# How did local health infrastructure and socio-political factors within different states and counties in the United States affect the disparities in COVID-19 outcomes, and what lessons can be learned for more targeted public health preparedness and response strategies in future pandemics?*

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First sentence. Second sentence. Third sentence. Fourth sentence.

## Table of contents

## 1 Introduction

*This reproduction was performed after a replication on the Social Science Reproduction platform:* ***link here***

*The introduction is self-contained and tells a reader everything they need to know including: 1) broader context to motivate; 2) some detail about what the paper is about; 3) a clear gap that needs to be filled; 4) what was done; 5) what was found; 6) why it is important; 7) the structure of the paper. A reader should be able to read only the introduction and know what was done, why, and what was found. Likely 3 or 4 paragraphs, or 10 per cent of total. The estimand is clearly stated in the introduction.*

*Code and data are available at: https://github.com/hannahyu07/US-Covid-Analysis.git

# 2 Data

Our results are summarized in (**fig:fig-GHS?**).

## 2.1 Source

The datasets utilized in this paper were mainly obtained from the `original paper` (Nuzzo and Ledesma 2023). Additionally, to address the original paper's lack of US Covid statistics and political party support data, we incorporated information from Jack and Oster (2023) and Elflein (2023).

Jack and Oster (2023) discusses the long-term impacts of COVID-related school closures. From this source, we utilized the dataset on voting shares during the 2020 election by county. Elflein (2023) provides summaries of COVID-19 death rates in the United States as of March 2023, organized by state. Analyzing results from both datasets allows us to explore the relationship between political affiliation and COVID-19 outcomes.Our reproduction aims to fill these gaps and also includes tables and graphs that were not presented in the original paper to support our findings.

## 2.2 Methodology

`R` (R Core Team 2022) was the language and environment used for the bulk of this analysis, alongside `tidyverse` (Wickham et al. 2019), `sf` (Pebesma 2018), `readxl` (Wickham and Bryan 2023), `knitr` (Xie 2014), `janitor` (Firke 2023), `lubridate` (Grolemund and Wickham 2011), `dplyr` (Wickham et al. 2023), `data.table` (Barrett et al. 2024), `RColorBrewer` (Neuwirth 2022), `ggpubr` (Kassambara 2023), `ggplot2` (Wickham 2016), `here` (Müller 2020), `kableExtra` (Zhu 2024), `webshot` (Chang 2023a), `webshot2` (Chang 2023b), `gt` (Iannone et al. 2024), and `scales` (Wickham, Pedersen, and Seidel 2023).

## 2.3 Data Measurement

*A thorough discussion of measurement, relating to the dataset, is provided in the data section.*

## 2.4 Data cleaning

# 3 Results

Our results are summarized in the following figures. **?@fig-ELE** illustrates the trend of life expectancy at birth across different racial groups over time. Table **??** provides a more

