Correlation of Vaccine Hesitancy with COVID-19 Deaths and Cases

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Contents

This is my project website.

You can download the pdf version here. https://github.com/tzuyuhua/PM566-finalproject/blob/main/Final-Project.pdf

Introduction

Vaccine hesitancy, which is the reluctance or refusal to vaccinate despite the availability of vaccines, has been proposed by the World Health Organization (WHO) as one of the ten threats to global health in 2019 https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019, even before the global pandemic of COVID-19.

Vaccine is currently one of the most cost-effective ways of preventing disease outbreak and reducing disease consequence, and consequently disease's impact on economic. As of 2019, 2-3 million deaths a year are prevented by vaccination. If global coverage of vaccinations is improved , an estimated 1.5 million of death could be further avoided.

As for the reason of vaccines hesitancy are complex, could be a result of numerous factors including lack of education, knowledge of how vacines are produce, distrust of government or authorities, or even just fear of needles. Its existence dates back the time vaccines were invented, however, it is only recently that it started to resurface to the discussion of mainstream media.

After the global outbreak of COVID-19 and the invention of COVID-19 vaccines, vaccine hesitancy plays an even more important role than before. We can observe vaccines being not just a measure of disease prevention, but also a mean of politics, yet we can also see a subset of population refused to get vaccinated even with the resources at hand.

This report is not to discuss the cause of vaccine hesitancy or the legitimacy of the claims by certain "anti-vaccinationism", but to see if vaccine hesitancy actually impacts the death and case number of COVID-19 on a state level in the US.

Methods

Datasets

A total of 3 datasets will be used in this project. The first two are from US Center for Disease Control and Prevention, and the third one are from United States Census Bureau (an official website of the United State Government).

1. The fisrt dataset is "Vaccine Hesitancy for COVID-19: County and local estimates" from https://data.cdc.gov/Vaccinations/Vaccine-Hesitancy-for-COVID-19-County-and-local-es/q9mh-h2tw

2. The second dataset is "United States COVID-19 Cases and Deaths by State over Time" from https://data.cdc.gov/Case-Surveillance/United-States-COVID-19-Cases-and-Deaths-by-State-o/9mfq-cb36

3. And for the comparison between states summary statistics to be reasonable and effective, I need the population data of different places. "County Population Totals: 2020-2021" from https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html

Estimated state vaccine hesitancy level

The state vaccine hesitancy level is estimated by calculating the weighted average of the county hesitancy level, with population information from the third dataset as weight.

Results

First, we look at the distribution of estimated hesitancy level for each state. It seems that Montana, Wyoming, Alaska, Arkansas are the few states with the higher estimated state vaccine hesitancy level among all the states within the US (Figure 1).

Figure 1. State level hesitancy
(Hover for value)

State level hesitancy

0.2

0.1

0
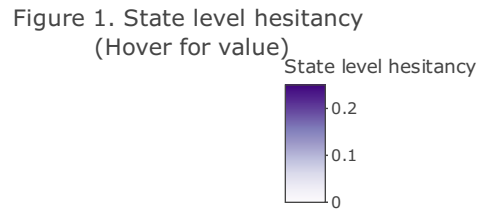
Next, we look at the Population-normalized COVID-19 deaths/cases over time (Figure 2). We are trying to see if states with higher estimated state vaccine hesitancy level would also show a stronger surge of COVID-19 cases and deaths per person (state level case number and death number divided by state population) over time. We can observe that for both Alaska and Arkansas, two state that were previously observed with higher estimated state vaccine hesitancy level among all the states within the US, shows a strong surge of cases and deaths compare to other state. However, this trend does not hold for Montana, while it only shows an average level of surge of COVID-19 cases and deaths compare to other states.
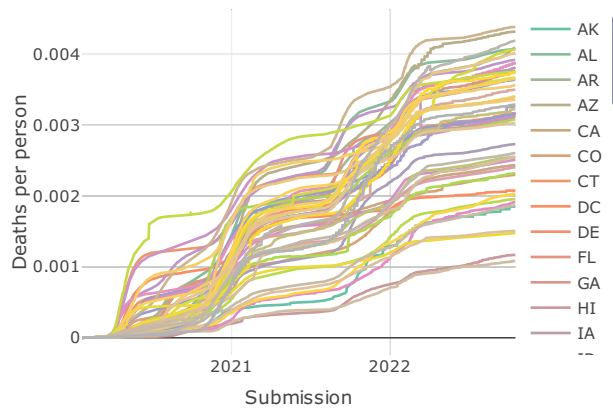
**Tab 1**

ure 2a. Population-normalized COVID-19 cases over ti
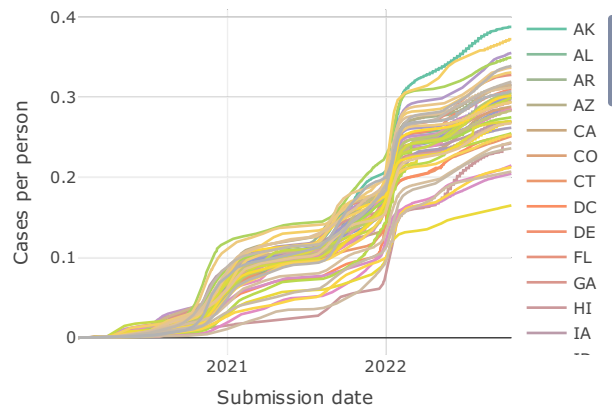
Tab 2

ıre 2b. Population-normalized COVID-19 deaths over t

Third, we examine the relationship between total cases, total deaths, and with the diameter of the data point as the estimated state hesitancy level. We are expecting to see a positive correlation between total cases and total deaths (controlled for state population), which is shown in Figure 4. We are also trying to see if data points closer to the upper right hand corner (more deaths and cases per person), would also be bigger in diameter, showing correlation with vaccine hesitancy level. And that is generelly the case in Figure 4, although Alaska is interesting, with high cases per person and high estimated hesitancy level, but relatively low deaths per person.

Figure 3.
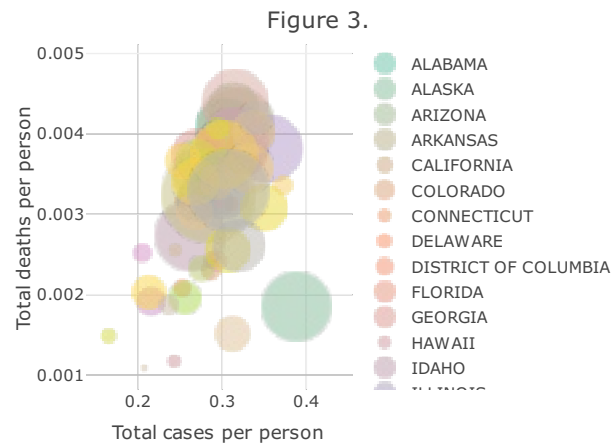
Conclusion

Overall, COVID-19 vaccine hesitancy does seem to be correlated with COVID-19 cases and deaths, however, more confounding variables (etc, age, masks or population density) should be included to better understand the relationship, and better explain the variability in data.