristics and health factors.

Results. The odds of having a COVID-19 fatality increased with a unit percent increase in the proportion of adults with diabetes (OR: 1.10, CI=1.00-1.21) and adults with fair or poor health (OR: 2.39, CI=1.28-4.48). In the second part of the model, there was a statistically significant increase in COVID-19 fatalities/100,000 population with every one percent increase in the proportion of Asians ($\beta = 81.29$; $p=0.001$) and African Americans ($\beta=74.73$; $p\text{-value}=0.027$).

Conclusion. Counties with higher rates of minorities, specifically Asian and African Americans, have a higher fatality burden. Targeted interventions are needed to raise awareness of preventive measures in these communities.

Introduction

The COVID-19 pandemic is by far the largest global health emergency in modern history. Over 2.6 million cases have been reported in the United States (US) resulting in excess of 130,000 deaths [1]. In addition to the sheer scale of the pandemic which has shown minimal signs of abatement, there are currently no approved cures or vaccines for COVID-19. Currently, state and federal governments have instituted stay-at-home mandates, handwashing, social distancing and respiratory hygiene to slow the spread of the virus. Early findings suggest that being male, age 50 and older, and having one or more underlying medical conditions are associated with a COVID-19 hospitalization. In a recent publication by the Centers for Disease Control and Prevention (CDC), 50 percent of all U.S. adults hospitalized for COVID-19 had hypertension as an underlying medical condition, 48 percent had obesity, 34 percent had chronic lung disease and 28 percent had diabetes [2]. While case fatality ratios by underlying condition are not reported, overall estimated fatality ratios ranged from 0.7% in Utah to 5.7% in Kentucky [3].

COVID-19 affects different states and cities in the US at varying intensities and timeframes. As of June 2020, Texas ranked 3rd in the number of total cases, a sudden rise from the 13th position only a month earlier. The numbers of cases in Texas reflects an upward trend throughout the months of May and June, and coincides with the expiration of statewide stay-at-home orders [4, 5]. In addition to the increasing numbers of cases being reported in Texas, the nationwide protests following the death of George Floyd in late May have drawn tens of

thousands to the streets of Texas in major cities such as Houston and Dallas as well as smaller communities [6], where people were in close proximity for hours, increasing the risk of COVID-19 transmission. COVID-related hospitalizations have also increased, reaching over 2000 hospitalized cases in the month of June [5]. Texas currently has over 1,400 ICU beds available and over 5,500 available ventilators [5], but the persistent increase in hospitalizations through the month of May and June is nevertheless concerning. Hospitals in the Texas Medical Center, the largest medical center in the world, have had to invoke surge planning as ICU capacity exceeded 100 percent [7].

Texas COVID-19 demographic data suggests that the majority of the COVID-19 cases have occurred in 20-59 years olds; however, nearly 40 percent of the deaths reported thus far have occurred individuals 80 and older [8]. The five counties with the most fatalities are home to major cities including Dallas, Houston, Fort Worth, Austin, and El Paso [8]. Although the concentration of fatalities is concerning, these counties also have increased hospital capacities, unlike some rural counties, where there are fewer per capita cases but the cases are increasing at a greater rate than metropolitan areas [9].

Many have suggested that prior existing disparities in healthcare, based on race, ethnicity, and rurality, may be intersecting with the COVID-19 pandemic to worsen the disease burden in vulnerable populations. Long-standing systemic inequities that people of color face have allowed for racial disparities to become magnified in the setting of this public health crisis. Recent racial data has revealed that COVID-19 is disproportionately impacting communities of color across the United States. Black Americans suffer a devastating mortality rate to COVID-19 at approximately 2.3 times as high as the mortality rate for their white counterparts, and though they only represent about 12.4 percent of the U.S. population, Black Americans make up over 23 percent of reported deaths related to COVID-19 [10]. In addition, Hispanic Americans are disproportionately testing positive for COVID-19 across most of the nation [11]. In Texas specifically, forty percent of cases and 26 percent of deaths have occurred in the Hispanic population; in the African American population in Texas, COVID-19 cases and fatality distribution are 16 and 13 percent respectively [8].

