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Diabetes & its Complications

The Relationship of Diabetes and COVID-19: A Health Disparity

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ABSTRACT

The COVID-19 pandemic has become one of the most devastating events in the world. It has been particularly severe in the United States relative to cases, hospitalizations, and deaths. As the pandemic has progressed in the United States it has become obvious that cases and deaths of COVID-19 are not randomly distributed in the population. A disproportionate number of cases and deaths have occurred in racial minorities. Underlying conditions may be contributing to COVID-19 deaths.

This study's objectives are to evaluate the number and rates of cases and deaths among racial minorities, identify the distribution of underlying conditions in COVID-19 cases and deaths, and to review the relationship of COVID-19 and diabetes. Diabetes, as well as several diabetes comorbidities, are considered health disparities among racial minorities.

The study findings concluded that the areas with high number of COVID-19 and high morbidity and mortality rates have a high percentage of Blacks in their populations. The percentage of Blacks in areas with the highest COVID-19 mortality rate is between 70.9% to 60.2 percent. The prevalence of diabetes in these areas ranges from 14% to 10 percent. The prevalence of obesity in these areas varies from 43.0% to 37.0 percent. Diabetes seems to be contributing to COVID-19 classification as an infectious disease health disparity.

Keywords

Diabetes, Obesity, Hypertension, COVID-19, Health disparity.

Introduction

The coronavirus 2019 (COVID-19) first emerged in late 2019 in Wuhan, China and, at first, seemed to be a problem far away for the United States. In early January 2020, China announced that Wuhan and other cities were locked down in attempt to stop the spread of the virus. Still, the United States deemed it a China problem, although travel to and from China was prohibited. It was thought that this would reduce the risk that the COVID-19 would not become a problem in the United States. But, despite these travel restrictions, it soon became evident that the COVID-19 was spreading throughout the world, including the United States. The United States is now in the midst of a pandemic that is arguably the worse ever experienced in the nation, as well as other countries in the world.

Preliminary studies in China have provided important information about the risks of infection, as well as the endpoints. These studies should be used to inform health care professionals who are fighting COVID-19. A retrospective cohort study evaluated laboratory confirmed cases of COVID-19 who were admitted to a hospital [1]. The study found that the median time from illness symptoms to death, which occurred in 28% of patients, was 18.5 days. Those who were discharged were hospitalized 22 days. Of the hospitalized patients nearly half had at least one comorbidity. Nearly 50% of those hospitalized had hypertension and diabetes as a comorbidity, with coronary heart disease found in 8% of patients.

Another retrospective study examined data from laboratory-confirmed cases across China. Over 1500 hospitalized patients in 31 hospitals were evaluated using endpoints of admission to an intensive care unit, invasive ventilation, or death [2]. Across the 31 hospitals, as many as 51% of these admitted presented with at least one comorbidity. The most common comorbidities were diabetes and hypertension. Data analysis confirmed the admission information that diabetes, hypertension, and other cardiovascular

diseases were notable comorbidities. Interestingly, none of the patients had physician-diagnosed asthma. The percentage of patients with renal disease or malignancy was relatively low. The presence of a comorbidity was most common in severe cases. As expected, those with comorbidities were older patients.

A meta-analysis of the prevalence of comorbidities in the COVID-19 infection evaluated eight studies [3]. The meta-analysis revealed that the most common comorbidities were hypertension and diabetes. Other comorbidities were cardiovascular disease and respiratory disease. The risk of COVID-19 infection was 2.36 times greater in severe cases who also had hypertension. Similarly, the risk factors for non-severe cases were hypertension and respiratory disease.

A recent study evaluated the effect of COVID-19 on the cardiovascular system in patients in China [4]. The study found that the pathogenesis of the disease was respiratory symptoms, some patients also experienced cardiovascular issues. The study found that those with current cardiovascular diseases were at higher risk for death if infected with COVID-19. A different study reviewed the clinical predictors of death in COVID-19 cases in Wuhan, China [5]. Data were abstracted from hospital records on 68 deaths and 82 discharged cases. The study found that the group of patients who died were significantly older than those who were discharged and 64% of the deaths had an underlying chronic disease. Cardiovascular disease was the underlying disease which significantly increased the risk of death.

