Disparities in COVID-19 Rates Among Various Demographics and Lack of Racial Representation in Medical Texts

DiAngelo Gonzalez
Augustana College, Rock Island Illinois

RESEARCH

Disparities in COVID-19 Rates Among Various Demographics and Lack of Racial Representation in Medical Texts

DiAngelo Gonzalez

Abstract

Background: The 2019 novel coronavirus (COVID-19) outbreak, which originated in Wuhan, China in December of 2019, has impacted nations all over the globe. Given the health disparities which existed within the United States prior to the COVID-19 pandemic, this pandemic continued to pose a significant challenge to the health of the public. The aims of this research study were twofold: (1) to analyze the incidence rates of COVID-19 among different racial and ethnic groups within the United States and (2) to describe the occurrence of diversity within medical texts.

Methods: For Aim 1, a descriptive study design was utilized to identify incidence rates of COVID-19 among different racial and ethnic groups in some of the most populous counties in the United States on April 30, 2021. Data was obtained from the public health department websites of Los Angeles, King, Clark, Maricopa, and San Diego counties. A one-way ANOVA was used to gauge statistical significance between these categorical variables. Further, for Aim 2, various medical texts were analyzed to gauge representation of diverse populations within these texts. Data was obtained from the following medical texts: McMaster Textbook of Internal Medicine, Clinical Methods 3rd Edition: The History, Physical, and Laboratory Examinations; and StatPearls Online Text. Within each text, word choice pertaining to either dark-skinned patients or light-skinned patients was analyzed within chapters relating to cyanosis and pulse oximetry.

Results: Aim 1 showed a statistically significant difference between incidence rates and race as demonstrated by the one-way ANOVA ($F(5,23) = 5.5$, $p= 0.002$). Specifically, a Tukey post hoc tested showed that there was statistically significant difference between the following groups: White and Native Hawaiian/ other Pacific Islander ($p=0.009$); Asian and Native Hawaiian/ other Pacific Islander ($p=0.004$); Black and Native Hawaiian/other Pacific Islander ($p=0.031$); and Latino or Hispanic and Asian ($p=0.038$). The data obtained for Aim 2 was not sufficient enough to conduct any meaningful statistical analyses. A chi-square test for independence would have been used to compare the two variables to see whether the frequencies of these categorical variables differed significantly from one another.

Conclusion: Overall, the COVID-19 pandemic exacerbated health disparities within the United States. Understanding the magnitude of these disparities and the potential impact of medical education in reducing them is critical in improving the health of the general population. This study sought to achieve two research aims related to the complex intersectionality between race and disease outcomes. The data presented in this study shows that there is a statistically significant difference between incidence rates of COVID-19 and various racial and ethnic groups within the United States (Research Aim 1). While no statistical analyses were able to be conducted for research Aim 2, the preliminary data shows a stark difference in word choice used to represent dark-skinned population versus light-skinned populations. Frankly, these data show an overall disappointing inadequacy in the representation of diverse populations expected from an increasingly diverse nation.

Keywords: Disparities, COVID-19, Incidence rates, Demographics, Diversity, Medical Texts, Representation, Medical Equity

Introduction

The 2019 novel coronavirus outbreak which originated in Wuhan, China in December of 2019 has come to impact nations all over the globe. With existing health disparities in the United States prior to the COVID-19 pandemic, this pandemic continues to pose a significant risk to the public's health. This outbreak has been plagued by miscommunication from government officials, including variance in conciseness, clarity, and consistency of the information being presented. Thus, this miscommunication has added to public confusion and overall inaction [1]. The evident miscommunication by government officials and the overall misinformation present in the general public exemplifies an overall poor response on behalf of the United States to a situation which was constantly evolving. This miscommunication and misinformation have not only led to rampant spread of the virus within the United States, but it has also led to millions of infections and hundreds of thousands of deaths.

History of the SARS-CoV-2 Pandemic

In December 2019, an outbreak of a mysterious respiratory illness characterized by fever, dry cough, fatigue, and occasional gastrointestinal symptoms was reported in Wuhan, Hubei, China [2]. Most reported illnesses were clustered in a wholesale wet market, the Huanan Seafood Wholesale Market. Because of the high rate of infection among the staff (66%), the market was shut down on January 1, 2020 after the announcement of an epidemiological alert by the local health authority on December 31, 2019 [2]. The alert issued by the Chinese government on December 31, 2019 informed the World Health Organization (WHO) about the illness induced by the then unknown virus [3]. Within two months of the initial outbreak in Wuhan, China, the disease spread all over the world, reaching thousands of people in provinces and cities within China and to other countries such as Thailand, Japan, Republic of Korea, Vietnam, Germany, Singapore, and the United [2]. On March 11, 2020, the WHO declared the coronavirus disease (COVID-19) a pandemic. The illness was identified to be caused by the novel coronavirus, SARS-CoV-2 and had spread to over 140 countries [3]. By April 2020, the United States became the epicenter of COVID-19 with the country recording the highest number of officially confirmed cases of COVID-19 according to Johns Hopkins University [3].