While these numbers are disturbing, it unfortunately is no surprise that racial minority groups are carrying the heaviest burden of disease in the current pandemic. Racial minorities make up approximately 41.2 percent of frontline workers in the United States, putting them at a significantly greater risk for COVID-19 exposure and subsequent infection than Americans who have the comfort of working from home [12]. Additionally, people of color face higher rates of unemployment and underemployment than white workers [13]. Thus, racial minorities may be more likely to take temporary occupational opportunities that may put them at a greater risk for COVID-19 exposure, like food delivery. Lower socioeconomic status due to unemployment or underemployment may limit the degree to which an individual can minimize their exposure to COVID-19 and socially distance from others. For example, low-income families that qualify for SNAP benefits in the United States have not been able to purchase their groceries online for delivery until recently, and even then, the list and locations of grocery stores that allow for this service is limited. Instead, some may have no choice but to enter a busy grocery store, thereby putting them at a greater risk for COVID-19 exposure.

In addition, chronic diseases, which are associated with increased severity and mortality in COVID-19, tend to be overrepresented in communities of color. Black and Hispanic Americans are disproportionately affected by chronic disease burden [14]. More specifically, multiple underlying chronic conditions, including type II diabetes, obesity, and hypertension, are significantly more prevalent in Black Americans than their white counterparts [15].

This disparity is further perpetuated by the gaps that exist in chronic disease management. A notable contribution to this gap is the fact that minorities are more likely to report higher levels of physician distrust [16], due in part to the deep history of racism in the practice of medicine that continues in the health care system today. Unethical research and experimentation on Black individuals, including but certainly not limited to the Tuskegee syphilis experiment, Henrietta Lacks' "immortal cells," and James Marion Sims' surgical experiments, have long exploited Black bodies to bring about medical advancement. The modern-day lack of trust in physicians by Black Americans is complex, but nevertheless relates to the lack of willingness to seek health care when they need it and contributes to the persisted burden of chronic disease.

The interplay between these sociodemographic factors demonstrates a need for population-level studies to evaluate determinants of COVID-19 fatality and to develop policies and strategies to prevent excess mortality in populations at greatest risk. To our knowledge, no study has analyzed the intersection of race/ethnicity, primary care availability and other health characteristics in relation to Texas COVID-19 deaths. This paper uses county-level COVID-19 fatality data to: 1) explore the relationship between county-level race/ethnic composition and COVID-19 fatality in the state of Texas and 2) determine whether county-level health factors, healthcare access measures, and other demographic characteristics explain this relationship. Findings from this study are especially important as Texas and other states have been forced to pause reopening due to burgeoning COVID-19 cases subsequent to relaxing stay-at-home mandates.

Methods

Data

Publicly available Texas COVID-19 case and fatality data (from March 04, 2020 when the first Texas case was detected, through May 28, 2020) were obtained from the Texas Department of State Health Services Center for Health Statistics COVID-19 Dashboard. Fatality Data on all 254 Texas counties are reported by date. This dataset was merged with the 2020 Robert Wood Johnson Foundation (RWJF) County Health Rankings data. The RWJF's County Health Ranking datasets contain demographic characteristics, economic, environmental and health-related factors to provide a better understanding of community context. Importantly, they provide county-level indicators of health behaviors, healthcare outcomes and factors that impact overall health. Because data was obtained from publically available sources, research procedures fit within one or more of the exemption categories in the federal institutional review board (IRB) regulations

Measures.

There were two outcomes of interest was 1) COVID-19 death (no (0), yes (1)) and 2) cumulative COVID-19 fatalities per 100,000 population in counties with one or more COVID-19 deaths. The independent variables of interest were county-level racial/ethnic composition, reported as percent non-Hispanic White, Black, American Indian/Alaska Native, Asian, Native Hawaiian/Other Pacific Islander and Hispanic. We controlled for health factors (tobacco use, obesity, diabetes, fair or poor health), healthcare access measures (insurance status and primary care physician rate) and other county-level demographics (high school graduation rate, unemployment, black-white segregation index and rurality).

Statistical Analyses.

Univariate analyses were used to report county-level economic, environmental and health-related characteristics. Because 59 percent of counties reported zero fatalities, a two-part/hurdle model was used to 1) examine the probability of a COVID-19 related mortality and 2) assess determinants of fatalities per 100,000 population in counties with one or more fatalities. For both parts of the hurdle model, we examined the impacts of county-level race/ethnic composition controlling for health factors, healthcare access measures and other county-level demographic characteristics. A total of four models were estimated as follows: i) Logistic regression model with COVID-19 related fatality (0/1) as the dependent variable, and proportion of racial/ethnic groups as the only independent variables, ii) Logistic regression model with COVID-19 related fatality (0/1) as the dependent variable, and proportion of racial/ethnic groups + healthcare access measures + other demographic characteristics as the independent variables; iii) generalized linear models with fatalities per 100,000 population as the dependent variable and proportion of racial/ethnic groups alone as the only independent variables, and iv) generalized linear models with fatalities per 100,000 population as the dependent variable and proportion of racial/ethnic groups + healthcare access measures + other demographic characteristics as the independent variables. Sensitivity analyses were performed using robust linear regression. All statistical tests were 2-sided, and findings were considered statistically significant at $P < .05$. All analyses were conducted using Stata 15.1.

