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COVID-19 in the Bay Area: The Impact of a Pandemic on Different Demographics in Selected Counties from 2020 - 2021

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COVID-19 IN THE BAY AREA: THE IMPACT OF A PANDEMIC ON DIFFERENT DEMOGRAPHICS IN SELECTED COUNTIES FROM 2020 - 2021

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LIST OF ACRONYMS

AARP	American Association of Retired Persons
ACIP	Advisory Committee on Immunization Practices
ACS	American Community Survey
AC Transit	Alameda County Transit Authority
ADI	Area Deprivation Index
BART	Bay Area Rapid Transit
BIPOC	Black, Indigenous, and people of color
CDC	Centers for Disease Control and Prevention
COVID-19	SARS-CoV2
CVD	Cardiovascular Disease
eHealth	Electronic Health
EUA	Emergency Use Authorization
FDA	U.S. Food and Drug Administration
HPI	Healthy Places Index
ICU	Intensive Care Unit
mHealth	Mobile Health
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
SAMTRANS	San Mateo County Transit
SCCPHD	Santa Clara County Public Health Department
UFW	United Farm Workers
VTA	Santa Clara Valley Transportation Authority
WHO	World Health Organization

BACKGROUND

The Start of the Pandemic

The world experienced a novel coronavirus disease outbreak in Wuhan, China in December of 2019 (Dhillon et al., 2020). Within months it spread worldwide, becoming a pandemic known as the novel coronavirus SARS-CoV2 or COVID-19 (Hunter, 2020). COVID-19 continued to spread, with public health officials worldwide urging countries to enact stay-at-home orders that could decrease the fast spread of the virus. The Chinese government's official report states that the virus originated in the Huanan Seafood Market located in Wuhan in October of 2019 (Dhillon et al., 2020). The World Health Organization (WHO) was alerted of the virus within a month of when the first individual with the virus was discovered (Park et al., 2020). Despite this, it was not until January 2020 that WHO’s Emergency Committee announced a worldwide public health emergency due to the alarming increase of cases of COVID-19 at Chinese and international locations (Velavan & Meyer, 2020). COVID-19 is deadly, causing public health officials to work around the clock to slow its spread.

In 2020, the United States had more positive cases cumulatively than any other country globally, at more than 13 million. The transmission rate of the virus is high, as the United States reported 1.5 million deaths as of November 2020 (Johns Hopkins University and Medicine, 2020a). As the pandemic spread through the country, disparities in the illness’ impact became noticeable. Some of the differences in infection rates among different ethnicities may be due to socioeconomic, health, insurance, and medical care access (Hawkins, 2020). This study will focus on selected western Bay Area counties in California, home to a diverse population of many races and ethnicities. The analysis includes the rate of positive COVID-19 cases in selected Bay Area counties by ethnicity, age, and gender. What does the data reveal about the rate of positive

COVID-19 cases within different ethnicities? What factors may contribute to the impact of COVID-19 on different populations?

COVID-19 in the United States

The United States is home to many minorities, and as the country's population continues to grow, many states' demographics have become more diverse. In 2019, the American Community Survey (ACS) estimated that Florida, the third most populous state, had a population of 21.5 million people, with 15.2% African Americans (15% of positive COVID-19 cases), 2.73% Asians (1% of positive COVID-19 cases), 24.57% Hispanics/Latinx (42% of positive COVID-19 cases), 0.26% for both Native Americans and Pacific Islanders (1% of positive COVID-19 cases), 4.5% other races (5% of positive COVID-19 cases), and 53% Whites (37% of positive COVID-19 cases) (U.S. Census Bureau, 2019g; Kaiser Family Foundation, 2021).

In November of 2020, Florida had six counties in the top 50 with the most confirmed positive COVID-19 cases in the United States (Johns Hopkins University and Medicine, 2020b). Florida became an epicenter, with high rates of COVID-19 positive cases. The rapid spread of the virus throughout the state was probably due to Florida's reopening of public places while more than 5% of the people who were tested were positive for COVID-19 (Sen-Crowe et al., 2020). The spread of COVID-19 throughout Florida is relevant to this analysis due to the state's demographic similarities with California.

Another state with demographics like California's is the State of New York, the fourth largest state by population. According to the ACS for the year 2019, the State of New York's population of 19.5 million was composed of approximately 14.2% African Americans, 8.6% Asians, 19.3% Hispanics/Latinx, 0.2% Native Americans, less than 0.1% Pacific Islanders, 2.1% other races, and 55.1% Whites (U.S. Census Bureau, 2019h). Data information for New York's positive COVID-19 cases by ethnicity/race could not be found. By the end of November 2020, Queens County (2.3 million population) and Kings County (2.6 million population) were also in the top 50 counties with the most confirmed positive COVID-19 cases in the United States. New York, Queens and Kings counties combined, with almost 5 million residents, had more than 177,026 positive COVID-19 cases (Johns Hopkins University and Medicine, 2020b), a rate of 3.6%. Positive COVID-19 cases in the United States continued to increase, making more states focal points for spreading the pandemic.

Similarly, demographics in Texas, the second-most populous state, have changed. Population estimates for 2019 show that Texas had a population of 29 million, with 11.9% African Americans (15% of positive COVID-19 cases), 4.93% Asians (1% positive COVID-19 cases), 37.96% Hispanics/Latinx (52% of positive COVID-19 cases), 4.11% other races (less than 1% of positive COVID-19 cases), and 41.1% Whites (32% of positive COVID-19 cases) (U.S. Census Bureau, 2019l; Kaiser Family Foundation, 2021). Texas also had several counties in the top 50 for confirmed positive COVID-19 cases in the United States (Johns Hopkins University and Medicine, 2020b). It is important to note that despite Texas's high number of positive cases in urban areas, the increase in death rates and lack of health care in rural areas are likely to have had a more significant impact on the spread of the virus (Khose et al., 2020). The spread of the virus in Texas shows that COVID-19 is spreading through urban and rural areas throughout the country.

Demographics in all these states do not show causation for the rate of COVID-19 cases among different ethnicities in the United States. These numbers simply demonstrate the impact of COVID-19 in states with similar race and ethnicity demographics to California. In 2019, California's population of 39.5 million was estimated to have 5.5% African Americans (4% of positive COVID-19 cases), 14.6% Asians (6% of positive COVID-19 cases), 39.4% Hispanics/Latinx (63% of positive COVID-19 cases), 4.2% other races (10% of positive COVID-19 cases), and 36.3% Whites (17% of positive COVID-19 cases) (U.S. Census Bureau, 2019f; Kaiser Family Foundation, 2021). By the end of November 2020, California had five counties on the list of the 50 counties with the most confirmed positive COVID-19 cases in the United States. With a population of just over 10 million, Los Angeles County had the highest number of positive COVID-19 cases of any county in the country, with more than 390,000 positive cases, which is a 3.9% rate (Johns Hopkins University and Medicine, 2020b).

The pandemic significantly impacted the United States, the country with the third-largest population in the world (328 million) after China (1.4 billion) and India (1.37 billion) (World Population Review, 2022). It became the country with the highest number of COVID-19 cases globally, ending the month of November 2020, with more than 13 million confirmed positive cases (Johns Hopkins University and Medicine, 2020a), a rate of 3.9%.

Technology and Transportation Disparities that Impact Health

COVID-19 has impacted the population in many ways since its spread worldwide. Consequently, Americans increased their use of technology and reliance on the internet for everyday activities to decrease exposure to COVID-19. One of the areas impacted by the increased use of technology has been healthcare services. The increase in telehealth services played an essential role in stopping the spread of COVID-19 ("Coronavirus has made digital divide more dangerous", 2020).

The benefits of telehealth include a decrease in transportation needs to attend medical appointments, reducing the risk of contracting the virus by having people stay at home, and minimizing the time spent securing healthcare (Eruchalu et al., 2021). The increase in telehealth helped decrease the rate of positive COVID-19 cases. However, it has also exposed the digital divide that affects low-income, rural, racial/ethnic, elderly, and non-English speaker communities across the United States. Additionally, these groups are left behind without the technology needed to use telehealth services, increasing their barriers to accessing medical care (Horn, 2020). Disparities in communities with inadequate access to technology and the internet affected health outcomes during the pandemic.

The United States has more than 21 million individuals without internet access, which reduces their ability to use telehealth (Eruchalu et al., 2021). More than 31% of residents in rural areas lack access to the internet at home; about 44% of individuals in households with an annual income of under $300,000 also lack internet at home; and even if income is not a factor, African American and Hispanic/Latinx residents have less broadband access compared to their White peers ("Coronavirus has made digital divide more dangerous", 2020). In California, low-income households are 16 times less likely to have broadband internet than the wealthiest households in the state. In addition, Hispanic/Latinx homes are one-third less likely to have home internet compared to White households (Le & Moya, 2020). Access to the internet at home is not the only barrier contributing to the digital divide; the need for adequate technology is also essential.

An estimated 26% of low-income adults do not have a smartphone, and 46% do not own a computer (Bekiempis, 2020). Low-income households are not the only ones affected by the digital divide, as about 25% of the population 65 and older do not use the internet, and about half of those do not own a smartphone. Indeed, technology literacy and access to broadband internet have broadened inequities in healthcare access (Press et al., 2021). A survey conducted in South San Francisco revealed that an estimate of 300 households located in the city's low-income neighborhoods did not have the adequate technology to use the internet (Walsh, 2021). In times of a pandemic, access to technology and the internet is crucial to follow stay-at-home orders to stop the spread of COVID-19 effectively.

Furthermore, with the increased use of telehealth, many physicians have switched from in-person medical appointments to phone and video. Due to this change, medical providers at University of California at San Francisco, for example, have identified the disparities in access to healthcare for these vulnerable groups caused by telehealth technologies (Blackwell & Steyer, 2020). The disparities increase for non-English speakers and people with low education levels and low health education. The use of interpreters through telehealth has not been too efficacious for medical providers. Interpreters have primarily only been used for phone appointments, thus making video appointments difficult for many individuals (Horn, 2020).