At the time of this article, multiple variants of COVID-19 have emerged which have continued to pose a challenge to vaccine development. In the fall of 2020, the United Kingdom identified a variant which spread more easily and quickly—variant B.1.1.7. In October of 2020, officials in South Africa identified another variant which had similar characteristics to the U.K. variant and was identified as variant B.1.351. At the end of January 2021, officials conducting routine screening on travelers from Brazil in Japan identified the Brazilian variant P.1 [4]. Within the United States, Operation Warp Speed allowed for the rapid development of vaccines to combat the pandemic and to date, three vaccines have been given emergency by the Federal Drug and Food Administration (FDA): Pfizer-BioNTech, Moderna, and Johnson and Johnson [5, 6]. Other vaccines which are available worldwide but have not been given emergency authorization in the United States as of March 28, 2021 include the AstraZeneca/Oxford COVID-19 vaccine and the Sputnik V vaccine [6].

Human coronaviruses were first identified in the late 1960s, and prior to the 2003 severe acute respiratory syndrome (SARS) outbreak in Asia, only nineteen coronaviruses had been identified, with only two of the nineteen being human coronaviruses [7]. The 2003 SARS outbreak in Asia spread rapidly around the globe with a reported 8,000 infections and 776 deaths [7]. In 2012, a couple in Saudi Arabia was suspected to have been infected with a coronavirus—later named Middle East Respiratory Syndrome Coronavirus (MERS-CoV). Within that same year, the United Kingdom identified a male who traveled to Qatar and Saudi Arabia exhibiting symptoms of MERS-CoV [7]. By November 2019, the WHO stated that a total of 2,493 laboratory confirmed cases of MERS-CoV were reported globally [7]. Evidently, since their discovery, human coronaviruses have caused much dismay and to date represent a challenge to the public's health due to their potential for rapid global spread [8]. Further, these outbreaks illustrate the need for speedy and efficient global response mobilizations in order to protect the public's health [8].

COVID-19 Currently

Unlike the SARS-CoV-1 epidemic, which infected 8,100 persons in limited geographical locations within eight months, SARS-CoV-2 managed to infect millions of people and continues to spread rampantly around the globe—all within a period of five months [9]. According to Johns Hopkins University of Medicine, as of March 28, 2021, there have been 127,000,000+ confirmed cases of COVID-19 and 2,700,000 deaths globally [10]. Within the United States, there have been 30,260,000+ confirmed COVID-19 cases, with 550,000 deaths [10]. Given the basic reproductive number (R_0) of COVID-19 (which was calculated to be approximately 2.8) and the high rate of asymptomatic transmission of the virus, COVID-19 cases and deaths are predicted to continue to rise [9, 11]. Currently, asymptomatic transmission of COVID-19 and failure of governments to adequately respond to the virus makes the COVID-19 pandemic very difficult to contain.

Dr. Anthony S. Fauci, who was appointed as the director of the National Institute of Allergy and Infectious

Diseases (NIAID) in 1984, and his colleague stated that the past decade has seen many pandemic explosions. The two go on to state that the COVID-19 pandemic adds evidence to support the claim that the world has entered a pandemic era. Fauci and his colleague acknowledge that these situations are multifaceted, complex problems that must be taken seriously [12].

Ultimately, with an increase in globalization, COVID-19 is not the first and certainly won't be the last pandemic humanity will see. COVID-19 serves as a current example of the severity of pathogens and the problems that arise with their rapid spread around the globe. Given the destruction that COVID-19 has caused since its initial outbreak in Wuhan, China in December 2019, the world needs governments that are ready to efficiently respond to various outbreaks. Arguably, failure to contain SARS-CoV-2 resulted from various factors, with the precipitating factors including governments not being adequately equipped to handle a rapid influx of cases in their respective countries and a failure of governments to clearly and concisely communicate to their citizens the severity of the virus [1].

Differences in Attitudes, Perceptions, and Behaviors Regarding COVID-19 Between Various Racial and Ethnic Groups

Racial and Ethnic Disparities within the United States

Health disparities are differences in the incidence, prevalence, mortality, and burden of diseases and other adverse health conditions that exist among specific population groups [13]. These disparities can stem from health inequities, such as systematic differences in the health of groups and communities occupying unequal and unjust positions in society [14]. Race and ethnicity are two major characteristics of one's identify that can determine the types of health outcomes a person may experience. Weinstein et al. state that racial and ethnic disparities are some of the most persistent inequities over the years, despite many strides that have been made [14].

Within the United States, these health disparities among racial and ethnic groups are extremely evident. For example, it was found that overall mortality rates for Native Americans are almost 50 percent higher than that of their White counterparts, with the health and overall well-being of Native Americans reflecting a higher risk and higher rate of chronic diseases when compared to other racial and ethnic groups [15]. Similarly, obesity is a condition which has many associated chronic diseases and debilitating conditions which overall affects racial and ethnic minorities disproportionately. Moreover, heart disease and cancer are the leading causes of death across race, ethnicity, and gender, with African Americans being 30% more likely than Whites to die prematurely from heart disease and twice as likely as Whites to die prematurely from strokes [14].