Diabetes and cardiovascular disease are intimately linked. Studies have shown that diabetes is associated with development of cardiovascular disease, prematurely [6]. Previous research found that diabetes-related risk factors included dyslipidemia, hypertension, obesity and hyperglycemia, as well as insulin resistance. It has been shown that a major cause of deaths in patients with diabetes is cardiovascular disease [7]. Patients with type 2 diabetes (T2D) are 2 to 4 times more likely to develop coronary artery disease [8]. In fact, as insulin resistance is considered a component of metabolic disorders that are linked with an increased risk of cardiovascular disease and mortality [9]. The negative impact of diabetes on weakening individuals' immune system illustrates the link between the disease and being infected with COVID-19.

In a study of cardiovascular disease complications and diabetes, it was found that hypertension was the major cause of death [10]. Chronic hyperglycemia and insulin resistance are associated with the initiation of diabetes-related cardiovascular complications. The study found that hypertension is a major risk factor for diabetes-related cardiovascular complications, due to the vascular dysfunction that characterizes hypertension.

Studies have shown the prevalence of obesity and T2D continues to increase in the United States, and worldwide. This increase is particularly seen in lower-income individuals [11]. Hypertension prevalence in these subpopulations is increasing at a greater level [12]. To better understand the distribution of diabetes screening across the United States, a cross-sectional analysis was conducted [13]. The analysis evaluated diabetes screening on a national, regional, and state levels. One objective of the analysis was to determine if racial disparities affected screening. The distribution of diabetes across the United States is not random, but the prevalence is higher in non-Hispanic Blacks and American Indian/ Alaska Natives. Diabetes screening is lower across all racial groups compared to non-Hispanic Whites [14]. The study found a racial disparity in diabetes screening but could not explain these differences in screening across races.

The states of Georgia, Louisiana, and Michigan have areas which are hotspots of COVID-19 cases and deaths. A characteristic of the deaths from COVID-19 is the disproportionate number of minorities. This study will evaluate data from these areas with respect to COVID-19 comorbidities and the minority population. An objective of this study is to determine whether COVID-19, in conjugation with diabetes and its relationship with hypertension and obesity, is an example of an infectious disease health disparity.

Methods

COVID-19 data on the number of cases and deaths among non-Hispanic Blacks and Hispanics were acquired from state health departments. Information on comorbidities was also acquired from state health departments, when available. Crude rates of pathogenicity and virulence of COVID-19 were measured by the case fatality rate. The rates were, when possible, stratified by age, race, and comorbidity.

Results

The number of cases and COVID-19-related deaths were acquired from the health departments in Georgia, Louisiana, and the Michigan. These data were categorized by counties within each state which have shown a relatively high number of COVID-19 cases and deaths. It is important to note that the data presented is of April 16, 2020. The COVID-19 pandemic data is dynamic, but it is assumed that the rates of infection, death, and the underlying conditions will remain stable over time. Table 1 presents the number of cases, deaths, infection rate, mortality rate, and case-fatality rates in the states and counties.

Reviewing the morbidity rate (pathogenicity), so-called "hotspots" can be seen. Louisiana has a morbidity rate of 472.19 cases per 100,000 population, which is 68% higher than in Michigan and 84% greater than in Georgia. Compared to the U.S., the morbidity rate in Louisiana is nearly two times higher. The morbidity rate in the U.S. is 179.67 cases per 100,000 population and 484.68 cases per population in Louisiana.