Unfortunately, technology disparities are not the only barrier for many residents trying to obtain medical care. Approximately 3.6 million Americans skip or postpone their medical care due to a lack of transportation. Transportation barriers further disconnect individuals from accessing quality medical care (Reiff, 2020). Transportation can be a more significant burden to the elderly community, whose isolation can affect their health (Carino, 2019). Data from the latest census showed that 5% of commuters in the United States typically use public transportation, which increases to 10% in larger cities. Minority groups in large cities have higher rates of transportation usage (Fowers et al., 2020). Transportation disparities in California have also impacted COVID-19 vaccine distribution.

Transportation disparities in vaccine distribution efforts encouraged the opening of mass distribution locations in California that targeted communities without transportation access. The sites were scheduled to open on February 16, 2021 and were to be in Eastside Los Angeles and at the Oakland Coliseum, providing a drive-through and walk-up option. Additionally, these vaccination sites were to be located near bus and train stops to provide easier access for individuals who use public transportation (Megerian & Shalby, 2021). California identified the need for accessible public transportation to vaccination sites, as many were in low-income communities as defined by the California Healthy Places Index (HPI). The California HPI considers access to health care, education levels, income, and the use of transportation, among other factors. Some of the Bay Area communities in the bottom quartile of the index include East San Jose, East and West Oakland, San Francisco's Bayview, Richmond, Gilroy, Antioch, and Pittsburg (Kendall, 2021). Selected Bay Area counties took further measures to provide additional transportation options for low-income residents to travel to vaccination sites.

Several Bay Area counties made it easier for residents to access COVID-19 vaccination locations. For example, San Mateo County Transit District (SAMTRANS) offered free bus rides to vaccination sites for county residents. Santa Clara Valley Transportation Authority (VTA), Bay Area Rapid Transit (BART), and Alameda County (AC) Transit also provided free rides to vaccination locations in the Bay Area. Transportation disparities in the Bay Area broaden the barriers to vulnerable communities accessing vaccination sites, further impacting these communities (Green, 2021). Technology and transportation disparities are essential factors in addressing the barriers that affect different ethnicities/races and their rate of positive COVID-19 cases.

Vaccination Distribution in California

The U.S. Food and Drug Administration (FDA) issued an Emergency Use Authorization (EUA) for three vaccines to combat COVID-19. On December 11, 2020, Pfizer-BioNTech was the first vaccine given EUA, followed by Moderna on December 18, 2020, and lastly, Janssen on February 27, 2021 (Centers for Disease Control and Prevention [CDC], 2020). Public health departments and medical organizations began distributing vaccines in the United States to mitigate the impact of COVID-19 in communities. Vaccine distribution continued to highlight the barriers and challenges faced by low-income communities of color throughout California ("Public Health Advocates for Anti-Racism in COVID-19 Response", 2020). Additionally, "a lack of trust among the communities most at risk stemming from racist practices and policies in our public health and health delivery systems" further exacerbates vaccine distribution problems in these communities ("Public Health Advocates for Anti-Racism in COVID-19 Response", 2020, n.p.). California continued its efforts to decrease the disparities and barriers experienced by the communities affected the most by COVID-19.

Vaccine distribution needs to be equitable in California, where communities of minority groups have been impacted the most by coronavirus (Ho et al., 2021). According to data from the CDC, African Americans, Hispanic/Latinx, and Native Americans die from COVID-19 at nearly three times the rate of White Americans (Murphy & Ramirez, 2021). Approximately 17% of Hispanic/Latinx have been vaccinated in California despite accounting for 39% of the state's population (Bobrowsky & Sanchez, 2021). African Americans accounted for about 3% of distributed vaccines and 6.5% of the population, and Asian Americans received an estimated 3% of vaccines while making up 15.5% of California's population (Bobrowsky & Sanchez, 2021; US Census Bureau, 2021). In comparison, of the 39% population that Hispanic/Latinx account for in California, they also make up 55% of the State's COVID-19 cases and 46% of deaths (Ho et al., 2021). Within these groups are undocumented residents who have also suffered disproportionately from the impacts of the pandemic. Further implementation of vaccine distribution should include undocumented residents to stem the tide of infections, since many undocumented workers are essential service workers in the agriculture and meatpacking industries in California (Della Cava et al., 2020). However, this research can only account for the first three months of vaccine distribution based on data that was available when this study was conducted.

The state began with an age-based vaccine distribution program to speed up the rollout of the vaccine to individuals most at risk of having severe symptoms due to COVID-19. The vaccine distribution strategy allowed seniors 65 and over to be some of the first individuals to get vaccinated, along with health care workers, nursing home residents, teachers, agriculture workers, and childcare workers. Seniors have been hit the hardest by COVID-19. Of the 31,102 deaths in California since the pandemic began in 2020, 75% were individuals 65 years old and over, and 94% were 50 years old and over (Rogers, 2021).

After vaccine distribution data analysis, California decided to allocate “40 percent of its COVID-19 vaccine supplies to people at the bottom 25 percent of the state’s socioeconomic ladder” (Krieger, 2021, n.p.). About 8 million individuals live in the 400 zip codes receiving the additional COVID-19 vaccines from the state (Krieger, 2021). Despite California’s new efforts in allocating more vaccines to low-income communities affected the most by COVID-19, “Bay Area residents make up just 2 percent” of the individuals living in the targeted zip codes “even though the nine-county region accounts for 20 percent of the state’s population” (Palomino & Ho, 2021, n.p.). California’s strategy leaves out many low-income communities in the Bay Area, including “Southeast San Francisco, West Oakland, and East San Jose” (Palomino & Ho, 2021, n.p.). From the 400 zip codes selected to receive additional vaccines, only “10 Bay Area zip codes made the list – and not a single one is located in Santa Clara, San Mateo or Marin Counties” (Kelliher, 2021, n.p.). Regardless of the state’s inadequate vaccine distribution strategy, the Bay Area organized “drop-in sites, mobile clinics, and door-to-door outreach” to reach some of its most vulnerable communities (Kelliher, 2021, n.p.). Bay Area counties continued their efforts to provide equitable vaccine distribution to the communities impacted the most by COVID-19.

Nonprofit organizations joined the Santa Clara County Public Health Department (SCCPHD) and Gardner Health Services to provide translation services and outreach to individuals without health insurance to increase vaccine administration. Moreover, San Jose's Mexican Heritage Plaza also provided facilities to set up clinics, facilitate COVID-19 testing, and then distribute vaccines to the community (Deruy, 2021). However, their work does not stop here; they "created public service announcements featuring people in the community who have gotten the vaccine to encourage others to get it and dispel fear and myths" (Deruy, 2021, n.p.). SCCPHD also partnered up with the mushroom farm, the United Farm Workers (UFW), and the UFW Foundation to set up vaccination clinics for farmworkers (Almond & Vazquez, 2021). In addition, SCCPHD opened Levi's Stadium, and pop-up clinics to reduce barriers to coronavirus vaccine access (Kendall, 2021). Other Bay Area counties also opened local vaccination sites. Alameda County set up a "vaccination clinic in the heavily Latinx Fruitvale neighborhood of Oakland" and opened the Oakland-Alameda Coliseum (Kendall & Kelliher, 2021, n.p.). San Francisco began vaccine distribution at the Moscone Center, and Contra Costa County set up mobile vaccination clinics (Kendall & Kelliher, 2021).

Each of the selected western Bay Area counties made available demographic data for the first three months of vaccine distribution from December 2020 through February 2021. Vaccine distribution in Alameda County shows that from their cumulative 590,452 doses distributed, 6.8% went to African Americans (10.3% of the population), 27.5% to Asians (31% of the population), 10.5% to Hispanic/Latinx (22.3% of the population), 0.3% to Native Americans

(0.3% of the population), 0.7% to Pacific Islanders (0.8% of the population), 35.5% to Whites (30.4% of the population), and 18.7% to “unknown” which cannot be grouped with any ethnic/racial group (Alameda County, 2021b; U.S. Census Bureau, 2019e).

Ethnicity/race was not the only demographic found in the data collected from the counties on their vaccine distribution. Age and gender demographics were also provided in the data. In Alameda County, of their cumulative 590,452 doses distributed, 0.1% went to individuals 16 years old and younger (22.7% of the population), 15.5% to ages 16 to 34 years old (22.4% of the population), 20.1% to 35 to 49 years old (22.1% of the population), 18.9% to ages 50 to 64 years old (18.5% of the population), 43.4% to 65 years old and over (14.3% of the population), and 2% were given to individuals who selected the “unknown” option which cannot be attributed to a specific age range in the population (Alameda County, 2021b; U.S. Census Bureau, 2019a). As far as gender, 59% of vaccines distributed were given to females (51% of the population), 40% to males (49% of the population), and 1% to individuals who selected the “unknown” option and cannot be attributed to a specific percentage in the population data (Alameda County, 2021b; U.S. Census Bureau, 2019m).

Vaccination distribution data for San Francisco County was also released. The data collected reflect that from the cumulative 423,845 doses distributed, 3.9% went to African Americans (10.3% of the population), 39% to Asians (34.6% of the population), 12% to Hispanic/Latinx (15.2% of the population), 0.2% to Native Americans (0.3% of the population), 0.3% to Pacific Islanders (0.4% of the population), 2.2% to Whites (40% of the population), and 36.5% to the “unknown” group, which cannot be attributed to any one ethnic/racial group. The last 5.9% of vaccines went to another ethnicity/race, accounting for 0.4% of the county’s population (San Francisco County, 2021b; U.S. Census Bureau, 2019i).