Unfortunately, these health disparities are evident at the moment of birth for many minority populations. It was found that for indigenous populations, infant mortality rates are staggering. Native Americans and Alaska Natives have infant mortality rates which are 60% higher compared to their White counterparts [16]. Furthermore, in 2013 it was found that infants born to African American mothers experienced disproportionate rates of infant mortality, with the highest rate at 11.11 deaths per 1,000 births [13]. Although the rate of low birthweight infants remained essentially unchanged for White infants between 2008 and 2015, the rate of low-birthweight infants increased for African American and Hispanic infants [14]. It is evident that health disparities exist between various racial and ethnic groups, and although strides have been made to close these gaps, these disparities persist to this day

COVID-19 Health Disparities Between Racial and Ethnic Groups

These health inequalities can be exacerbated and made more evident in times of national crises. Such was the case with COVID-19, which has impacted every aspect of the United States from healthcare to employment. For example, in early April of 2020, Wisconsin and Michigan released data which showed stark racial disparities in rates of COVID-19 cases and deaths. In those respective states, it was found that the percentage of affected people who were African American was more than twice as high as the proportion of African Americans in the overall population [17]. This is a trend that is not unique to the COVID-19 pandemic. In fact, with past epidemics and natural disasters, it has been seen that some of the most socially marginalized populations will suffer disproportionality [17].

Furthermore, in a study published in the Radiological Society of North America journal, researchers sought to examine whether minority patients that were hospitalized with COVID-19 presented with increased severity on admission for chest x-rays when compared to White/ non-Hispanic patients [18]. The researchers used a retrospective cohort study and a sample size of approximately 140 White/non-Hispanic patients and 21 non-White patients.

Concerningly, the researchers found that non-White patients who were admitted to the hospital with confirmed COVID-19 infections were more likely to present with increased disease severity symptoms. Further, non-White patients were also seen to have a delayed presentation (i.e. time from presentation of symptoms to seeking care), low English proficiency, and higher rates of obesity—all factors which are consistent with lower socioeconomic status [18].

In another study published in the Journal of Public Health, researchers found that African Americans and Hispanics had increased rates of infection and mortality stemming from COVID-19. Although African Americans accounted for less than a third of the population in Chicago and Louisiana, they still represented >70% of COVID related deaths [19]. Likewise, in New York, Hispanics made up 29% of the population, yet they comprised 34% of COVID related deaths [19]. These findings exemplify the role that underlying social determinants of health, socioeconomic disparities, and pervasive racial disparities have in health outcomes within the United States [19].

In light of these findings, it is important to not report the disparities that occur within these populations without providing an explanation as to why this may be the case. Failure to provide explanations without the acknowledgement of the complexities associated with these disparities can perpetuate harmful myths and overall misinformation that can actually undermine the goal of eliminating health inequities [17]. Thus, in order to avoid the harmful myths of racial biology and behaviors associated with racial stereotypes, COVID-19 disparities need to be explained within the context of overarching socioeconomic factors. It is important to understand the impact that low socioeconomic status and chronic stress brought on by racial discrimination can have on individuals within these populations [17]. In sum, it is central to understand the complexities behind why certain health behaviors are practiced rather than blaming a certain population for these behaviors for no other reason than they belong to a certain demographic.

COVID-19 Attitudes and Perceptions Between Racial and Ethnic Groups

Undoubtedly, the health inequities and disparities that are seen today are exacerbated not only by COVID-19, but also by the types of information certain populations receive. The way in which messages are delivered affects peoples' ability to comprehend and trust the information they are receiving, which ultimately influences their enactment of these recommendations in their day to day lives.

COVID-19 messaging from government officials, including recommendations and guidance, has been spotty at best. The messaging received from government officials has varied greatly from state to state, with significant variance in conciseness, clarity, and consistency [1]. Multiple studies have been conducted whose aims were to gauge knowledge, attitudes, and perceptions among nationally representative samples of the United States population, with significant differences being observed between various racial and ethnic groups.

In a study by Alobuia et al. (2020), the researchers examined recent reports which indicated racial disparities in the rates of infection and mortality from the 2019 novel coronavirus [19]. The researchers sought to understand whether these disparities exist as a result of differences in knowledge, attitudes, and practices—or any combination of three. It was hypothesized that groups with high knowledge scores would be more likely to have better practices [19]. The study found that White respondents had a median (interquartile range) knowledge score of 16, compared with 14 among African American, Hispanic, and Asian/ multiracial respondents. Further, compared to the 70% of White respondents with a high knowledge score, only 25% of African American, 41% of Hispanic, and 48% of Asian/ multiracial respondents had a high knowledge score of COVID-19 [19]. Interestingly, the researchers found that despite having lower average knowledge scores and reporting more negative experiences related to COVID-19, people of minority racial/ethnic backgrounds were more likely to report engaging in better practices to reduce their risk of becoming infected with COVID-19. Despite reporting higher levels of better practices to reduce the risk of becoming infected with the virus among minority populations, the fact that they are disproportionately affected by COVID-19 indicates that these imbalances could be the result of other underlying systemic factors.

Wolf et al. (2020, p. 1) conducted a study aimed at determining the awareness, knowledge, attitudes, and related behaviors toward COVID-19 among adults within the United States who were more vulnerable to complications because of their age or comorbid conditions [1]. The researchers utilized a cross-sectional survey linked to three active clinical trials and one cohort study, all based in Chicago, Illinois. It was found that African American participants were more likely than White participants to report that they were "not worried at all" about contracting COVID-19 [1]. Women, African American and Hispanic persons, those with low English proficiency, those living below the poverty level, those with lower health literacy, and those who were unmarried were significantly more likely to respond that they were "not at all likely" to contract COVID-19. Furthermore, adults living below the poverty level rated COVID-19 as less serious than those with higher incomes [1]. Overall, participants who were older, African American, unmarried, unemployed, or retired, had poorer health, or that had lower health literacy showed poorer knowledge of COVID-19 and were less likely to make changes to their everyday lives as a result of the novel coronavirus [1]. These findings are cause for concern because populations with low health literacy towards COVID-19 can be more likely to spread the virus (through no fault of their own) and can ultimately contribute to the health disparities and outcomes that are observed between different racial and ethnic groups.