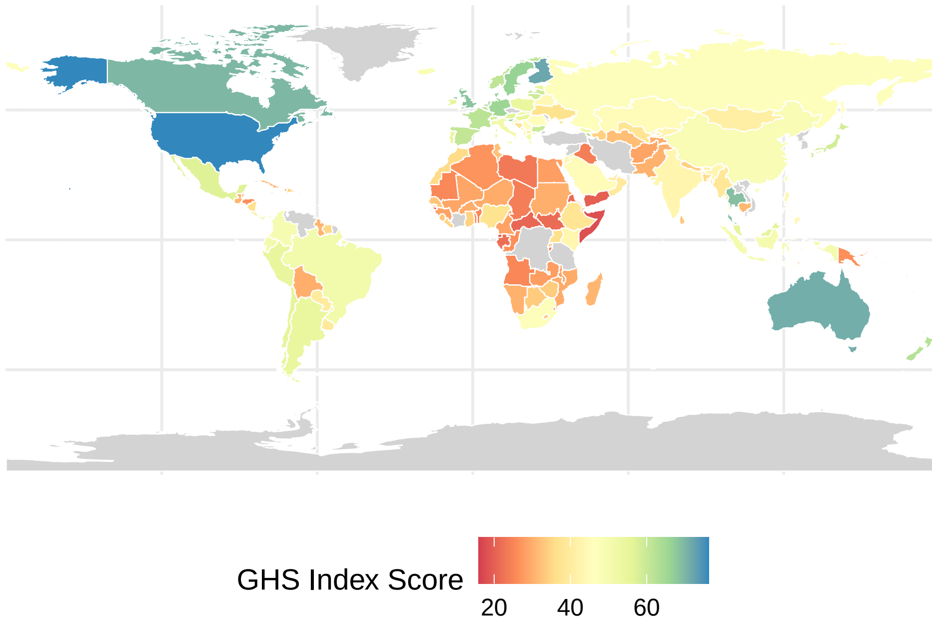


Figure 1: Global Health Security Index Scores by Country

Table 1: Life Expectancy by Race (2019-2021)

detailed breakdown of the life expectancy before and during COVID for... Unfortunately, due to the unavailability of data over time for Asians and American Indian and Alaska Native communities, they have been excluded from the time series graph.

An intriguing observation is the consistently higher life expectancy among Hispanic individuals compared to other groups, even amidst the challenges posed by COVID-19. On the other hand, Black individuals 1 have consistently exhibited lower life expectancy, which further declined notably in 2021, reaching just over 70.8 years old. The life expectancy trends of white people and all other races and origins remain close together throughout the 14 year time period, with minimum variance. Specifically, the life expectancy for White individuals decreased from 78.8 to 76.4 years old from pre-pandemic levels in 2019 to 2021, while for Hispanic individuals, it dropped by 4.2 years, and for Black individuals, it declined by 4 years during the same period.

Figure **??** serves as a valuable addition to our previous analysis with the inclusion of Asians and American Indians and Alaska Natives during the critical period from 2019 to 2021. With these additional ethnic categories, we can discern that American Indians and Alaska Natives experienced significant impacts from the pandemic, with a decrease of 4.7 years in the first year and 1.9 years in the second year, totaling 6.6 years.