San Francisco County vaccine distribution age demographic included less than 0.1% of residents 11 years old and younger (8% of the population), 0.1% to ages 12 to 17 years old (7% of the population), 37.7% ages 18 to 49 years old (51.3% of the population), 19% ages 50 to 64 years old (17.7% of the population), and 43.2% to individuals 65 years old and over (16% of the population) (San Francisco County, 2021b; U.S. Census Bureau, 2019b). Gender demographics for vaccine distribution showed that 54% of vaccines were given to females (49% of the population), 45% to males (51% of the population), and 1% to individuals who selected the "unknown" option, which cannot be attributed to gender in population data collected by the US Census Bureau (San Francisco County, 2021b; U.S. Census Bureau, 2019n).

Subsequently, in three months, San Mateo County distributed 292,361 vaccines. Vaccine distribution by ethnic/racial group was 1.2% to African Americans (2.1% of the population), 19.6% to Asians (29.7% of the population), 9.2% to Hispanic/Latinx (24% of the population), less than 0.1% to Native Americans (0.2% of the population), 0.6% to Pacific Islanders (1.2% of the population), and 30.8% to Whites (38.4% of the population). From the rest of the vaccine distribution, 21.8% went to individuals from another race (0.6% of the population) and 16.7% to the "unknown" group, which cannot be attributed to any specific ethnic/racial groups (San Mateo County, 2021b; U.S. Census Bureau, 2019g).

Vaccine distribution by age for San Mateo County reflects those residents 15 years old and younger (16.8% of the population) did not receive any of the vaccines, 3.2% went to residents ages 16 to 24 years old (10.8% of the population), 22.5% ages 25 to 44 years old (29.4% of the population), 24.9% ages 45 to 64 years old (26.6% of the population), and 49.4% of vaccines to residents 65 years old and over (16.6% of the population) (San Mateo County, 2021b; U.S. Census Bureau, 2019c). The gender demographic shows that females (51% of the population) received 59% of vaccines, and males (49% of the population) received the other 41% (San Mateo County, 2021b; U.S. Census Bureau, 2019o).

Lastly, Santa Clara County distributed 731,503 vaccines from December 2020 to February 2021. The data collected by the county show that vaccines were distributed 1.9% to African Americans (2.4% of the population), 36.9% to Asians (37.6% of the population), 13.7% to Hispanic/Latinx (25% of the population), 0.2% to Native Americans (0.2% of the population), 0.4% to Pacific Islanders (0.4% of the population), 4.7% to other races (0.4% of the population), and 37.6% to Whites (30.4% of the population). The last 4.6% of vaccines went to the "unknown" group, which cannot be attributed to specific ethnic/racial groups (Santa Clara County, 2021b; U.S. Census Bureau, 2019k).

Similarly, vaccine distribution per age group reflects those residents 11 years old and younger (11.4% of the population) received less than 0.1% of vaccines, 0.2% went to ages 12 to 17 years old (12.5% of the population), 31.3% ages 18 to 49 years old (43.7% of the population), 18.9% to ages 50 to 64 years old (18.5% of the population), and 49.6% to residents 65 years old and over (13.8% of the population) (Santa Clara County, 2021b; U.S. Census Bureau, 2019d). The gender demographic shows that females (49% of the population) received 57% and males (51% of the population) 43% of the cumulative vaccines distributed from December 2020 to February 2021 in Santa Clara County (Santa Clara County, 2021b; U.S. Census Bureau, 2019p).

It is important to provide context for the early vaccine distribution trends. Vaccine distribution began in California in December 2020. Initially, while supplies were very limited, vaccines were only approved for administration to adults. The vaccination campaign began in long term care homes, focused on residents and workers (Mathews & McGinty, 2020). By January of 2021 adults over 65 years old and those with pre-existing health conditions that could lead to serious health outcomes from COVID-19 disease were eligible for vaccination (Rochester Regional Health, 2021).

Table 1: Percentage of People by Age Group, Race and Ethnicity

Age Group	**55-64**	**65-74**	**75-84**	**85+**
African American	46.7%	33%	16.1%	4.3%
Asian & Pacific Islander	51.1%	30%	16.1%	2.9%
Hispanic/Latinx	50.6%	30.6%	14.7%	4.1%
Native American & Alaskan Native	51.7%	30%	14.6%	3.6%
White	42.1%	30.1%	21.6%	6.2%
Source: U.S. Census Bureau, The Older Population in the United States: March 2002. Issued April 2003				

Source: Pandya, 2005.

The demographics of long term care residents in California show that 78% are over 65 years of age, 65% are female and 58% are white (Johnson, 2020). As shown in Table 1, most Americans over 55 are either African American or White. Asians and Hispanic/Latinx clustered in the 55 to 64 years old age group, while African American (20%) and White (28%) were in the over 75 years of age group (Pandya, 2005). While long term care residents are only 1% of the California population, by January 2021 they accounted for 39% of the deaths from COVID-19 and 10% of the illnesses (Johnson, 2020).

The likelihood of elders being cared for at home varies by ethnicity. A study by the American Association of Retired Persons (AARP) found that multigenerational households are more common among African Americans, Asians and Hispanics/Latinx than among Whites. Asians (42%) were more likely to care for an older relative than Hispanics/Latinx (34%), African Americans (28%), or Whites (19%) (Pandya, 2005). Thus, more elderly White people are in nursing homes than people of other ethnicities. This demographic information helps to explain the disparities in the vaccination patterns in the first three months of administration, when the focus was on the elderly, and no vaccines had yet been approved for children.

Importance of the Topic

COVID-19 rapidly spread throughout the United States, with more positive cases and deaths each day. As public health departments continued to work tirelessly to contain the virus and 'flatten the curve', individuals continued to be exposed to the virus through their employment as essential workers (Dhillon et al., 2020). California placed strict stay-at-home orders to slow down the spread of COVID-19 (Wells, 2020). The rapid increase of COVID-19 positive cases in counties throughout California with large numbers of African Americans, Native Americans, and people of color (Black, Indigenous, and people of color -BIPOC) may correlate with these communities' racial demographics (Iacobucci, 2020; Kaiser Family Foundation, 2021; U.S. Census Bureau, 2019f).

This research analyzed the rate of positive COVID-19 cases among individuals in California's selected San Francisco Bay Area counties. Analyzing the rate of positive COVID-19 cases in each county by demographics helped identify the groups affected the most by the virus. The study results will inform of future resources that could be made available to BIPOC groups in the selected Bay Area counties to reduce their vulnerability during a pandemic. In addition, it is beneficial to know some of the factors that explain why certain ethnic groups are more vulnerable to contracting COVID-19.

LITERATURE REVIEW

Socioeconomic

The virus does not discriminate among race, ethnicity, economic status, age, or gender. As months passed and the virus continued to spread, it became evident that certain groups were being impacted the most (Burström, 2020). Some conclusions of the early data collected indicate that BIPOC groups are affected the most by the pandemic. Literature confirms that some of the causes of the increase in COVID-19 cases among minorities are social, economic, and health factors (Iacobucci, 2020), which are related to the socioeconomic inequalities in BIPOC groups.

A few of the factors that disproportionately affect minority groups and drive the increase of COVID-19 cases are overcrowding, work environment, and employment types (Mulholland, 2020). Minority groups are more likely to live in densely populated locations, and have more socioeconomic barriers (Hawkins, 2020). Social distancing is one of the critical steps in preventing the spread of the virus. Overcrowded living conditions that affect certain ethnic groups prevent social distancing and make them more vulnerable to contracting COVID-19 because it is hard to isolate themselves from others (Poole et al., 2020). By living in overcrowded housing due to low wages and high housing costs, these groups have more significant challenges in practicing social distancing (Rogers, 2020). Social distancing is one of the primary preventive measures against the spread of COVID-19.

Overcrowded households place BIPOC groups at higher risk of contracting COVID-19. Poor housing conditions among minority groups place the families living in the household at risk and make it more likely that the virus will spread to individuals they contact outside of their homes. Low-income households with overcrowded conditions are likely to infect others by an estimated 2 to 4 times more than individuals who can socially distance themselves within their living quarters (Shadmi et al., 2020). While it may be easier for some population groups to shelter at home, maintain a 6-feet distance, and do outdoor activities, not all populations have that opportunity. During times of a pandemic, it is a luxury to stay at home and prevent contact with others as much as possible.

Furthermore, socioeconomic disparities among BIPOC groups also affect home stability and housing security. As if economic inequality is not evident, communities in low-income areas account for a substantial portion of households with economic hardships, including an increased risk of housing instability and less healthcare access. Inadequate access to housing contributes to the economic disparities that affect BIPOC groups. Nevertheless, housing insecurity is not the only risk seen in overcrowded households. Low-income communities with various ethnicities are less likely to be able to follow all the public health precautions without being economically affected (Mehdipanah, 2020). While public health officials continue to order the population to shelter at home, households with overcrowding and poor-quality living conditions do not have the economic means to follow these instructions.

Economic disparities among BIPOCs are not only seen through their housing situations but also in their work environments. Minority and low-income individuals are more likely to be essential workers, increasing their vulnerability to contracting COVID-19 (Oronce, 2020). While many employers could move their employees to telework, not everyone had the same opportunity. The opportunity to work from home reduces the employees' risk of contracting COVID-19 due to their ability to socially distance themselves (Rollston & Galea, 2020). Essential workers have continued their regular jobs to provide the population with the necessary services. Sometimes employers do not provide adequate services and protective measures for their essential workers, making disease transmission worse.

Some of the most common occupations essential workers perform are in supermarkets, warehouses, and public transportation (Patel et al., 2020). This also includes many healthcare workers who have been at the front lines since the onset of the pandemic further, death rate data have spotlighted the excessive effect on BIPOC healthcare workers due to COVID-19 (Abbas et al., 2020). Being an essential worker increases the vulnerability of the individuals to exposure to the virus while performing their jobs (Rollston & Galea, 2020).