Lastly, in another article published in the Journal of Medical Internet Research, the researchers examined similarities and differences in COVID-19 awareness and concern by race and ethnicity [19] The researchers conducted a cross-sectional survey between the months of March and April. Overall, it was found that there were differences between these populations in regard to understanding and utilization of different COVID-19 prevention methods [20]. Specifically, it was found that Hispanic and non-Hispanic African American participants were more likely to report that "it was somewhat likely, likely, or very likely" that they currently had COVID-19 compared to Asian and non-Hispanic White participants [20]. Given that African American and Hispanic persons were typically found to have lower health literacy regarding COVID-19 it makes sense as to why these two groups were more likely to believe that they were infected with COVID—even if this was not necessarily the case [1]. Because a lower health literacy translates to an inability for a person to identify whether he or she is infected with the virus, those with lower health literacies would be unable to accurately identify symptoms and understand how COVID-19 is spread. For example, it was found that Asian and non-Hispanic Whites and groups with higher health literacies were more likely to correctly estimate the number of COVID-19 cases when compared to African Americans and Hispanics [20].

Diversity within Medical Texts and Trainings

After review of the existing literature surrounding COVID-19's impact on various racial demographics, disparities in infections and outcomes inarguably exist within these populations. As previously mentioned, Alobuia et al. (2020) found that although people of minority racial and ethnic backgrounds were more likely to report engaging in better practices to reduce their risk of becoming infected with COVID-19, these populations were still disproportionately affected [19]. If minority populations are more likely to engage in safer practices to reduce their risk of infection, then how is it possible that COVID-19 is disproportionately affecting them? This paradox could possibly be explained in terms of larger issues within our healthcare infrastructure. Specifically, inadequacies in the way our healthcare system represents people of minority populations and those of darker skin tones.

This study will examine two ubiquitous medical techniques employed for the identification of severe distress in COVID-19 patients: the use of pulse oximetry and the identification of cyanosis [21, 22]. Pulse oximetry is a medical technology which measures arterial oxygen saturation levels, and which indicates the percentage of hemoglobin binding sites occupied by oxygen [22]. In recent years, questions about pulse oximetry have been raised, given that the original development of this technology was aimed at populations that were not racially diverse [23]. Regarding arterial oxygen saturation, a common identifier of low arterial oxygen saturation is a condition known as cyanosis—a biological response to poor blood circulation or inadequate oxygenation of the blood [24].

While technologies such as pulse oximetry and diagnostic criteria such as the identification of cyanosis are utilized to help in the reduction of morbidity and mortality in COVID-19 patients, existing articles shows that current racial biases exist in real-world applications and may be furthering the disparities in COVID-19 morbidity and mortality among minority populations. In principle, a medical device is said to be biased when it shows undesirable variations in performance among various demographic groups [25]. As previously mentioned, one such optical biosensor which uses light to monitor vital signs is the pulse oximeter which can be used to diagnose hypoxemia, or low levels of arterial oxygen—a symptom indicative of severe COVID-19 manifestation [25]. To measure blood oxygenation in a patient, a pulse oximeter uses two colors of light: one in near-infrared and another in visible light. However, it was found that dark skin tones respond differently to the different wavelengths of light.

In a study involving patients receiving supplemental oxygen at the University of Michigan Hospital and patients in intensive care units (ICUs) at 178 hospitals, it was found that 90 patients out of 750 had an arterial oxygen saturation of less than 88% even though their pulse oximeter showed an oxygen saturation of 92-96% [23]. When compared to White patients who only showed a 3.6% difference in actual oxygen saturation versus oxygen saturation outputted by the pulse oximeter, 11.4% of black patients showed inconsistencies between actual versus measured oxygen saturation levels [19].

In addition to the use of pulse oximetry, cyanosis is another characteristic aimed at helping to identify COVID-19-related complications [26]. Although a problematic definition, for the purpose of this study, cyanosis is defined as a bluish discoloration of the skin resulting from poor circulation or inadequate oxygenation of the blood. The very fact that bluish discoloration is included in the definition of a significantly dangerous medical condition exemplifies the need for diversification of medical texts. In a study published in the British Journal of Dermatology, the researchers examined the issue of an absence of images of skin color in publications of COVID-19 skin manifestations—such as cyanosis [27]. Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), researchers analyzed articles describing cases of cutaneous manifestations associated with COVID-19. After completion of the analysis, the researchers found that cutaneous manifestations of COVID-19 showed almost exclusively clinical images from patients with lighter skin [27]. When looking at the physicians' responses to their

perceived adequacy in diversity training, 47% of patients reported that training involving patients with darker skin tones was inadequate and lacking [27].