Results

Table 1 shows descriptive statistics of the independent variables. The percentage of non-Hispanic Whites ranged from 2.69 to 89.4 (mean =55.34; std. dev.= 21.02), African Americans/Blacks ranged from 0 to 33.14 (mean =6.28; std. dev. =6.39) and Asians ranged from 0-20.79 (mean=1.35; std. dev. =2.09). The percentage of Hispanics ranged from 3.72 to 96.36 (mean =35.36; std. dev. =22.95). The percentage of smokers ranged from 10.64 to 19.87 (mean =14.94; std. dev. =1.56). Primary care physician rate ranged from 0-141.50 (mean =40.50; std. dev. 25.85).

Table 2 shows that the odds of a COVID-19 death increased with increasing proportion of Asians. Controlling for health factors (tobacco use, obesity, diabetes, fair or poor health), this association was no longer statistically significant. There was an increased likelihood of COVID-19 death with increasing proportion of county residents living with diabetes (OR= 1.10; 95% CI=1.00, 1.21) or fair/poor health (OR=2.39; 95% CI=1.28, 4.48).

Table 3 shows multivariable analyses of COVID-19 fatality/100,000 in counties with at least one COVID-19 death. There was a statistically significant increase in COVID-19 deaths/100,000 population with every one percent increase in the proportion of African Americans/Blacks ($\beta=168.88$; 95% CI=40.41, 297.34), Asians ($\beta=163.40$; 95% CI=30.73, 296.07), non-Hispanic Whites ($\beta=165.64$; 95% CI=38.75, 292.52), and Hispanics ($\beta=161.39$; 95% CI=37.22, 285.55). The fully adjusted model shows that county racial/ethnic composition remained statistically significant and increasing county African American/Blacks population remained associated with the highest number of deaths/100,000. There was an increased likelihood of COVID-19 deaths with every one percent increase in the proportion of African Americans/Blacks ($\beta=142.87$ (36.31, 249.44)),

Asians ($\beta = 148.39$; 95% CI=39.47, 257.31)), non-Hispanic Whites ($\beta = 133.16$; 95% CI=26.37, 239.95), Hispanics ($\beta = 129.29$; 95% CI=26.50, 232.09)). These associations were consistent on robust regression although the effect size was reduced.

Discussion

In this study, we examined disparities in COVID-19 related mortality, adjusting for demographic characteristics and health-related factors in Texas. To date, few studies have examined associations between county demographics, health characteristics and COVID-19 fatalities in Texas. Our findings suggest that while COVID-19 might be an equal opportunity disease, counties with higher proportions of African Americans and Asians experience significantly larger mortality rates in Texas. All races demonstrated significant associations with mortality, however, African Americans and Asians experienced significantly larger magnitudes of association with COVID-19 fatalities. These findings align with other racial/ethnic reports on COVID-19 morbidity and mortality that suggest minorities, including African Americans, Hispanics, American Indian, Alaska Native, and Pacific Islander populations bear a disproportionate burden of disease [17]. Mahajan & Larkins-Pettigrew (2020), in their analysis of all US states, observed a weak but significant correlation between African American race and COVID-19 related mortality, indicating that counties with a higher proportion of African Americans have higher COVID-19 fatalities [18]. They also found that Asian Americans experienced a significantly higher burden of COVID-19 cases and mortality [18].