Due to the high risk of contracting COVID-19 at the workplace, the Occupational Safety and Health Administration (OSHA) issued a testing mandate that "required businesses with 100 or more employees to ensure each of their employees is fully vaccinated or undergoes weekly COVID-19 testing" (Walsh & Zients, 2021, n.p.). Many socioeconomic disparities are amplified during COVID-19.

Health

BIPOCs are more likely to suffer from health issues that increase their vulnerability to COVID-19. These health conditions include diabetes and high blood pressure, which are more common in Black individuals (Nowicki, 2020). Many members of BIPOC groups also suffer from more chronic medical conditions, such as cardiovascular disease (CVD), cancer and asthma (Chin-Hong, 2020). Pre-existing health conditions increase this population's vulnerability to contracting COVID-19. Data shows that about 60% of patients who have died due to COVID-19 had at least three or more pre-existing conditions (Aguiar & Stollenwerk, 2020).

Data shows that poor nutrition increases an individual's chances of contracting COVID-19 (Burström, 2020). Similarly, patients with diabetes are more vulnerable to infections compared to individuals without the disease. As a result, diabetics have a higher risk of complications due to symptoms of COVID-19. In this case, ethnicity is not the only factor that is considered. Age and gender also play an essential role in contracting the virus. Females younger than 30 years of age with Type 1 diabetes have better health compared to their male counterparts with Type 2 diabetes (Joshi et al., 2020). Younger women seem to have less severe symptoms from COVID-19 than their opposite gender and age group. Regardless of age or gender, ethnic groups with pre-existing health conditions continue to be at a higher risk of developing acute symptoms from the virus.

Obesity and diabetes can be seen more frequently among ethnic minorities. Specifically, BIPOC individuals suffer from these diseases at a much higher rate compared to their White counterparts (Abate & Chandalia, 2003). It is essential to consider these health factors when analyzing the rate of positive COVID-19 cases among different ethnicities. Certain ethnic groups can also have Vitamin D deficiencies and a high inflammatory burden (El-Khatib et al., 2020). While everyone is exposed to contracting the virus, pre-existing health conditions place some ethnic groups at a higher risk of getting sick. The implications for those among BIPOC groups who have existing health conditions are severe and should be considered when implementing outreach and education to communities composed of different ethnicities.

Obesity, diabetes, Vitamin D deficiencies, and inflammatory burdens are common among BIPOC groups; cardiovascular disease is another health condition of importance. In this case, cardiovascular disease is more common in African American individuals and is associated with a higher risk of fatal COVID-19 outcomes. The same literature shows that African Americans have a 30-60% higher prevalence of obstruction of blood vessels than White individuals. Pre-existing cardiovascular conditions are one of the leading causes of death among those who contract COVID-19 (Chin-Hong, 2020). High rates of heart disease among African Americans increase their vulnerability to COVID-19, providing more factors that affect BIPOC individuals during the pandemic. Pre-existing health conditions common among different races and ethnicities caused discrepancies in the rate of positive COVID-19 cases among BIPOC.

Insurance and Access to Medical Care

While pre-existing health conditions represent a concern in reducing the spread of COVID-19 within BIPOC communities, another factor to consider is health insurance and access to medical care during the pandemic. The lack of health insurance among individuals experiencing food insecurity and pre-existing health conditions also contributes to the disparities experienced by BIPOC (Nowicki, 2020). Likewise, as noted in the literature, there was bias in healthcare services provided to African Americans, as several were turned away from hospitals or refused treatment at the beginning of the pandemic (Clarke, 2020). Also, a lack of health insurance and disproportionate challenges in getting treatment by health professionals contributed to the barriers BIPOC faced during the pandemic while seeking treatment for COVID-19 (Polonijo, 2020). The disparities observed by BIPOC groups while trying to obtain healthcare can contribute to their vulnerability to contracting COVID-19 at higher rates than other ethnic groups.

Having medical insurance during the pandemic made the difference in whether a BIPOC individual would seek medical care or not. As literature shows, individuals who do not have health insurance are less likely to seek medical care, worsening their health conditions. Consistently, health results for patients of color without insurance became a concern during the pandemic (Rogers et al., 2020). Ethnicity, socioeconomic status, and health insurance are barriers that impact health outcomes during COVID-19 (Collier & Rothstein, 2020). As the pandemic continues to spread among the population, factors that affect BIPOC groups at higher rates than whites, such as access to medical care and lack of health insurance coverage, can lead to poorer health outcomes for BIPOC people who contract the virus.

Digital Divide

While many individuals were able to use technology to access medical information and eventually increase the use of Mobile Health (mHealth), not everyone had immediate access to the internet. mHealth is the application of health information through mobile devices, such as cell phones and tablets (Smith & Magnani, 2019). A study conducted in 2014 showed that adults 65 and older were notably less likely to use the internet or obtain medical information online. In addition, a separate study demonstrated that even though 81% of adults between the ages of 65 to 79 had a cell phone, only less than one-third (31.2%) had access to a smartphone. Access to mHealth decreases even more as age increases for BIPOC groups (Gordon & Hornbrook, 2016).

The use of mobile devices to access medical health information is not the only factor in the digital divide. BIPOC groups are more likely to live in low-income neighborhoods, frequently remote from the advanced internet connection needed to access health care (Ray et al., 2017). Socioeconomic status also plays an important role in access to mHealth, thus decreasing the opportunities for older people and BIPOC groups to make appointments or schedule COVID-19 testing.

Regardless of access to mobile technology, another factor that affects older BIPOC is the lack of education. Older groups have been shown to have less electronic health (eHealth) knowledge. A study found that older African Americans and Hispanic/Latinx have a more challenging time navigating the patient portal compared to their White counterparts. This includes understanding medical terminology, which can be difficult for individuals with limited health technology experience. Lastly, website and portal design can discourage an individual's access to medical information through the internet (Smith and Magnani, 2019).

As COVID-19 continues to demonstrate the digital divide among different ethnic groups, it is important to consider the factors that further affect access to health information. Closing the digital divide by accessing health information on mobile devices gives individuals the opportunity to have better health outcomes (Ray et al., 2017). Resources to improve health literacy among different groups can reduce the digital divide that these groups are currently experiencing when trying to access COVID-19 information (Smith & Magnani, 2019). eHealth and mHealth are great resources for the population to take advantage of, but it also decreases the chances of BIPOC and older groups accessing health information during the pandemic.

Vaccine Distribution

COVID-19 exacerbated the social disparities ethnic groups face by having pre-existing health conditions and living circumstances barriers that impact their access to healthcare (Lin, 2021). As the COVID-19 vaccines began to roll out, their distribution began to address these disparities. Vaccine distribution to individuals in minority communities, such as healthcare workers, could decrease vaccine hesitancy among other members of these groups (Razai et al., 2021). Nichol and Mermin-Bunnell (2021) noted that the CDC's Advisory Committee on Immunization Practices (ACIP) recommended that vaccine distribution begin "in Phase One: (a) healthcare workers and long-term care facilities' residents, (b) essential workers, and (c) adults over 65 or those with high-risk medical conditions" (n.p.). This framework focused on maximizing the available resources, encouraging health justice, and mitigating health barriers (Nichol & Mermin-Bunnell, 2021). Despite the efforts to decrease the social inequalities with this framework in the COVID-19 vaccine distribution, other strategies could be used to also maximize the vaccine impact on BIPOC communities.

In 2022, COVID-19 vaccines are widely available to any individual who seeks to get vaccinated. However, at the beginning of its distribution, a framework had to be implemented to increase its impact on the most vulnerable communities. Prior research on vaccine allocation during a pandemic recommends increasing the impact of limited resources, prioritizing individuals and communities impacted the most, and providing equal treatment to all individuals (Emanuel et al., 2020). These recommendations were implemented in Phase One of the distribution, with long-term care residents, individuals with high healthcare risk, and healthcare workers being some of the first to receive the COVID-19 vaccine. In addition, older adults constitute the majority of hospitalizations due to COVID-19 infection. This includes residents in long-term care facilities who do not have the means to socially distance themselves. Including residents and workers of long-term care facilities, adults over 65, and individuals with high-risk health conditions maximizes the benefits of the vaccines and protects the scarce resources in hospitals, such as intensive care unit (ICU) beds, medical staff, and ventilators (Jecker et al., 2021). Although this was an effective strategy, the first vaccine distribution phases did not provide equal distribution to communities impacted the most by COVID-19.

Low-income and ethnically diverse communities were also the most impacted groups by the COVID-19 pandemic. Within the United States, Hispanic/Latinx and African American communities were disproportionately impacted by COVID-19, with a three times higher possibility of contracting the virus in contrast to their White counterparts. These same communities have a higher risk of severe illness due to the virus compared to the general population. Individuals living in predominantly African American counties who became infected with COVID-19 had six times the mortality rate of the general population (Jecker et al., 2021). Prioritizing communities that scored low on the Area Deprivation Index (ADI), which would have included individuals that were "worst off" during the pandemic, would have been ethically correct (Schmidt, 2020). Additionally, prioritizing communities in zip codes low in ADI and low income would have also helped mitigate health disparities (Jean-Jacques & Bauchner, 2021). Although the first phase of vaccine distribution did not address the health inequalities, later strategies were taken to decrease some barriers to access to vaccines.

Further measures taken during the distribution of vaccines focused on decreasing the barriers to access to vaccines, including the location of vaccine distribution sites (Fisk, 2021). It was noted that transportation to vaccination sites was a barrier to individuals attending their appointments (Guhlincozzi & Lotfata, 2021). Other strategies were implementing a hybrid approach that included traditional vaccination sites and large mass vaccination distribution sites. Mass vaccination sites in proximity to or in low-income communities helped decrease some of the transportation barriers to obtaining the COVID-19 vaccines (Goralnick et al., 2021). Vaccine distribution in the United States was challenged to cover all groups impacted the most by COVID-19. Although phase one of the vaccine distribution successfully covered high at-risk individuals and seniors, communities and ethnic groups who were greatly impacted by the virus were omitted, thus continuing the health disparities. Strategies in vaccine distribution were later implemented to make up for the late inclusion of individuals affected the most by the pandemic.