Summary and Importance for Proposed Study

As depicted by these studies, it is evident that there are differences in attitudes and perceptions regarding COVID-19 between various racial and ethnic groups. It was consistently found that minority populations, specifically African American and Hispanic populations, exhibited lower health literacy levels regarding COVID-19, had lower knowledge scores, were more likely to believe they would not contract COVID-19, and were less likely to make changes to their everyday lives because of the pandemic [1, 17, 19, 20]. As stated earlier, it is important to not report these findings without explanatory background as doing so can perpetuate harmful myths and misunderstandings regarding these specific populations. Instead, public health officials should target material source deprivation caused by low socioeconomic status or chronic stress brought on by racial discrimination [17]. Being able to educate these populations on COVID-19, including how it is spread, its symptoms, and the seriousness of the virus will be crucial in combatting future waves of COVID-19. It is important to understand the complexities associated with different demographics to help curb the spread of future outbreaks. By understanding how different populations respond to these outbreaks, public health officials will be able to better target these populations in order to implement plans that are specific to certain demographic groups.

It cannot be overstated that our medical system needs to enter an era in which it strives to achieve medical equity in both the technologies that are utilized and the diagnostic processes that are implemented. Multiple studies exist within the literature which depict flaws in the differential diagnosis process of COVID-19 and in fundamental technologies which are essential in the treatment of the disease. Provided that oxygen is among the most frequently administered medical therapies and which is adjusted according to pulse oximetry, it is essential that we achieve technology equity in an intentional effort to lower disparities in poor racial health outcomes. Given that hypoxemia is identified through pulse oximetry and is directly related to morality, such a biased medical device could lead to disparate outcomes for minority populations, especially those with dark skin. Furthermore, understanding that skin diseases manifest differently in patients, knowledge of cutaneious manifestations of COVID-19 (such as cyanosis) and the ability to identify them in patients of all skin types is critical for healthcare providers evaluating patients who may be infected with the virus. The approach that our current medical system is taking toward diagnosing and treating COVID-19 positive patients will not change overnight. However, the first step toward combatting the disparities that we're are seeing in COVID-19—and other diseases—is acknowledging that an issue exists. Understanding how medical texts are teaching the doctors of tomorrow will pave the way for equal and equitable representation of various populations within the medical community.

Methods

Design and Sources

Research Aim 1

Research Aim 1 utilized a descriptive study design which identified incidence rates of COVID-19 among different racial and ethnic groups in some of the most populous counties in the United States on April 30, 2021. Data for this Research Aim was obtained from the public health department websites of the respective counties. The following counties were analyzed: Los Angeles County, King County, Clark County, Maricopa County, and San Diego County. Overall, Research 1 explored the relationship that existed between race and ethnicity as it relates to the incidence of COVID-19.

Research Aim 2

Research Aim 2 aimed to analyze existing medical texts in an effort to gauge representation of diverse populations within these texts. Specifically, the following medical texts were analyzed: McMaster Textbook of Internal Medicine; Clinical Methods 3rd Edition: The History, Physical, and Laboratory Examinations; and StatPearls Online Text. Given the focus of the study, only sections on cyanosis and pulse oximetry within these texts were analyzed.

Data Sources

County Public Health Department Websites

Since the onset of the pandemic, public health departments kept track of data pertaining to COVID-19, including data on case fatality rates, incidence rates, and hospitalization rates. As such, the counties which were analyzed in this study all had public health department websites which made obtaining information regarding COVID-19 incidence rates by demographics easily accessible.

Medical Texts

To gauge diversity representation in present day texts, three textbooks were chosen on the basis of online accessibility and are as follows: McMaster Textbook of Internal Medicine; Clinical Methods 3rd Edition: The History, Physical, and Laboratory Examinations; and StatPearls Online Text. The McMaster Textbook of Internal Medicine is a Canadian textbook which was developed at McMaster University—one of the leading medical schools in the world [28]. It is stated that the textbook was created to meet an increasing demand for access to reliable

information by medical professionals. Similarly, Clinical Methods 3rd Edition: The History, Physical, and Laboratory Examinations is a medical text which emphasizes the more basic aspects of clinician-based practices. Given that it is now in its third edition, the text has undergone substantial revisions in regard to content and organization. The last text is an online text made available by StatPearls, a company which markets its content towards medical students and those preparing for various medical certifications.

Key Variables

Research Aim 1

Information gathered from the websites of various county public health departments was used to fulfill Research Aim 1. The variable of interest was race/ ethnicity, with each county reporting its data using the following racial/ ethnic categories: Latino/Hispanic, American Indian/Alaska Native, Asian, Black/African American, Native Hawaiian/ Other Pacific Islander, and White. These categories were consistent with those found in other governmental surveys and questionnaires, including those in the Behavioral Risk Factor Surveillance System [29].

Research Aim 2

Information gathered from the aforementioned texts were used to fulfill Research Aim 2. The variable of interest for this aim was word choice within the various texts. Specifically, word choice pertaining to either dark skinned patients or light skinned patients was analyzed within chapters relating to cyanosis and pulse oximetry. Word choices such as "darker skin pigmentation", "people of color", and "deeply pigmented" are examples of phrases representative of darker-skinned populations. Contrastingly, word choices such as "light skin" and "bluish discoloration" are examples of phrases representative of lighter-skinned populations.