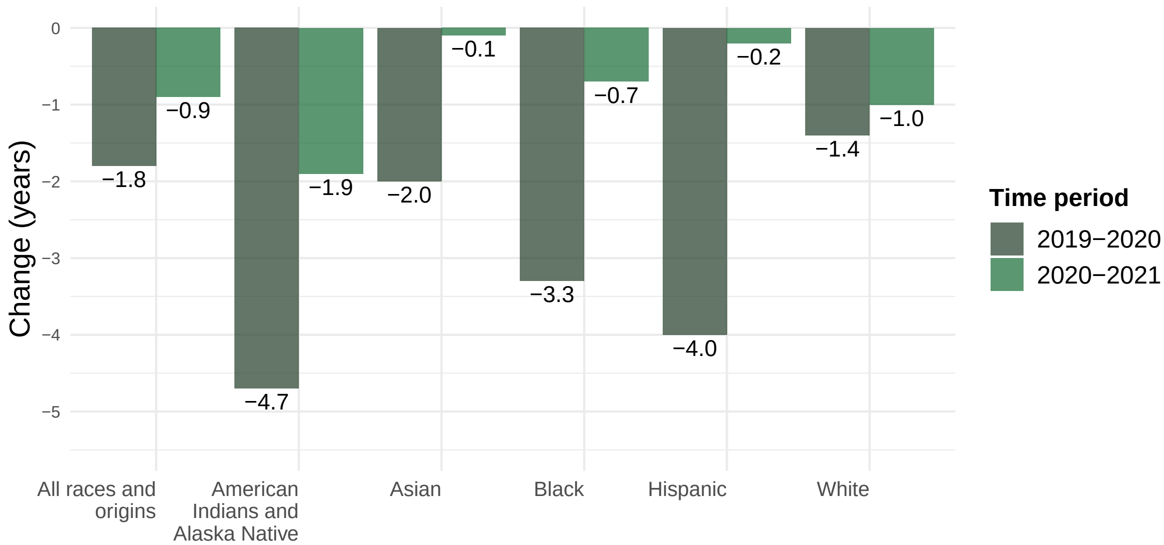


Figure 2: Change in Life Expectancy at Birth from the Previous Year

With a chart that depicts the change of life expectancy each year by ethnicity, we are able to better gain a more comprehensive understanding of the impact of COVID by ethnicity. While the declines in life expectancy are smaller in magnitude from 2020 to 2021, they are notably minimal for Asians and Hispanics, with reductions of -0.1 and -0.2 years respectively. (Insert some sources tmrw)

Numerous sources have indicated a correlation between a state's political affiliation and its handling of COVID issues (sources to be inserted tomorrow). To testify the claim, we collected the voting data for each of the 50 states for the 2020 presidential election. We then selected the ten states with the highest proportions of Republican votes.These voting patterns are visualized in Figure Figure **??**, where red symbols represent Republican votes and blue symbols represent Democratic votes. Among the top ten states, Tennessee recorded the highest total number of votes, while Wyoming boasted the highest proportion of Republican votes.

Given the variation in population sizes among states, direct comparisons of COVID case numbers are inherently flawed. As an alternative, we employed death rates per 100,000 people as a metric for evaluating each state's COVID preparedness and situation. We then produced Table **??** that ranks the top ten states with the highest death rates from COVID per 100,000 people to examine the potential correlation between party preferences and COVID related deaths. Notably, We found that six of the ten top Republican states made a reappearance in the top death rates table; these states are Oklahoma, West Virginia, Arkansas, Alabama, Tennessee, and Kentucky. (Insert quotes about republican party and covid tmrw)

Following from our previous analysis regarding individuals' political affiliations, we have de-

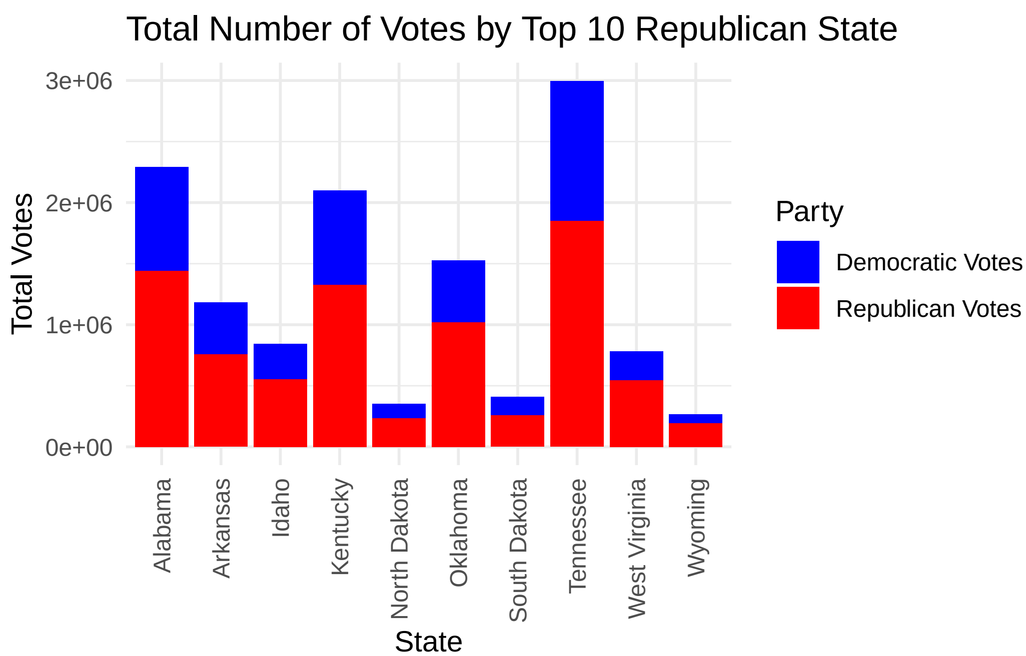


Figure 3: Total Number of Votes in Top 10 States with Highest Proportion of Republican Votes

Table 2: Top 10 States with Highest Death Rates from COVID-19 (per 100,000 people)

veloped Figure Figure **??**, which encompasses all 50 states of the US along with their political leanings based on which party garnered the majority votes. This information is juxtaposed against their respective COVID death rates.