METHODOLOGY

Program Evaluation

The program evaluation methodology was used to analyze the data on disease prevalence and response evaluation (Sylvia & Sylvia, 2012). This methodology examined the implementation of the vaccine distribution strategy during phase one implemented by public health officials. It also examined whether these strategies' performance correlates with the rate of positive COVID-19 cases in different demographics in the selected Bay Area counties.

Data Collection and Selection

The analysis was conducted using the data from each of the selected counties from February 2020 to February 2021, the first year of the pandemic. This study is separated into sections, and each section examines the correlation between positive cases and population demographics. The data and research collected are from aggregated data provided through public reports published by the public health departments of San Mateo, Santa Clara, Alameda, and San Francisco counties. None of the published data consists of individually identifiable private information.

IRB Exclusion

The research project is excluded from the San Jose State University Institutional Review Board review because there are no human subjects.

FINDINGS

Positive COVID-19 Cases

To understand the disparities in COVID-19 impacts, it is important to display the ethnic characteristics of the population of each county. The ethnicity distribution of the county population can then be compared to the distribution of COVID-19 illness by ethnicity in that county to understand the disparities.

Table 2: Population Demographics by Social Characteristics: Santa Clara, San Mateo, San Francisco & Alameda Counties

Demographic	Santa Clara County	San Mateo County	San Francisco County	Alameda County
Population	1,927,852	766,573	881,549	1,671,329
African American	2.4%	2.1%	5.2%	10.3%
Asian	37.6%	29.7%	34.6%	31%
Hispanic/Latinx	25%	24%	15.2%	22.3%
Native American	0.2%	0.2%	0.3%	0.3%
Pacific Islander	0.4%	1.2%	0.4%	0.8%
Other races	0.4%	0.6%	0.4%	0.5%
White	30.4%	38.4%	40%	30.4%
Speaks other than English at home	51%	44.5%	42.3%	45.7%
Living in poverty	6.1%	6%	9%	9%
Average monthly apartment rent	$2,392	$2,497316	$1,959	$1,982

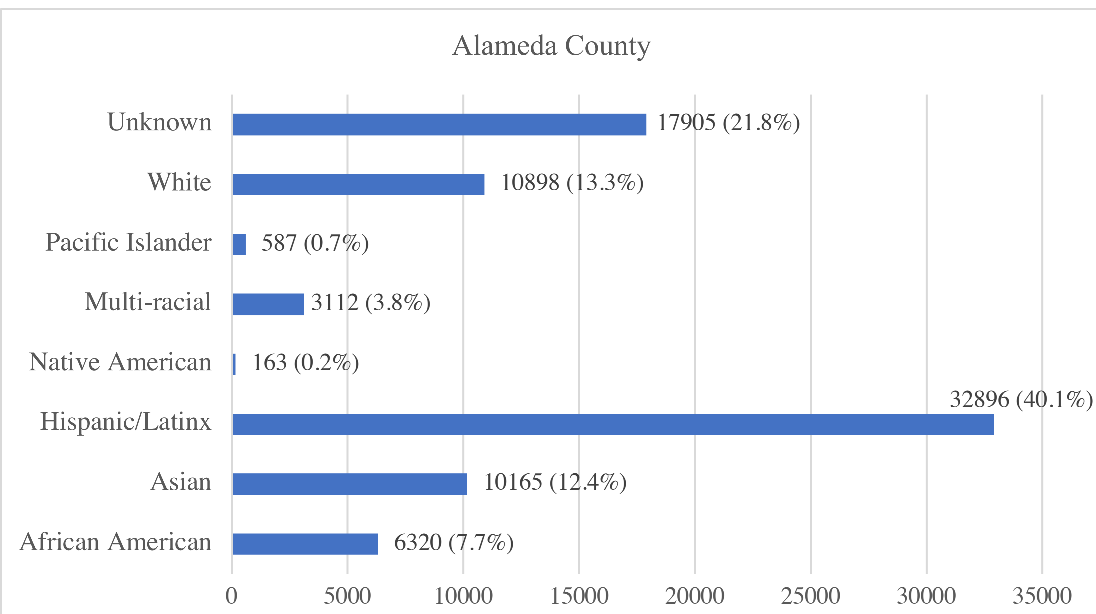
Source: U.S. Census Bureau, 2019e; U.S. Census Bureau, 2019i; U.S. Census Bureau, 2019g; U.S. Census Bureau, 2019k.

Ethnicity/Race

This research aimed to identify the impact of COVID-19 on different ethnic groups that live in the four contiguous western Bay Area counties that were selected for data collection and analysis: Alameda County, San Francisco County, San Mateo County, and Santa Clara County. The public health departments of each county created a website at the beginning of the pandemic where the population could view and track the spread of COVID-19 (Alameda County, 2021a; San Francisco County, 2021a; San Mateo County, 2021a; Santa Clara County, 2021a). Since this is public data, any individual can view and download the information, as was done for this research.

The COVID-19 case incidence data used in this research only focuses on ethnicity/race, age, and gender demographics. The data represents the information collected from the population in each of the selected counties when they were diagnosed or tested positive for COVID-19. Information from individuals who chose not to share their demographics is not represented in this data. The figures below show the rate of positive COVID-19 cases from February 2020 to February 2021 in each of the selected Bay Area counties one-year after the start of the pandemic. This analysis only takes into consideration the data from the county's public health departments. Figures 1 – 4 show the rate of positive COVID-19 cases in each county broken down by ethnicity/race.

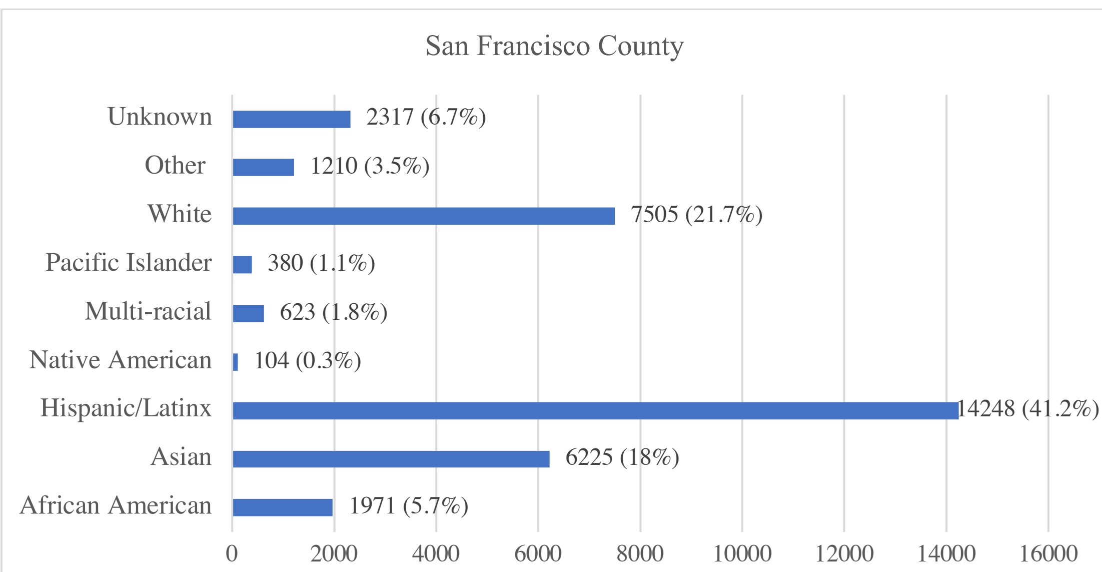
Figure 1. Alameda County positive COVID-19 cases – Ethnicity/Race



Source: Alameda County, 2021a.

Alameda County had 82,046 COVID-19 cases between February 2020 and February 2021. Figure 1 – Alameda County positive COVID-19 cases one year after the start of the pandemic shows the ethnic/racial groups affected the most by the virus. African Americans (10.3% of the population) had 7.7% of the cases, Asians (31% of the population) had 12.4% of the cases, Hispanic/Latinx (22.3% of the population) had 40.1% of the cases, Native Americans (0.3% of the population) had 0.2% of the cases, Pacific Islanders (0.8% of the population) had 0.7% of the cases, and Whites (30.4% of the population) had 13.3% of the positive COVID-19 cases. The "unknown" group had 21.8% of the cumulative COVID-19 cases, which cannot be attributed to a specific ethnicity or racial group (Alameda County, 2021a; U.S. Census Bureau, 2019e).

Figure 2. San Francisco County positive COVID-19 cases - Ethnicity/Race

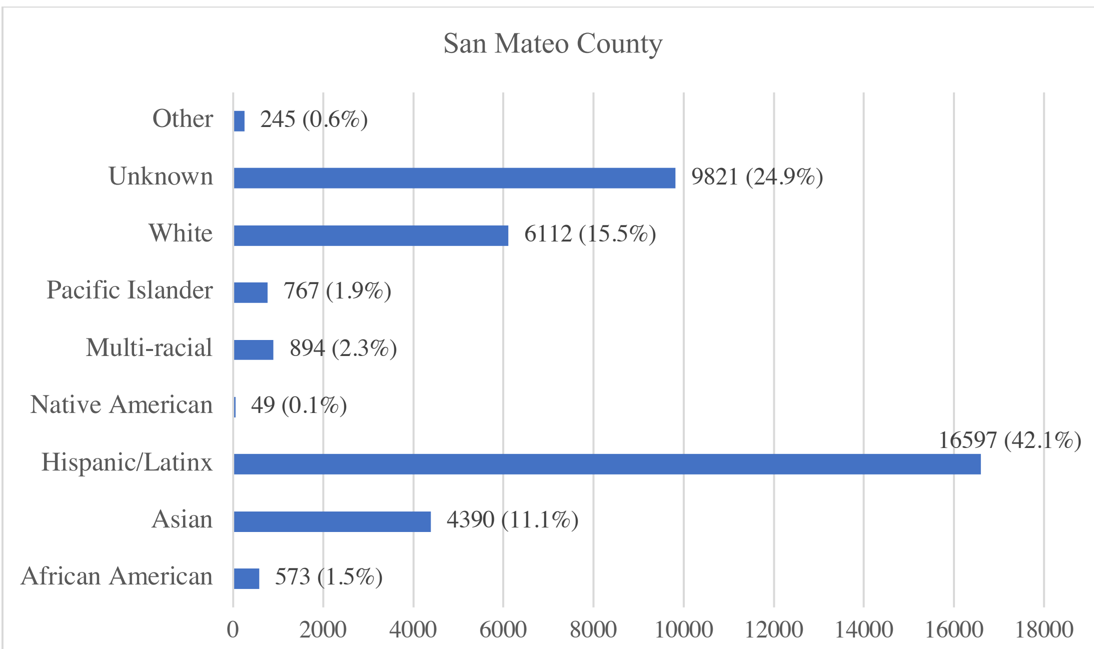


Source: San Francisco County, 2021a.