Data Analysis

Research Aim 1

Incidence rates (per 100,000 people) for each demographic group was obtained from the various county public health department websites. The data from these websites allowed for the identification in the distribution of cases by race and ethnicity. Given that these data were ultimately proportions, a one-way ANOVA was used to determine if there were any statistical significances between these categorical variables.

Research Aim 2

Data obtained for Research Aim 2 was used to understand how often people of different skin tones were mentioned or described in numerous medical texts. To gauge representation in these texts, a simple frequency count of the number of times these word choices are used was tallied. This was compared to the number of times phrases which are typically associated with lighter skin-tones were mentioned (e.g. bluish coloration).

Potential Study Limitations

Research Aim 1 and 2

With regards to study limitations, a similar limitation is present in both research Aims 1 and 2. Utilization of data from only five of the most populous counties provided a very limited amount of data and may not be entirely representative of the entire United States. Similarly, given budget constraints and lack of access to more medical textbooks, analyzing only three medical texts yielded limited data and may not be representative of the training received by medical students and others in the medical field. Thus, this study is limited in that it may not acquire a true snapshot of how diversity is represented in the medical field.

Study Strengths

While many articles analyzing race and ethnicity as it relates COVID-19 are beginning to emerge, this study further adds to the understanding of the complex dynamics of race and COVID-19. Understanding these subtleties will allow public health officials to better target certain demographics throughout the United States. Furthermore, this study offers insight into the significantly limited body of literature surrounding diversity within medical texts and training. Such insight is crucial in drafting texts which are representative of the diverse communities the medical field encounters daily.

Results

Research Aim 1

Using IBM® SPSS Statistics, a one-way ANOVA was conducted to understand the relationship, if any, between incidence rates and various racial groups. There was a statistically significant difference between incidence rates and race as demonstrated by the one-way ANOVA ($F(5,23) = 5.5$, $p = 0.002$). Specifically, a Tukey post hoc tested showed that there was statistically significant difference between the following groups: white and Native Hawaiian/ other Pacific Islander ($p=0.009$); Asian and Native Hawaiian/ other Pacific Islander ($p=0.004$); black and Native Hawaiian/other Pacific Islander ($p=0.031$); and Latino or Hispanic and Asian ($p=0.038$). There was no statistically significant difference between any of the other racial groups and their respective incidence rates.

Research Aim 2

Research Aim 2 utilized a simple frequency count for the number of times word choices which represented diverse populations and the number of times word choice which represented light-colored populations was made for

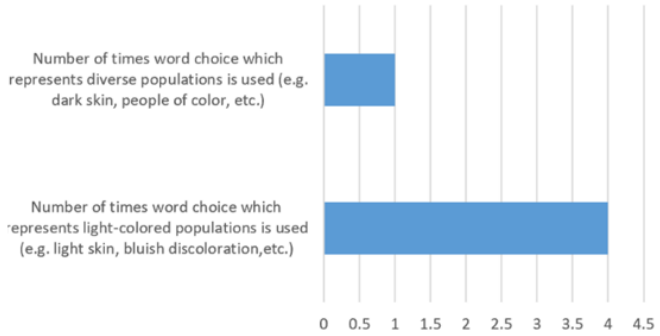

Figure 1. Differences in word count frequencies of word choice representing diverse populations vs. word choice representing light-colored populations in McMaster Textbook of Internal Medicine.

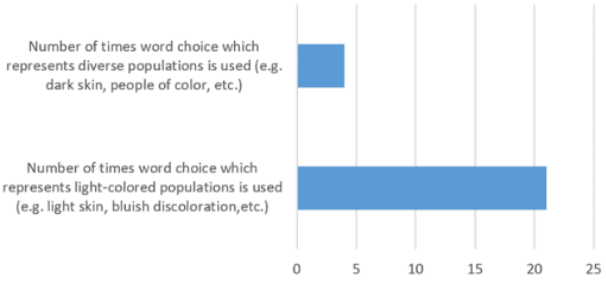

Figure 2. Differences in word count frequencies of word choice representing diverse populations vs. word choice representing light-colored populations in Medical Methods 3rd Edition: The History, Physical, and Laboratory Examinations.

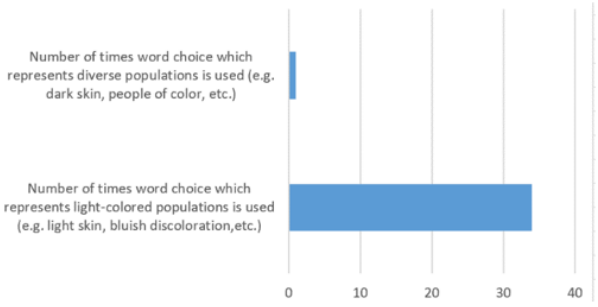

Figure 3. Differences in word count frequencies of word choice representing diverse populations vs. word choice representing light-colored populations in StatPearls Online Text.

each of the respective texts. Data for this research aim was tabulated and a bar graph depicting these differences was created. McMaster Textbook of Internal Medicine used word choice which represented lighter-skinned populations four times as opposed to the one instance that word choice which represented darker-skinned populations was used (see figure 1). Medical Methods 3rd Edition: The History, Physical, and Laboratory Examinations text used word choice which represented lighter-skinned populations 21 times as opposed to four instances that word choices which represented darker-skinned population were used (see figure 2). The last text used word choice which represented lighter skinned populations 34 times as opposed to the one instance that word choice which represented darker-skinned populations was used (see figure 3). Interestingly, of the three texts, StatPearl's online text was the only text which acknowledged the inaccuracy of pulse oximetry in darker skinned patients. As mentioned in the study limitations section of this study, the data obtained for this section was not sufficient enough to conduct any meaningful statistical analyses. A chi-square test for independence would have been used to compare the two variables to see whether or not the frequencies of these categorical variables differed significantly from one another.