While we cannot make any definitive assertions about stark differences, we do observe that the Republican-leaning states are slightly more clustered around higher death rates ranging from 350 to 450 deaths, while the Democratic-leaning states appear to be more evenly distributed, and notably one Democratic-leaning state has the lowest death rate.An intriguing observation is that although many Republican-leaning states demonstrate higher COVID death rates, it is noteworthy that Arizona, typically considered a Democratic-leaning state, records the highest death rate among all states.

(may add more)

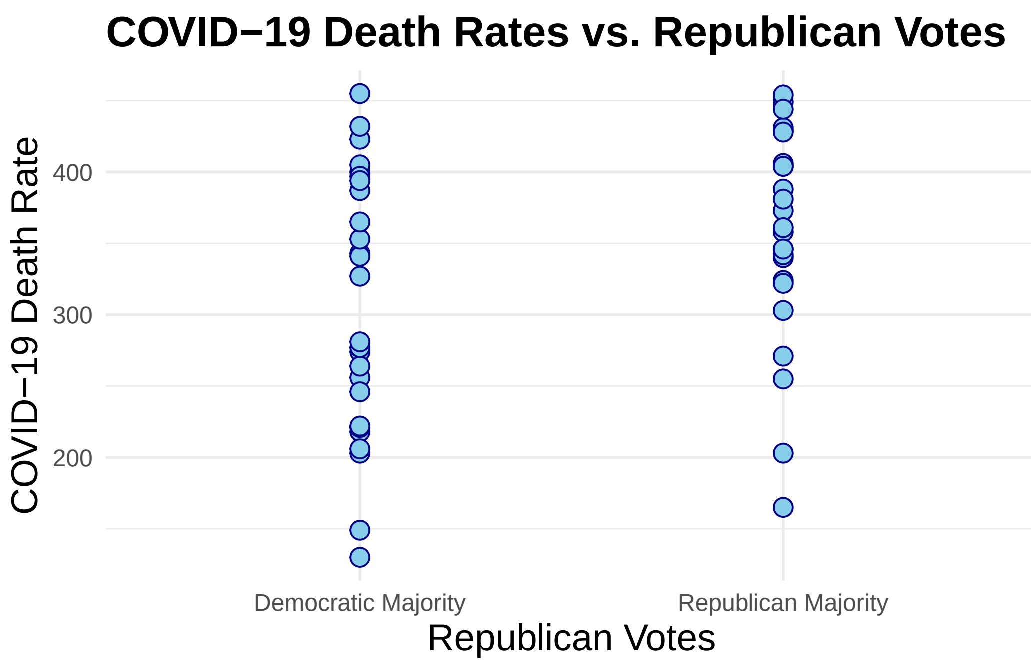


Figure 4: COVID-19 Death Rates vs. Republican Votes

# 4 Discussion

This begs the question as to why we are seeing these results. There isn't exactly a single answer to this question, however we can certainly point out some considerable factors to this result.

## 4.1 Influence of political polarization on adherence to health guidelines.

Political polarization has significantly impacted the adherence to health guidelines during the COVID-19 pandemic. The divergence in political ideologies has translated into differing attitudes towards health directives, including mask mandates, social distancing, and vaccination uptake.