San Francisco County had 34,583 positive COVID-19 cases between February 2020 and February 2021, shown in Figure 2, in a population of 881,549. The County's positive cases were distributed with African Americans (5.2% of the population) having 5.7% of the cases, Asians

(34.6% of the population) had 18% of the cases, Hispanic/Latinx (15.2% of the population) had 41.2% of the cases, Native Americans (0.3% of the population) had 0.3% of the cases, Pacific Islanders (0.4% of the population) had 1.1% of the cases, other races (0.4% of the population) had 3.5% of the cases, and Whites (40% of the population) had 21.7% of the cases. The "unknown" group in San Francisco County had 6.7% of the cumulative COVID-19 cases, which cannot be attributed to a specific ethnic/racial group (San Francisco County, 2021a; U.S. Census Bureau, 2019i).

Figure 3. San Mateo County positive COVID-19 cases - Ethnicity/Race

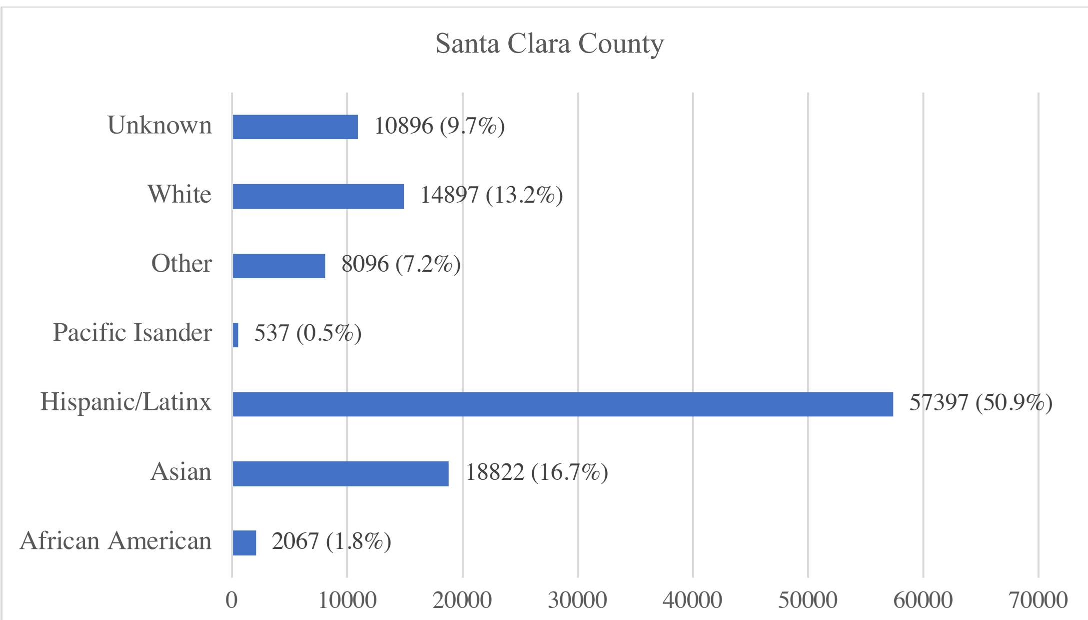


Source: San Mateo County, 2021a.

San Mateo County had 39,448 cases of COVID-19 between February 2020 and February 2021, as shown in Figure 3. It is worth noting that their data only represents a small portion of the total number of likely cases in the county due to limited testing capacity, as stated in San Mateo County's COVID-19 data dashboard (San Mateo County, 2021a).

African Americans (2.1% of the population) had 1.5% of the cases, Asians (29.7% of the population) had 11.1% of the cases, Hispanic/Latinx (24% of the population) had 42.1% of the total cases, Native Americans (0.2% of the population) had 1% of the cases, Pacific Islanders (1.2% of the population) had 1.9% of the cases, other races (0.6% of the population) had 0.6% of the cases, and Whites (38.4% of the population) had 15.5% of the COVID-19 cases in San Mateo County. The "unknown" group had 24.9% of the cases in the county, which cannot be attributed to a specific ethnic/racial group (San Mateo County, 2021a; U.S. Census Bureau, 2019g).

Figure 4. Santa Clara County positive COVID-19 cases - Ethnicity/Race



Source: Santa Clara County, 2021a.

Santa Clara County had 112,712 positive COVID-19 cases for a population of 1,927,852. African Americans (2.4% of the population) had 1.8% of the positive cases, Asians (37.6% of the population) had 16.7% of the cases, Hispanic/Latinx (25% of the population) had 50.9% of the positive cases, Pacific Islanders (0.4% of the population) had 0.5% of the cases, other races (0.4% of the population) had 7.2% of the cases, and Whites (30.4% of the population) had 13.2% of the cumulative positive COVID-19 cases in the county. The "unknown" group had 9.7% of the cases, which cannot be attributed to a specific ethnic/racial group (Santa Clara County, 2021a; U.S. Census Bureau, 2019k).

Age

The second demographic taken into consideration for this research was the age of the individuals in the data collected by the counties. The age percentages of the population in each of the selected Bay Area counties are shown in Table 2.

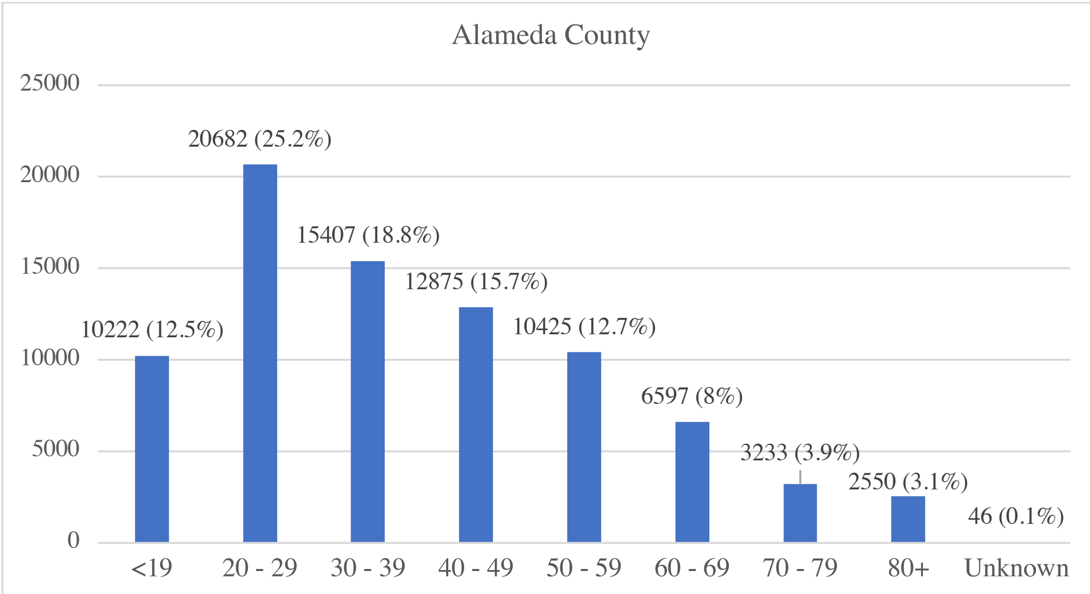
Table 3: Population Demographics by Age: Santa Clara, San Mateo, San Francisco & Alameda Counties

Demographic	**Santa Clara County**	**San Mateo County**	**San Francisco County**	**Alameda County**
Population	1,927,852	766,573	881,549	1,671,329
Under 19 years	23.9%	22.2%	15%	22.7%
20 to 29 years	14.2%	12.6%	16.7%	13.8%
30 to 39 years	15.7%	15.5%	21.3%	16.6%
40 to 49 years	13.8%	13.6%	13.3%	14.1%
50 to 59 years	12.8%	13.6%	12.1%	12.6%
60 to 69 years	10%	11.1%	10.5%	10.4%
70 to 79 years	5.9%	7.2%	6.8%	6.3%
80 years and over	3.6%	4.4%	4.3%	3.5%

Source: U.S. Census Bureau, 2019a; U.S. Census Bureau, 2019b; U.S. Census Bureau, 2019c; U.S. Census Bureau, 2019d.

Figures 5 – 8 show data only for the individuals who tested positive for COVID-19 and provided their age at the time of testing.