Conclusion

This study sought to achieve two research aims related to the complex intersectionality between race and disease outcomes. The data presented in this study shows that there is a statistically significant difference between incidence rates of COVID-19 and various racial and ethnic groups within the United States (Research Aim 1). While no statistical analyses were able to be conducted for research Aim 2, the preliminary data shows a stark difference in word choice used to represent dark-skinned population versus light-skinned populations. Frankly, these data show an overall disappointing inadequacy in the representation of diverse populations expected from an increasingly diverse nation.

Current studies in the literature exemplify differences in the attitudes, perceptions, and behaviors among various populations throughout the United States. Further, it is also known that COVID-19 is affecting case, hospitalization, and death rates among minority populations—especially Latino and black Americans—at

disproportionate rates. The pairing of differences in these attitudes, perceptions, and behaviors and overall lack of representation of minority populations in medical texts illustrates that an overhaul of the fields responsible for ensuring the health of the public is long overdue. Public health and the medical field alike need to strive for information and medical equity in order to meet the demands of an increasingly globalized world. Further research is needed to gauge the true extent to which minority populations are or are not being represented in various parts of the medical field.

Acknowledgements

The author would like to express gratitude to his mentor and professor, Dr. Rebecca Heick, for her unwavering support and dedication. The author would also like to thank the Department of Public Health at Augustana College for their commitment to the success of its students.