Various studies and our own results have shown that areas with higher support for one political party exhibited distinct behaviors and compliance levels with health recommendations, which directly correlated with COVID-19 case rates and mortality. An news article from `ABC News` (Diab and Kumar 2023) shows that the top states with the highest COVID-19 deaths are Arizona, and Washington with 581 deaths and 526 deaths respectively per 100,000 people. According to 2020 presidential voting data published by `CNN`, we have both states having the electoral vote of democrat with Washington wining by 58% (*2020 Election Results by State, Washington* 2020) and Arizona winning by 49.4% (*2020 Election Results by State, Arizona* 2020). Another news article by `ContagionLive` (Parkinson 2023) also makes the claim of both Arizona and Washington having the highest COVID-19 mortality. This polarization has not only influenced individual behavior but also shaped state and local health policies, further entrenching the disparities in health outcomes.

The adherence to health guidelines are evident in the varied health outcomes observed across the United States. Regions with lower compliance to health directives, often influenced by political leanings, have experienced higher rates of COVID-19 transmission, hospitalizations, and deaths. The disparities in vaccine uptake, driven by political affiliations, have further exacerbated these outcomes, leaving certain communities more vulnerable to the virus and its variants. In order to mitigate the influence of political polarization on public health, it is imperative to depoliticize health guidelines and focus on evidence-based approaches to disease prevention and control. Building trust in health institutions and promoting bipartisan support for public health measures are essential steps towards achieving higher compliance and better health outcomes. Engaging trusted community leaders and utilizing targeted communication strategies can also help bridge the divide and encourage adherence to health guidelines.

## 4.2 Impact of government transparency and consistent communication on public trust.

The politicization of health guidelines and mixed messages from political and health leaders during the COVID-19 pandemic have significantly undermined the effectiveness of public health messaging, leading to confusion, skepticism, and eroded trust among the public. Initially, inconsistencies in recommendations, such as on mask usage, challenged the principle of clear, consistent, and science-based communication essential for an effective public health response. Moreover, the transparency of government actions and decision-making processes is crucial in building and maintaining public trust, especially during health crises. The level of public trust was greatly affected by the openness and accuracy with which governments, at all levels, communicated about the evolving situation, the reasoning behind guidelines, and the measures taken to combat the virus, emphasizing the importance of transparent reporting of data related to case counts, hospitalizations, vaccine distribution, and side effects. Furthermore, consistent communication from public health officials and government leaders is key to ensuring adherence to health guidelines, where inconsistencies, such as changes in mask-wearing guidelines without clear explanations, have led to public confusion. The direct correlation between government transparency, consistent communication, and public behavior is self-evident, with populations receiving clear and transparent information being more likely to adhere to guidelines, participate in testing and tracing efforts, and accept vaccination. Drawing lessons from the pandemic, strategies for improving government transparency and communication in future health emergencies should include establishing centralized information hubs, ensuring regular and predictable communication from health authorities, engaging community leaders in information dissemination, and harnessing digital platforms and social media to amplify public health messages, thus reinforcing public trust and compliance.

## 4.3 Role of social vulnerabilities and healthcare access disparities in pandemic impact.

## 4.4 Strategies for improving real-time data collection and sharing for public health decisions.

To address the fragmentation in data collection and sharing witnessed during the pandemic, it's crucial to establish integrated data platforms that enable seamless health data exchange among various health agencies and stakeholders, utilizing cloud computing and APIs for real-time accessibility and usability. Equally important is enhancing data standardization and interoperability through universal standards like FHIR (Fast Healthcare Interoperability Resources) to facilitate efficient data sharing. Investing in digital surveillance systems, which employ AI and machine learning to sift through diverse data sources for early outbreak detection, is essential for rapid response to health threats. Furthermore, fostering public-private partnerships can harness the agility of the private sector and the public health expertise of governmental agencies to enhance data analytics capabilities. Ensuring the privacy and security of health data through robust governance frameworks and advanced encryption is paramount to maintaining public trust. Engaging communities in these initiatives ensures their relevance and fosters trust, while building global data sharing networks encourages international collaboration, crucial for a concerted response to pandemics. Collectively, these strategies are fundamental to bolstering public health decision-making and preparedness, making our health systems more resilient against the challenges posed by emerging infectious diseases.

### 4.5 Weaknesses and next steps

Weaknesses and next steps should also be included.