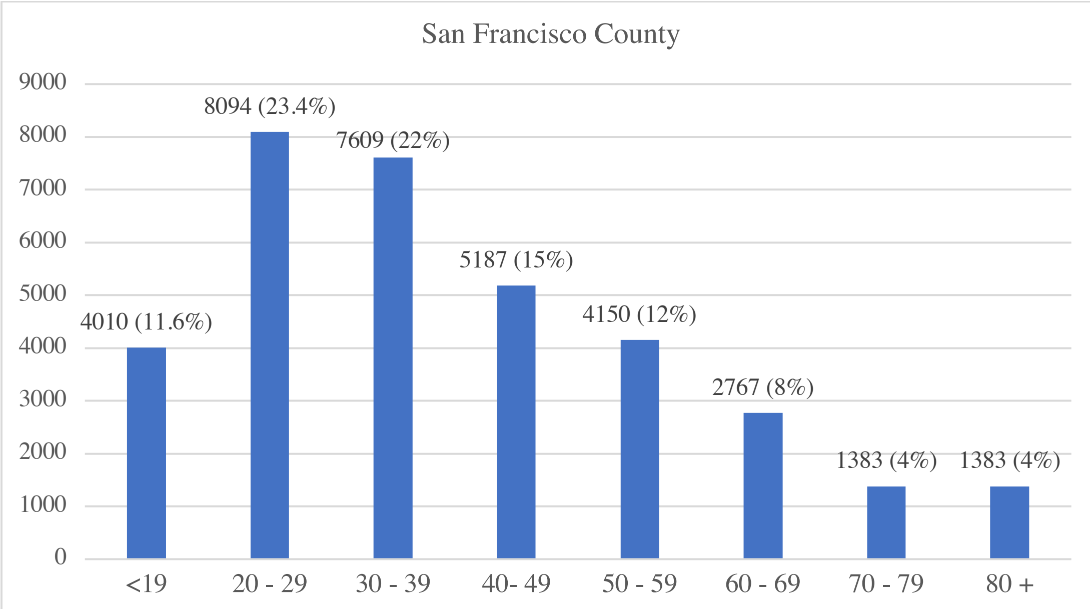
Figure 5. Alameda County positive COVID-19 cases - Age



Source: Alameda County, 2021a.

Alameda County's positive COVID-19 data based on age group is represented in Figure 5. Individuals 19 years old and younger (22.7% of the population) account for 12.5% of the positive cases, 20 to 29 years old (13.8% of the population) account for 25.2% of the cases, 30 to 39 years old (16.6% of the population) account for 18.8% of the total cases, 40 to 49 years old (14.1% of the population) had 15.7% of cases, 50 to 59 years old (12.6% of the population) had 12.7% of the cases, 60 to 69 year old (10.4% of the population) had 8% of the cases, 70 to 79 year old (6.3% of the population) had 3.9% of the cases, and residents 80 years old and over (3.5% of the population) had 3.1%of the cases in Alameda County. Less than 0.1% of residents in Alameda County chose not to provide their age during their COVID-19 test and who also tested positive for the virus (Alameda County, 2021a; U.S. Census Bureau, 2019a).

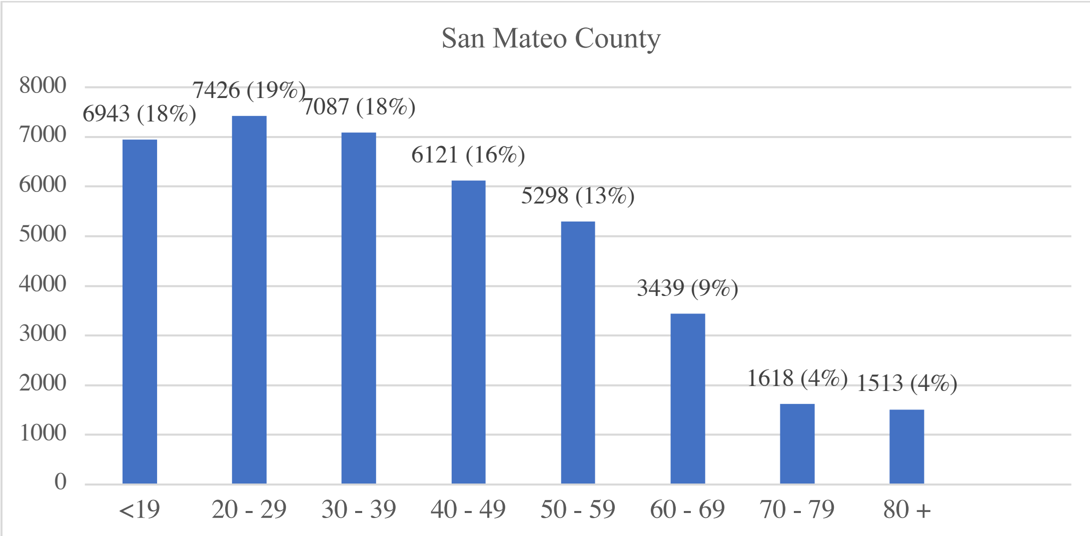
Figure 6. San Francisco County positive COVID-19 cases - Age



Source: San Francisco County, 2021a.

San Francisco County's positive COVID-19 cases by 19 years old and younger (15% of the population) had 11.6% of positive COVID-19 cases, 20 to 29 years old (16.7% of the population) had 23.4% of cases, 30 to 39 years old (21.3% of the population) had 22% of cases, 40 to 49 years old (13.3% of the population) had 15% of the positive cases. Residents 50 to 59 years old (12.1% of the population) had 12% of the cases, 60 to 69 years old (10.5% of the population) had 8% of the cases, 70 to 79 years old (6.8% of the population) had 4% of the total cases. Moreover, individuals 80 years old and over (4.3% of the population) also had 4% of the COVID-19 cases. (San Francisco County, 2021a; U.S. Census Bureau, 2019b).

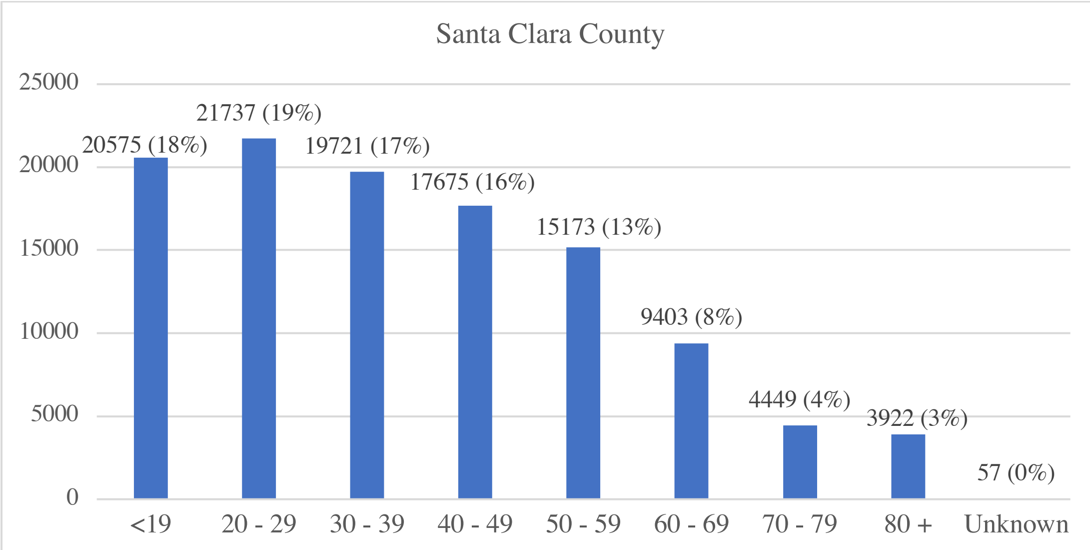
Figure 7. San Mateo County positive COVID-19 cases - Age



Source: San Mateo County, 2021a.

San Mateo County's positive COVID-19 rate by age demographics shows that residents 19 years and younger (22.2% of the population) had 18% of the positive cases. Individuals in the age range 20 to 29 years old (12.6% of the population) had 19% of the positive case, 30 to 39 years old (15.5% of the population) had 18% of cases, 40 to 49 years old (13.6% of the population) had 16% of positive cases, 50 to 59 years old (13.6% of the population) had 13% of the cases, 60 to 69 years old (11.1% of the population) had 9% of the cases, 70 to 79 years old (7.2% of the population) had 4% of the cases, and residents 80 years old and over (4.4% of the population) also had 4% of the cases of the cumulative positive COVID-19 cases in the county (San Mateo County, 2021a; U.S. Census Bureau, 2019c).

Figure 8. Santa Clara County positive COVID-19 cases – Age



Source: Santa Clara County, 2021a.

Lastly, for the age group data, is Santa Clara County, which shows the following incidence of disease. Residents 19 years and younger (23.9% of the population) had 18% of the cases, 20 to 29 years old (14.2% of the population) had 19% of the cases, 30 to 39 years old (15.7% of the population) had 17% of the cases, 40 to 49 years old (13.8% of the population) had 16% of the cases, 50 to 59 years old (12.8% of the population) had 13% of the cases, 60 to 69 years old (10% of the population) had 8% of the cases, 70 to 79 years old (5.9% of the population) has 4% of the positive COVID-19 cases, and 80 years old and over (3.6% of the population) had 3% of cases. Santa Clara County also had a couple of individuals who did not state their age at the time of testing, which accounted for less than 0.01% of the positive COVID-19 cases in this county (Santa Clara County, 2021a; U.S. Census Bureau, 2019d).

Gender

Table 4: Selected Bay Area Counties' Positive COVID-19 Cases by Gender

County	Female Case Rate	Female Population	Male Case Rate	Male Population	Unk/Other Case Rate
Alameda	50%	51%	48%	49%	2%
San Francisco	47%	49%	52%	51%	1%
San Mateo	51%	51%	49%	49%	0%
Santa Clara	50%	49%	49%	51%	1%

Source: Alameda County, 2021a; San Francisco County, 2021a; San Mateo County, 2021a; Santa Clara County, 2021a; U.S. Census Bureau, 2019m; U.S. Census Bureau, 2019n; U.S. Census Bureau, 2019o; U.S. Census Bureau, 2019p.