Within each state "hotspots" can be identified. Dougherty County in Georgia has a morbidity rate of 1,506.44 cases per 100,000. This is significantly higher than other counties and the state average. In Louisiana, three parishes (counties) have morbidity rates greater than 1,000 cases per 100,000 population. Orleans Parish, whose major city is New Orleans, has the highest morbidity rate, closely

County	Population	Cases	Deaths	Morbidity Rate*	Mortality Rate*	Case-fatality Rate+
United States	362,239,523	650,833	32,707	179.67	9.03	5.03
Georgia	10,617,423	14,223	501	133.96	4.72	3.52
Fulton	1,063,937	1,916	63	180.09	5.92	3.29
Dougherty	87,956	1,325	83	1,506.44	94.37	6.26
DeKalb	759,141	1,227	17	161.63	2.24	1.39
Louisiana	4,648,794	22,532	1,156	484.68	24.87	5.13
Orleans	390,144	5,795	287	1,485.35	73.56	4.95
St. John	42,837	569	47	1,238.29	109.71	7.19
Caddo	240,204	1,118	57	465.44	23.73	5.09
Michigan	9,986,857	28,059	1,921	280.91	19.24	6.85
Wayne	1,749,343	5,408	409	309.14	23.38	6.52
Oakland	1,257,584	5,576	392	443.39	31.17	6.84
Macomb	873,972	3,792	330	433.88	37.76	7.02

Table 1: COVID-19 Cases, Deaths. Mortality Rate, Case-fatality Rate.
Sources: U.S. Census Bureau (http://www.census.gov/quickfacts).
Georgia Department of Public Health (http://www.dph.georgia.gov/covid-19-daily-status-report).
Louisiana Department of Health (http://www.ldh.la.gov/coronavirus).
Michigan Department of Health (http://www.michigan.gov/coronavirus).
*per 100,000 population.
+percent
Note: Data are of April 16, 2020.

followed by St. John the Baptist and Caddo Parishes. In Michigan, Wayne County, whose major city is Detroit, has the highest morbidity rate; three times greater than the average in Michigan.

Louisiana has the highest mortality rate (a measure of virulence) from COVID-19. The mortality rate in Louisiana is 1.46 times greater than in the U.S., four times higher than in Georgia, and nearly 16% higher than in Michigan. The case-fatality rate is highest in Michigan, closely followed by Louisiana. The case-fatality rate in Michigan is 36% higher than in the U.S., and 95% higher than the COVID-19 virulence in Georgia.

As was seen in morbidity rates, significant differences in both mortality and case-fatality rates can be seen in counties within states. Dougherty County, Georgia has the higher mortality rate of 94.37 deaths per 100,000 population. St. John the Baptist Parish, Louisiana has a mortality rate of 93.38 deaths per 100,000 population. Orleans Parish, Louisiana has a mortality rate of 65.54 deaths per 100,000 population, and Wayne County, Michigan's rate is 43.44 deaths per 100,000. The mortality rate of these four counties is significantly greater than the U.S., their states, and other counties.

St. John the Baptist Parish, Louisiana has the highest case-fatality rate (7.19% of cases died). Macomb County, Michigan's case-fatality rate is 7.02%. Wayne and Oakland Counties in Michigan has case-fatality rates of 6.52 and 6.84, respectively. Dougherty County, Georgia has a case-fatality rate of 6.26%, which is significantly greater than the state and other counties in Georgia.

An assumption of this study is that diabetes, and its related comorbidities, have a contributing effect on COVID-19 cases and deaths. Table 2 shows prevalence of diabetes and obesity, and cardiovascular disease (CVD) mortality rates. Louisiana's diabetes prevalence is 13%, compared to Georgia (12%) and Michigan (11%). These are higher than in the U.S. prevalence of 10.5 percent. The CVD mortality rate in the U.S. is 163.6 deaths per 100,000, which is less than in Georgia and Louisiana. Louisiana has the highest mortality rate (212.2 deaths per 100,000 population). The prevalence of obesity is 32.5% in Georgia, 36.8% in Louisiana, and 33.0% in Michigan.