References

1. Wolf, M., Serper, M., Opsasnick, L., O'conor, R., Curtis, L., Benavente, J., . . . Bailey, S. (2020). Awareness, attitudes, and actions related to COVID-19 among adults with chronic conditions at the onset of the U.S. Outbreak. Annals of Internal Medicine, 173(2), 100-109. doi:10.7326/m20-1239
2. Wu, Y. C., Chen, C. S., & Chan, Y. J. (2020). The outbreak of COVID-19: An overview. *Journal of the Chinese Medical Association : JCMA*, *83*(3), 217–220. https://doi.org/10.1097/JCMA.0000000000000270
3. Niepel, C., Kranz, D., Borgonovi, F., Emslander, V., & Greiff, S. (2020). The coronavirus (COVID-19) fatality risk perception of US adult residents in March and April 2020. *British journal of health psychology*, *25*(4), 883–888. https://doi.org/10.1111/bjhp.12438
4. Centers for Disease Control and Prevention. (2021). About variants of the virus that causes COVID-19. Retrieved March 29, 2021, from https://www.cdc.gov/coronavirus/2019-ncov/transmission/variant.html
5. Operation Warp Speed: Accelerated COVID-19 Vaccine Development Status and Efforts to Address Manufacturing Challenges. (2021, February 21). U.S. Government Accountability Office. https://www.gao.gov/products/gao-21-31
6. *Different COVID-19 Vaccines*. (2021, March 4). Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines.html
7. Yang, Y., Peng, F., Wang, R., Yange, M., Guan, K., Jiang, T., Xu, G., Sun, J., & Chang, C. (2020). The deadly coronaviruses: The 2003 SARS pandemic and the 2020 novel coronavirus epidemic in China. *Journal of autoimmunity*, *109*, 102434. https://doi.org/10.1016/j.jaut.2020.102434
8. Anderson, L. J., M.D., & Baric, R. S., Ph.D. (2012, November 8). Emerging human coronaviruses — disease potential and preparedness [Editorial]. *The New England Journal of Medicine*, *367*(1850-1852).
9. Gandhi, M., Yokoe, D. S., & Havlir, D. V. (2020). Asymptomatic Transmission, the Achilles' Heel of Current Strategies to Control Covid-19. *New England Journal of Medicine*, *382*(22), 2158–2160. https://doi.org/10.1056/nejme2009758
10. Coronavirus Resource Center. (2020). *Johns Hopkins University of Medicine.* Retrieved October 18, 2020, from https://coronavirus.jhu.edu/
11. Liu Y, Gayle AA, Wilder-Smith A, Rocklöv J. The reproductive number of COVID-19 is higher compared to SARS coronavirus. J Travel Med. 2020 Mar 13;27(2):taaa021. doi: 10.1093/jtm/taaa021. PMID: 32052846; PMCID: PMC7074654.
12. Morens, D.M., Fauci, A.S. (2020). Emerging pandemic diseases: How we got to COVID-19. *Cell, 182(5),* 1077-1092. Doi:10.1016/j.cell.2020.08.021
13. National Center for Health Statistics (US). Health, United States, 2015: With special feature on racial and ethnic health disparities. Hyattsville (MD): National Center for Health Statistics (US); 2016 May. Report No.: 2016-1232. PMID: 27308685.
14. Weinstein, J. N., Geller, A., Negussie, Y., & Baciu, A. (2017). The state of health disparities in the United States. In *Communities in action: Pathways to health equity* (pp. 57-97). Washington, DC: National Academic Press.
15. Bauer, U. E., & Plescia, M. (2014). Addressing disparities in the health of American Indian and Alaska Native people: The importance of improved public health data. *American Journal of Public Health*, *104*(S3). doi:10.2105/ajph.2013.301602
16. Office of Minority Health. (2020). *US Department of Health and Human Services.* Retrieved October 18, 2020, from https://minorityhealth.hhs.gov/default.aspx
17. Chowkwanyun, M., & Reed, A. (2020, July 16). Racial disparities and COVID-19 -- caution and context [Editorial]. *The New England Journal of Medicine*, *383*(3).
18. Joseph, N. P., Reid, N. J., Som, A., Li, M. D., Hyle, E. P., Dugdale, C. M., . . . Flores, E. J. (2020). Racial/ethnic disparities in disease severity on admission chest radiographs among patients admitted with confirmed COVID-19: A retrospective cohort Study. *Radiology*, 202602. doi:10.1148/radiol.2020202602
19. Alobuia, W. M., Dalva-Baird, N. P., Forrester, J. D., Bendavid, E., Bhattacharya, J., & Kebebew, E. (2020). Racial disparities in knowledge, attitudes and practices related to COVID-19 in the USA. *Journal of Public Health*, *42*(3), 470-478. doi:10.1093/pubmed/fdaa069
20. Jones, J., Sullivan, P. S., Sanchez, T. H., Guest, J. L., Hall, E. W., Luisi, N., . . . Siegler, A. J. (2020). Similarities and differences in COVID-19 awareness, concern, and symptoms by race and ethnicity in the United States: Cross-sectional survey. *Journal of Medical Internet Research*, *22*(7). doi:10.2196/20001
21. Quaresima, V., & Ferrari, M. (2020). COVID-19: efficacy of prehospital pulse oximetry for early detection of silent hypoxemia. *Critical Care*, *24*(1), 1–2. https://doi.org/10.1186/s13054-020-03185-x
22. Singh, A., Kataria, S., Das, P., & Sharma, A. (2020). A proposal to make the pulse oximetry as omnipresent as thermometry in public health care systems. *Journal of Global Health*, *10*(2), 1–4. https://doi.org/10.7189/jogh.10.0203102
23. Sjoding, M. (2021). More on Racial Bias in Pulse Oximetry Measurement. *New England Journal of Medicine*, *384*(13), 1278. https://doi.org/10.1056/nejmc2101321
24. Shi Y, Wang Y, Shao C, Huang J, Gan J, Huang X, Bucci E, Piacentini M, Ippolito G, Melino G. COVID-19 infection: the perspectives on immune responses. Cell Death Differ. 2020 May;27(5):1451-1454. doi: 10.1038/s41418-020-0530-3. Epub 2020 Mar 23. PMID: 32205856; PMCID: PMC7091918.
25. Kadambi, A. (2021). Achieving fairness in medical devices. *Science*, *372*(6537), 30–31. https://doi.org/10.1126/science.abe9195
26. Greenhalgh, T., Thompson, P., Weiringa, S., Neves, A. L., Husain, L., Dunlop, M., Rushforth, A., Nunan, D., de Lusignan, S., & Delaney, B. (2020). What items should be included in an early warning score for remote assessment of suspected COVID-19? qualitative and Delphi study. *BMJ Open*, *10*(11), e042626. https://doi.org/10.1136/bmjopen-2020-042626
27. Lester, J., Jia, J., Zhang, L., Okoye, G., & Linos, E. (2020). Absence of images of skin of colour in publications of COVID-19 skin manifestations. *British Journal of Dermatology*, *183*(3), 593–595. https://doi.org/10.1111/bjd.19258
28. *What is the McMaster Textbook of Internal Medicine*. (2021). About - McMaster Textbook of Internal Medicine. https://empendium.com/mcmtextbook/about
29. CDC - BRFSS. (2020, August 31). *Centers for Disease Control and Prevention* Retrieved November 15, 2020, from https://www.cdc.gov/brfss/index.html
30. *Clinical Methods: The History, Physical, and Laboratory Examinations*. (1990). Butterworth-Heinemann.
31. *StatPearls*. (2021). StatPearls. https://www.statpearls.com/
32. *Maricopa County, AZ*. (2021). Maricopa County Coronavirus Disease (COVID-19). https://www.maricopa.gov/5460/Coronavirus-Disease-2019
33. *COVID-19 data dashboard - King County*. (2021). King County COVID-19 Data Dashboard. https://kingcounty.gov/depts/health/covid-19/data.aspx
34. *Department of Public Health*. (2021). County of Los Angeles Public Health. http://publichealth.lacounty.gov/
35. Jaeschke, R., Gajewski, P., & O'Byrne, P. M. (2019). *McMaster Textbook of Internal Medicine 2019/2020* (1st ed.). Medycyna Praktyczna.

36. *Public Health*. (2021). Clark County Public Health. https://clark.wa.gov/public-health
37. *Public Health Services*. (2021). San Diego County Health and Human Services. https://www.sandiegocounty.gov/hhsa/programs/phs/
38. SPSS Statistics - Overview. (2020). *IBM*. Retrieved November 15, 2020, from https://www.ibm.com/products/spss-statistics