Several underlying factors could contribute to the greater risk of COVID-19 fatality among African Americans. African Americans face higher rates of chronic disease prevalence (5) and report poorer outcomes on several health indicators, compared to their non-Hispanic white counterparts [19]. Importantly, before the COVID-19 pandemic, there were major health disparities ingrained into the system that disproportionately impacted minority populations, making them more prone to chronic diseases. The preexistence of these chronic diseases further puts these individuals at risk of infection from COVID-19. Chronic diseases such as diabetes, heart disease, and obesity occur mainly because of lifestyle and environment factors (Kolb H, Martin S. Environmental/lifestyle factors in the pathogenesis and prevention of type 2 diabetes. BMC Med. 2017;15(1):131. Published 2017 Jul 19. doi:10.1186/s12916-017-0901-x). However, one's lifestyle is not always created by choice. Many of these individuals work multiple jobs, leaving very little time or resources for them to prepare healthy meals at home, exercise daily, and/or get ample sleep, along with all the other obligations they may have. Many low-income neighborhoods also exist in areas without easy access to grocery stores that provide healthy eating options, or walkable neighborhoods (Child ST, Kaczynski AT, Fair ML, et al. 'We need a safe, walkable way to connect our sisters and brothers': a qualitative study of opportunities and challenges for neighborhood-based physical activity among residents of low-income African-American communities. Ethn Health. 2019;24(4):353-364. doi:10.1080/13557858.2017.1351923). In addition, African Americans are more likely live in densely populated areas where social distancing practices can be difficult to implement [20], making them more likely to contract the disease. Unfortunately, these inequities in these social determinants often result in healthcare being relegated a lower priority as more immediate concerns demand attention. These structural factors contributing to increased prevalence of chronic diseases in African American communities are then further exacerbated by a lack of trust in health care that exists due to historic injustices suffered by these populations.

Few studies have examined possible causes resulting in higher COVID-19 related mortality in Asian Americans. Abuelgasim et al (2020) postulated that the increased mortality in the Asian community may be correlated with the higher prevalence of comorbidities, such as heart disease, diabetes, and chronic kidney disease, all of which have been associated with more adverse COVID-19 outcomes, and more importantly, social factors such as a higher rate of multigenerational households that make it difficult to implement infection prevention practices[21]. However, this study was based on UK governmental data and may not apply to the United States. Further research is needed to identify contributors to excess mortality in Asian American communities.

In addition to the association with race/ethnicity, the presence of certain underlying medical conditions also portends higher risk of developing and dying from COVID-19 [22]. Our findings suggest that communities with higher proportion of adults with diabetes, and adults with self-reported fair/poor health had a higher likelihood of COVID-19 fatality. These findings are consistent with previous studies that reported greater mortality in patients with COVID-19 and diabetes [22]. For example, Kumar and colleagues reported a two-fold increase in mortality for diabetes patients, compared to non-diabetics [23]. The most significant increase in mortality, however, was in regard to self-reported fair/poor health, as defined by the CDC Healthy Days measure [24]. This is consistent with prior studies that have shown a correlation between COVID-19 outcomes and lower health-related quality of life [25], as well as poorer outcomes for patients who have comorbid hypertension, diabetes, cardiovascular disease and respiratory diseases [26]. Altogether, these findings suggest that COVID preys on those who are most vulnerable in our communities, which is probably exacerbated by the sub-optimal healthcare access experienced by members of these communities.

Unexpectedly, we also found that smoking was associated with lower odds of COVID-19 fatality, contrary to some preliminary reports that showed no significant change in mortality or significantly worse mortality for those who smoked [27, 28]. However, our analysis corroborates that of Miyara et al. who found that daily smokers had a significantly lower probability of developing severe COVID-19 cases [29]. Individual-level data may provide additional insights beyond this index study to allow researchers accurately capture the impact of smoking, and smoking intensity, on COVID-19 fatality rates.

Another key finding was that counties with higher proportions of adults 65 and older were less likely to report a COVID-19 fatality. We hypothesize that counties with a higher proportion of older adults over 65 may be less populated and/or in rural areas with reduced exposure to the virus. It is also possible that infected older residents may travel to other larger /urban counties for advanced hospital care and may succumb to the disease in these larger/urban counties. These fatalities will be reported as occurring in the large/urban counties where these critical care hospitals are located. Another explanation is that COVID-19 related messages highlighting risk in elderly may have prompted older adults to adhere more strictly to stay-at-home recommendations.

This study is not without limitations. First, our analysis is at the county-level, using county level aggregates of health factors (% adults with diabetes, % adults with obesity, % smokers), healthcare access (%uninsured, primary care physician rates), and other county-level demographic characteristics (% racial/ethnic composition American, % rural, % unemployed, high school graduate rate, % unemployed). Findings using county aggregates may not generate similar findings if individual level characteristics are modeled. Notwithstanding, these findings highlight the need for targeted interventions to raise awareness of preventive measures in these communities most significantly impacted by COVID-19. Although it has been said that this virus “does not discriminate”, the

setting of a global pandemic has only exacerbated disparities that already exist in our healthcare systems, making them more obvious and heightening the urgency to identify interventions to reduce health inequity.

Declarations

Funding

The authors have no funding sources to declare.

Conflicts of interest/Competing Interest

The authors have no conflicts of interest or competing interests to declare, financial or personal.