County	Diabetes Prevalence*	CVD Mortality Rate+	Obesity*
United States	10.5	163.6	42.4
Georgia	12	175.8	32.5
Fulton	8	181	25.0
Dougherty	14	284	37.0
DeKalb	9	176	26.0
Louisiana	13	212.20	36.8
Orleans	10	255	30.0
St. John	10	290	43.0
Jefferson	13	293	33.0
Caddo	12	329	40.0
Michigan	11	157.8	33.0
Wayne	12	374	34.7
Oakland	8	307	24.7
Macomb	12.3	389	34.0

Table 2: COVID-19 Risk Factors.
Source: Centers of Disease Control and Prevention (http://cdc.gov/nchs/fastats/)
*percent
+per 100,000

The following countries have high prevalence of diabetes and obesity. Dougherty County, Georgia has a prevalence of diabetes and obesity is 14.0% and 37.0%, respectively. St. John the Baptist Parish, Louisiana has a lower prevalence of diabetes (10%), but an obesity prevalence of 43.0 percent. Wayne and Macomb Counties, Michigan have high prevalence of diabetes (12.0% and 12.3%, respectively) and obesity (34.7% and 34.0%). Macomb County, Michigan has the highest CVD mortality rate (379 deaths per 100,000).

Table 3 shows COVID-19 cases and deaths by race. Deaths, morbidity, and mortality rates are significantly higher in Blacks compared to Whites. In Georgia, the morbidity rate is nearly two times higher in Blacks. The mortality rate is 1.6 times higher in Blacks, 8.72 deaths per 100,00 population compared to 3.38 deaths per 100,000 among Whites. Interesting, the case-fatality rate was slightly higher in Whites in Georgia. In Louisiana, the number of deaths is almost twice higher in Blacks. The mortality rate is four times greater among Blacks (45.39 deaths per 100,000) compared to Whites (11.19 deaths per 100,000 population). The morbidity rate in Blacks is 2.4 times higher than in Whites in Louisiana. The case-fatality rate among Blacks is higher than in Louisiana Whites. The morbidity rate in Blacks in Michigan is 657.50 deaths per 100,000 population, which is almost 6 times higher than in Whites. The mortality rate is also nearly 6 times higher in Blacks. However, the case-fatality rate is higher in Whites (9.78% compared to 8.29%).

		Total Population	Blacks	Cases	Deaths	Morbidity Rate*	Mortality Rate*	Case-fatality Rate+
Blacks	Georgia	10,617,423	3,440,045	3,821	300	111.07	8.72	7.85
	Louisiana	4,648,794	1,520,156	13,293	690	874.45	45.39	5.20
	Michigan	9,986,857	1,408,147	9,259	768	657.5	54.54	8.29
Whites	Georgia	10,617,423	6,423,541	2,484	217	38.67	3.38	8.74
	Louisiana	4,648,794	2,924,085	7,526	350	257.38	11.19	4.65
	Michigan	9,986,857	7,919,578	7,856	768	99.20	9.70	9.78

Table 3: COVID-19 Population, Cases and Deaths, by Race.
Sources: U.S. Census Bureau (http://www.census.gov/quickfacts)
Georgia Department of Public Health (http://www.dph.georgia.gov/covid-19-daily-status-report)
Louisiana Department of Health (http://www.ldh.la.gov/coronavirus)
Michigan Department of Health (http://www.michigan.gov/coronavirus)
*per 100,000 population
+percent
Note: Data are of April 16, 2020

To illustrate the relationship of diabetes and its comorbidities, Table 4 presents the underlying conditions of COVID-19 deaths in Louisiana. Hypertension is the leading underlying condition in COVID-19 deaths, contributing to nearly 60% of deaths. Diabetes is the second most common underlying condition, contributing to 38.10% of deaths. Other significant underlying conditions are chronic kidney disease and obesity. Many of those who died due to COVID-19 had more than one underlying condition.

