Introduction

The COVID-19 pandemic has affected individuals all over the world, economically, socially, and medically. As a highly populated state in the U.S., California has experienced an extremely heavy COVID-19 disease burden, with large numbers of COVID-19 cases and deaths over the course of the pandemic. However, this pandemic has not affected all groups and demographics in California equally. In this study, we investigated how COVID-19 cases and deaths in California have differentially affected age, sex, and racial groups.

Objective

Research Question: How and to what degree has each racial, sex, and age group experienced COVID-19 cases and deaths differently?

Hypothesis: Specific ages, races, and sex experienced a disproportionate level of cases and/or deaths during the COVID-19 epidemic in California.

The aim of this study was to:

* Identify the groups most affected by COVID-19 cases and deaths, promoting public health intervention for these at-risk groups.

Methods

* We used a repeated cross-sectional study to investigate the differential effect of the epidemic of cases and deaths on different demographics.
* Data was sourced from the California Department of Public Health. The case group was all who experienced a case or a death from COVID-19. We used the entire time period that COVID-19 data was recorded, from April 22, 2020, to May 16, 2023.
* The control group was all individuals in California who did not experience a case or a death from COVID-19, calculated from the total population subtracted by the COVID-19 cases or deaths in California.
* We found the odds ratios for both cases and deaths by each race, sex, and age group for Covid-19 caseload or mortality. Age groups were ages 0-17, 18-49, 50-64, and 65 and above. Race groups included white, black, American Indian, Asian, Hispanic/Latino, Multi-race, and Other race. Chi-square tests of homogeneity were also performed.
* All analyses were done in R using the tidyverse, tidycensus, and epiR packages.

Results

Captions beneath each table

Discussion

With age group 0-17 serving as the baseline, the most surprising result was that the 65 and older age group had the lowest odds of receiving a case of COVID-19, with odds of 0.9677 (0.9652, 0.9701). The 50-64 age group had the second highest caseload, with odds of 1.3243 (1.3213, 1.3273). The most at-risk group was the 18-49 age group , with odds of 1.9072 (1.9037, 1.9108) of having a case of COVID-19. Odds were lower during waves than overall, implying that the Delta and Omicron variants affected all age groups more equally than on average.

Using the white population as a baseline, three racial groups had a higher odds being afflicted with COVID-19—the black population (1.4387 (1.4337, 1.4438)), the Hispanic/Latino population (1.7858 (1.7825, 1.7890)) and the Hawaiian/Pacific Islander population(4.2895 (4.2454, 4.3341)). The other groups had lower frequencies, with Asians having an odds of 0.6699 (0.6629, 0.6770) of having a COVID-19 case and other races having an odds of 0.1113 (0.1105, 0.1120). Asians had a lower overall odds ratio for cases, while black, Hawaiian/Pacific Islander, and Hispanic/Latino individuals had larger odds ratios overall. Every race besides Asians had the highest case odds during the Delta Wave. \_\_\_\_\_

Between males and females, males had a lower odds of having a COVID-19 case of 0.8652 (0.8640, 0.8665).

The odds ratios of COVID-19 deaths does not follow those of the cases among groups. Although the 18-49 group has the highest odds of a COVID-19 case, the odds of dying from COVID-19 rise exponentially as the age groups increase. Using the 0-17 group as a baseline, the 18-49 group has an odds 44.8088 (36.3596, 55.2214) greater. The 50-64 group has an odds 275 greater, and the 65 and older group has an odds 1250 times greater. Clearly, the older one becomes, the more likely one is to die from a COVID-19 case, and this appears to be an extreme direct relationship.

Racial groups that have higher odds of having a COVID-19 case also have a higher odds of dying from COVID-19. The Black population (1.2481 (1.2160, 1.2810)), Hawaiian and Pacific Islander population (1.6445 (1.5162, 1.7836)), and the Hispanic/Latino population (1.0777 (1.0623, 1.0932)) all have higher death odds just as they do for case odds. In the same way, those groups with lower case odds also have lower deaths odds, including the Asian, American Indian, multi-race, and other race groups. These odds relationships suggest a homogeneity within racial groups, as more cases within a group to begin with will likely mean more deaths as a result of these increased cases. Black individuals had higher case odds during the Delta Wave, while Asians and other race individuals had higher odds during the Omicron wave. Other races all had lower odds during these waves compared to the overall odds.

Interestingly, although men are less likely to have a case of COVID-19, they are more likely to die from COVID-19(1.4017 (1.3839, 1.4198)) than women. Although men did not have as many cases, out of those cases, they were more serious and more deadly. This phenomenon has been confirmed by other studies.1,2

One weakness of this study is that our dataset reported the case and death numbers by aggregate instead of by individual. This means that there were not multiple variables associated with each individual and his or her COVID-19 case status or mortality status. As a result, we were not able to standardize adjusted odds ratios by each age, sex, or racial group. Further study should be done with higher-quality data to ascertain whether confounding variables affected this data.3–5

1. Peckham H, de Gruijter NM, Raine C, et al. Male sex identified by global COVID-19 meta-analysis as a risk factor for death and ITU admission. *Nature Communications 2020 11:1*. 2020;11(1):1-10. doi:10.1038/s41467-020-19741-6

2. Tabatabai M, Juarez PD, Matthews-Juarez P, et al. An Analysis of COVID-19 Mortality During the Dominancy of Alpha, Delta, and Omicron in the USA. *https://doi.org/101177/21501319231170164*. 2023;14. doi:10.1177/21501319231170164

3. Hennekens HC, Buring JE. *Epidemiology in Medicine*. (Mayrent SL, ed.). LIPPINCOTT WILLIAMS & WILKINS; 1987.

4. Kelsey JL, Whittemore AS, Evans AS, Thompson WD. *Methods in Observational Epidemiology*. Oxford University Press; 1996.

5. Rothman KJ. *Epidemiology: An Introduction*. Oxford University Press; 2002.