The last demographic analyzed in this section is the percentage of positive COVID-19 cases among the selected Bay Area counties by gender. Table 3 shows this breakdown by population and case rate. Male and female gender identification was used in county data collection, with an alternative for “unknown” or “other.” The U.S. Census Bureau population data is binary with male and female options only; thus, there is no data on “unknown” or “other” gender from this source. The rate of positive COVID-19 cases by gender reflects a similar distribution to the percentage of the population (Alameda County, 2021a; San Francisco County, 2021a; San Mateo County, 2021a; Santa Clara County, 2021a; U.S. Census Bureau, 2019m; U.S. Census Bureau, 2019n; U.S. Census Bureau, 2019o; U.S. Census Bureau, 2019p).

Additional Demographic Factors

Other factors in the population data collected from each of the selected Bay Area counties include language spoken at home, poverty percentage, and average monthly apartment rent. Alameda County has 45.7% of its population who speak a language other than English at home, 9% live in poverty, and the average monthly rent is $1,982 (U.S. Census Bureau, 2019e). For the San Francisco County population, 42.3% speak a language other than English at home, 9% live in poverty, and the average monthly rent is $1,959 (U.S. Census Bureau, 2019i). For San Mateo

County's population, 44.5% speak a language other than English at home, 6% live in poverty, and the average monthly rent is $2,497 (U.S. Census Bureau, 2019g). Lastly, of Santa Clara County's population, 51% speak a language other than English at home, 6.1% live in poverty, and the average monthly rate is $2,392 (U.S. Census Bureau, 2019k).

ANALYSIS

Impact of COVID-19 on Different Demographics

The data collected in the Findings for positive COVID-19 cases in each of the selected western Bay Area counties from February 2020 to February 2021 indicate that the ethnic/racial group affected the most across all the counties was Hispanic/Latinx. In all the counties, Hispanic/Latinx had at least double the positive COVID-19 cases compared to their population percentage. For example, in San Francisco, Hispanic/Latinx had almost three times the positive cases compared to their population percentage (San Francisco County, 2021a; U.S. Census Bureau, 2019i). In Santa Clara County, Hispanic/Latinx had half of the cumulative COVID-19 cases with only 25% of the county's population (Santa Clara County, 2021a; U.S. Census Bureau, 2019k). Inarguably, this ethnic/racial group was affected the most by COVID-19.

The "unknown" option for ethnic/racial groups also demonstrated a significant number of positive COVID-19 cases. In San Mateo County, almost 25% of the cumulative positive cases were of unknown ethnicity, and in Alameda County the unknown ethnicity accounted for less than 25% of the cases (San Mateo County, 2021a; Alameda County, 2021a). This is significant since those cases cannot be attributed to any specific ethnic/racial group. Residents who selected this option might not have seen their specific ethnic/racial group listed, or chose not to provide this demographic information at the time of testing.

The rest of the ethnic/racial groups, such as African Americans, Asians, Native Americans, Pacific Islanders, other races, and Whites, show a proportionate or lower positive COVID-19 case compared to their population percentages. In most counties, Asian Americans had a case rate about half of their population percentage. However, it is worth noting that San Francisco County's African American (5.2% of the population/ 5.7% of the cases) and Pacific

Islander (0.4% of the population and 1/1% of the cases) groups had higher percentages of positive COVID-19 cases than their population percentages (San Francisco County, 2021a; U.S. Census Bureau, 2019i).

Age demographics in the selected San Francisco Bay Area counties show that the groups affected the most by COVID-19 were those between the ages of 20 to 49, including 20 to 29 years old, 30 to 39 years old, and 40 to 49 years-old. These three age groups had a higher percentage of positive COVID-19 cases compared to their population. More specifically, ages 20 to 29 and 30 to 39 had significantly higher COVID-19 numbers in all the selected Bay Area counties. The data demonstrate the pandemic most impacted early and middle-aged adults, who were later getting vaccinated.

Older adults in the age groups 50 and older had an equal or a smaller number of COVID-19 cases compared to their population in all the counties. This may be an artifact of their early vaccinations, or of their greater ability to shelter in place due to being retired. The positive COVID-19 cases in older adults indicate their decreased exposure to the virus and lower rates of positive testing. This is similar for younger individuals 19 years of age and younger, who seemed to be more resistant to the early strains of COVID-19. These numbers only indicate the age groups with more COVID-19 cases and do not include the mortality rates among each of the age groups.

COVID-19's impact by gender demographic revealed that in all the selected Bay Area counties, the rate of positive cases was similar among the gender groups. San Francisco County's male population had a slightly higher rate of positive COVID-19 cases compared to the female population, which had a lower-case rate. On the other hand, Santa Clara County's female population had higher positive COVID-19 cases compared to its male population, but in each case the care rate was only a few percentage points different that the percent of population. Both Alameda and San Francisco Counties' positive case rate was consistent with their population numbers.

Overall, the data collected in each of the selected western Bay Area counties imply that the demographics affected the most by COVID-19 were Hispanics/Latinx and early to middle-aged adults. Neither gender had a disproportionate impact from the pandemic. As the virus affected various demographics in these counties, the correlation between these numbers and outside factors confirms that COVID-19 had a more significant effect on specific groups. Although the data is only for one year (February 2020 to February 2021) of positive COVID-19 testing, it also contains the numbers from the start of the pandemic, representing the real impact this pandemic had on each demographic group before vaccines became available.

Correlation Between Barriers and Positive COVID-19 Cases

The data collected from each county's public health department confirms that the Hispanic/Latinx community was affected the most by the COVID-19 virus. This is in addition to early to middle-aged adults who had higher rates of positive COVID-19 cases compared to other age groups. The results of this research and data collection propose that COVID-19 in the selected San Francisco Bay Area counties had a more significant impact on the Hispanic/Latinx working class.

As discussed in this research, the socioeconomic, health, digital divide, insurance, and access to medical care barriers affected ethnic/racial groups during the pandemic. Essential workers, in many cases composed of minority groups and low-income individuals, were more vulnerable to contracting COVID-19 due to their work environments (Oronce, 2020). Pre-existing health conditions like diabetes and obesity significantly impacted the vulnerability of minority groups to COVID-19 infections (Abate &Chandalia, 2003). The lack of access to adequate broadband internet and medical insurance faced by BIPOC individuals in low-income communities (Ray et al., 2017; Rogers et al., 2020) contributed to the high rate of COVID-19 cases among Hispanic/Latinx residents.

Moreover, factors affecting the positive COVID-19 cases are language, living in poverty, and average monthly apartment rent in each selected county. All the selected Bay Area counties had more than 40% of households that speak a language other than English at home. In addition, more than 6% of individuals in all counties live in poverty, and the lowest apartment monthly rent is in San Francisco at $1,959 (U.S. Census Bureau, 2019e; U.S. Census Bureau, 2019i; U.S. Census Bureau, 2019g; U.S. Census Bureau, 2019k). Employment type, overcrowded households, and work environments where social distancing is not possible contributed to the barriers and factors Hispanic/Latinx residents faced during the pandemic (Mulholland, 2020). These factors contribute to the socioeconomic barriers faced by BIPOC communities.

Further factors in the early vaccine distribution data indicate the limited distribution of vaccines to different ethnicities/racial groups in the first three months of distribution, when vaccine supplies were very limited. Distribution focused on nursing homes, where the population was predominantly white, in keeping with age demographics and research on different ethnicities' household makeup. Technology and transportation created barriers for some residents trying to get tested for COVID-19 and then obtaining the vaccine (Le & Moya, 2020; Megerian & Shalby, 2021). The vaccine distribution data collected from the selected western Bay Area counties are limited to the early phases. They do not reflect the first phase's overall effect on vaccine distribution.

Limitations

The data collected from each of the selected Bay Area counties were different. The age group breakdown provided by each county and from the U.S. Census Bureau differed. In addition, the gender data population numbers obtained from the U.S. Census Bureau are only binary. Moreover, the data for gender in positive COVID-19 cases compared to the population only show female and male options contrary to the unknown or other options given at the time of testing. Lastly, this research is based on the accuracy in data collection of positive COVID-19 cases by each Bay Area public health department.

CONCLUSION AND RECOMMENDATIONS

This research analyzed the rate of positive COVID-19 cases among individuals in California's selected San Francisco Bay Area counties. The literature review demonstrates several key factors to highlight, which include how overcrowding is an essential factor and contributor for minorities in contracting COVID-19, how socioeconomic disparities among people of color affect home stability and housing security; and how work environment and the limited access that minority populations have to telework contributes to the higher COVID-19 positive cases in vulnerable populations. Pre-existing health conditions, such as cardiovascular disease in BIPOC groups, increase their vulnerability to COVID-19, minority populations face barriers in receiving adequate medical services due to the lack of insurance coverage; and there are fewer technology-savvy individuals within the elderly population, which makes eHealth difficult to use, even though it decreases exposure to medical facilities where COVID-19 may be present (mHealth).

The data gathered reflects the Alameda, San Francisco, San Mateo, and Santa Clara counties' rates of positive COVID-19 cases. The findings review residents' ethnicities, ages, and gender within the county. The analysis was conducted using the data from each selected county over one year (February 2020 to February 2021). Recommendations moving forward include areas for further study in pandemic mitigation plans in different languages focused on BIPOC communities and the essential workforce. Also, further research on the vaccination program over an extended implementation period is needed to see whether the early ethnic disparities were resolved as more vaccines became available. Policy proposals include increasing language capacity and cultural competence in healthcare, adding more broadband internet access in low-income communities, revising vaccine distribution prioritization plans, increasing transportation services, and adding more affordable housing to reduce overcrowding conditions in low-income households. Lastly, creating more robust public health strategies and stockpiling personal protective equipment (PPE) in advance of the next pandemic to protect essential workers are important strategies. These recommendations will help reduce some barriers faced by minority groups, specifically Hispanic/Latinx, who were the ethnic/racial group affected the most in the selected California Bay Area counties by COVID-19.

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