Condition	Percent
Hypertension	59.76
Diabetes	38.10
Chronic Kidney Disease	22.50
Obesity	22.26
Pulmonary Disease	12.98
Congestive Heart Failure	11.43
Cancer	20.71
Neurological Disease	9.17
Asthma	4.52

Table 4: Underlying Conditions of COVID-19 Deaths in Louisiana.
Source: Louisiana Department of Health (http://www.ldh.gov/coronavirus)
Note: Data are of April 16, 2020

Discussion

A troubling preliminary finding is that the COVID-19 may be another example of a health disparity. Briefly, a health disparity can be defined as a higher burden of an illness or death experienced by one group relative to others. Data from studies from China indicate that hypertension is a significant comorbidity for COVID-19 infection, and subsequent death. Both hypertension and diabetes are examples of health disparities in the United States [15].

Majority of COVID-19 deaths have occurred in Blacks in the U.S. Blacks have higher prevalence of diabetes, hypertension, cardiovascular disease, and obesity than their White counterparts. These chronic conditions are the same COVID-19 comorbidities found in the preliminary data from China. Georgia, Louisiana, and Michigan have relatively high prevalence of diabetes, hypertension, and obesity.

The findings of this study are that the relationship of diabetes, obesity, hypertension, cardiovascular disease, and chronic kidney disease has proven to be a lethal combination with respect to the COVID-19 pandemic. Specifically, in counties with a) a high percentage of Blacks, b) high prevalence of diabetes, c) high prevalence of hypertension and cardiovascular disease, and d) obesity have a disproportionate distribution of COVID-19 cases and deaths. St. John the Baptist Parish, Louisiana has the highest

mortality rate in the U.S. St. John the Baptist Parish's population is 57.8% Black. Additionally, the diabetes and obesity prevalence in St. John the Baptist Parish is 10% and 43.0%, respectively. Dougherty County, Georgia has the highest morbidity rate and second higher mortality rate in the U.S. Its population is 70.9% Black. The diabetes prevalence in Dougherty County is 14%, with an obesity prevalence of 37.0 percent.

Using Louisiana as an example, according to the America's Health Rankings 17.7% of adult Black citizens in Louisiana have diabetes; compared to 12.8% of Whites. Over 35% of Louisiana citizens who earn less than $45,000 a year have diabetes. Twenty percent of Louisianans who have completed high school have diabetes [16]. With respect to hypertension, Louisiana has a higher prevalence than the average in the United States. In Louisiana, 38% females and 40.4% males are hypertensive. As is seen in diabetes, more Blacks have hypertension than other races. Based on data from America's Health Rankings, over 50% of those who earn less than $25,000 annually are hypertensive. More than half of people who have not graduated from high school have hypertension. Over 60% of people in Orleans Parish are Black, and the median household income in New Orleans, according to the U.S. Census Bureau, is $38,721, with the average income per person equal to $29,275. These data illustrate the problem for Black citizens in Orleans [17].

While convenient to do so, comorbidity statistics should not be used in isolation to rationalize the poor health outcomes in Black and other vulnerable populations. Research on the Social Determinants of Health (SOD) presents compelling evidence on how inequities in socioeconomic factors such as education, income, housing, and social isolation play an undeniable role in creating vulnerabilities in these populations. Additionally, policies over multiple generations have set in motion structural and environmental inequities that can be linked directly to disparities in social determinants. Low levels of education are unlikely to create a pathway to a living wage and upward social mobility. Many in vulnerable populations work in low paying jobs without benefit of social distancing to protect themselves from exposure to COVID-19. Unjust environmental policies that expose populations to unsafe levels of pollution, is a clear example and could provide elements worth exploring how St. John the Baptist Parish, Louisiana, has the highest COVID-19 morality rate in the U.S. The Political Determinants of Health is a concept that helps to explain the impact of policies on the poor health of individuals and population [18].

Conclusion

If this study's findings are validated as this pandemic continues, COVID-19 may end up being an infectious disease which must be added to the list of health disparities that are challenges to public health and the health care system. It will become critical that the underlying conditions of COVID-19 deaths must be vigorously addressed to reduce the mortality associated with the pandemic. Diabetes prevention, treatment, and control of glycated hemoglobin (HbA1c) are areas that must be strengthened with added emphasis. This reveals the connection between infectious and non-communicable diseases.

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