Availability of data and material

Publicly available data

Code availability

Stata codes are available

Author Contributions

Ojinnaka and O. Adepoju contributed to the study conception and design. Material preparation, data collection and analysis were performed by C. Ojinnaka and O. Adepoju. The first draft of the manuscript was written by A. Burgess. L. Woodard provided critical review for manuscript framing, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1: Summary Statistics of County-Level Characteristics

Variable	Mean	Std. Dev.
Percent Non-Hispanic White	55.34	21.02
Percent Black	6.28	6.39
Percent American Indian/Alaska Native	1.24	0.50
Percent Asian	1.35	2.09
Percent Native Hawaiian/Other Pacific Islander	0.10	0.13
Percent Hispanic	35.36	22.95
Percent Smokers	14.94	1.56
Percent Adults with Obesity	31.25	5.26
Percent Adults with Diabetes	11.36	4.62
Percent Fair or Poor Health	20.60	4.94
Percent Uninsured	21.21	4.05
Primary Care Physician Rate	40.50	25.85
High School Graduation Rate	93.65	5.67
Percent Unemployed	3.87	1.26
Black White Segregation Index	39.98	14.03
Percent Rural	55.36	31.94

Table 2: Logistic Regression Analyses of Probability of County-level COVID-19 Fatality

	OR (95% CI) Model 1	OR (95% CI) Model 2
Percent Black	1.41 (0.85, 2.31)	1.35 (0.65, 2.83)
Percent Non-Hispanic White	1.32 (0.80, 2.17)	1.46 (0.68, 3.12)
Percent Asian	3.74 (1.69, 8.25)	2.32 (0.86, 6.24)
Percent Hispanic	1.31 (0.81, 2.13)	1.21 (0.58, 2.52)
Percent Smokers		0.32 (0.13, 0.78)
Percent Adults with Obesity		0.99 (0.91, 1.08)
Percent Adults with Diabetes		1.10 (1.00, 1.21)
Percent Fair or Poor Health		2.39 (1.28, 4.48)
Percent Uninsured		0.90 (0.77, 1.06)
Primary Care Physician Rate		1.02 (1.00, 1.04)
High School Graduation Rate		0.98 (0.87, 1.09)
Percent Unemployed		1.04 (0.65, 1.65)
Black White Segregation Index		1.03 (1.00, 1.06)
Percent Rural		1.00 (0.97, 1.02)
Percent 65 Years or Older		0.66 (0.53, 0.82)

Table 3: Multivariable Regression Analyses of COVID-19 Deaths for Counties with at least One Death

	Linear Regression		Robust Regression	
	Model 1	Model 2	Model 3	Model 4
	Coef. (95% CI)	Coef. (95% CI)	Coef. (95% CI)	Coef. (95% CI)
Percent Black	168.88 (40.41, 297.34)	142.87 (36.31, 249.44)	69.55 (19.09, 120.01)	74.73 (15.16, 134.31)
Percent Non-Hispanic White	165.64 (38.75, 292.52)	133.16 (26.37, 239.95)	65.87 (16.03, 115.70)	70.74 (11.03, 130.45)
Percent Asian	163.40 (30.73, 296.07)	148.39 (39.47, 257.31)	65.04 (12.93, 117.15)	81.29 (20.40, 142.19)
Percent Hispanic	161.39 (37.22, 285.55)	129.29 (26.50, 232.09)	65.24 (16.47, 114.01)	70.63 (13.16, 128.11)
Percent Smokers		10.08 (-77.57, 97.74)		30.40 (-18.61, 79.41)
Percent Adults with Obesity		0.61 (-14.69, 15.90)		-2.00 (-10.55, 6.55)
Percent Adults with Diabetes		-3.23 (-19.17, 12.72)		-1.99 (-10.90, 6.93)
Percent Fair or Poor Health		20.71 (-38.56, 79.97)		3.81 (-29.33, 36.94)
Percent Uninsured		3.53 (-21.19, 28.25)		-4.10 (-17.92, 9.72)
Primary Care Physician Rate		-1.38 (-5.03, 2.27)		-1.80 (-3.84, 0.24)
High School Graduation Rate		-0.27 (-12.72, 12.18)		-2.75 (-9.71, 4.21)
Percent Unemployed		-76.91 (-155.64, 1.82)		-36.87 (-80.88, 7.15)
Black White Segregation Index		-1.19 (-6.73, 4.35)		-0.70 (-3.80, 2.40)
Percent Rural		-0.27 (-4.51, 3.97)		-0.60 (-2.97, 1.77)
Percent 65 Years or Older		12.42 (-15.96, 40.81)		9.68 (-6.19, 25.55)