# References

*2020 Election Results by State, Arizona*. 2020. CNN. https://www.cnn.com/election/2020/results/state/arizona.

*2020 Election Results by State, Washington*. 2020. CNN. https://www.cnn.com/election/2020/results/state/washington.

Barrett, Tyson, Matt Dowle, Arun Srinivasan, Jan Gorecki, Michael Chirico, and Toby Hocking. 2024. *Data.table: Extension of 'Data.frame'*. https://CRAN.R-project.org/package=data.table.

Chang, Winston. 2023a. *Webshot: Take Screenshots of Web Pages*. https://CRAN.R-project.org/package=webshot.

———. 2023b. *Webshot2: Take Screenshots of Web Pages*. https://CRAN.R-project.org/package=webshot2.

Diab, Dr. Alaa, and Dr. Keerthana Kumar. 2023. *COVID-19 Death Rates Varied Dramatically Across US, Major Analysis Finds*. ABC News. https://abcnews.go.com/Health/covid-19-death-rates-varied-dramatically-us-major/story?id=98055024.

Elflein, John. 2023. "U.s. COVID-19 Death Rate by State." *Statista*. https://www.statista.com/statistics/1109011/coronavirus-covid19-death-rates-us-by-state/.

Firke, Sam. 2023. *Janitor: Simple Tools for Examining and Cleaning Dirty Data*. https://CRAN.R-project.org/package=janitor.

Grolemund, Garrett, and Hadley Wickham. 2011. "Dates and Times Made Easy with lubridate." *Journal of Statistical Software* 40 (3): 1–25. https://www.jstatsoft.org/v40/i03/.

Iannone, Richard, Joe Cheng, Barret Schloerke, Ellis Hughes, Alexandra Lauer, and JooYoung Seo. 2024. *Gt: Easily Create Presentation-Ready Display Tables*. https://CRAN.R-project.org/package=gt.

Jack, Rebecca, and Emily Oster. 2023. "COVID-19, School Closures, and Outcomes." *Journal of Economic Perspectives* 37 (4): 51–70. https://doi.org/https://doi.org/10.1257/jep.37.4.51.

Kassambara, Alboukadel. 2023. *Ggpubr: 'Ggplot2' Based Publication Ready Plots*. https://CRAN.R-project.org/package=ggpubr.

Müller, Kirill. 2020. *Here: A Simpler Way to Find Your Files*. https://CRAN.R-project.org/package=here.

Neuwirth, Erich. 2022. *RColorBrewer: ColorBrewer Palettes*. https://CRAN.R-project.org/package=RColorBrewer.

Nuzzo, Jennifer B., and Jorge R. Ledesma. 2023. *Why Did the Best Prepared Country in the World Fare so Poorly During COVID?* https://www.aeaweb.org/articles?id=10.1257/jep.37.4.3.

Parkinson, John. 2023. *Which States Saw Greatest COVID-19 Mortality?* ContagionLive. https://www.contagionlive.com/view/which-states-saw-greatest-covid-19-mortality-.

Pebesma, Edzer. 2018. "Simple Features for R: Standardized Support for Spatial Vector Data." *The R Journal* 10 (1): 439–46. https://doi.org/10.32614/RJ-2018-009.

R Core Team. 2022. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. https://ggplot2.tidyverse.org.

Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D'Agostino McGowan, Romain François, Garrett Grolemund, et al. 2019. "Welcome to the tidyverse." *Journal of Open Source Software* 4 (43): 1686. https://doi.org/10.21105/joss.01686.

Wickham, Hadley, and Jennifer Bryan. 2023. *Readxl: Read Excel Files*. https://CRAN.R-project.org/package=readxl.

Wickham, Hadley, Romain François, Lionel Henry, Kirill Müller, and Davis Vaughan. 2023. *Dplyr: A Grammar of Data Manipulation*. https://CRAN.R-project.org/package=dplyr.

Wickham, Hadley, Thomas Lin Pedersen, and Dana Seidel. 2023. *Scales: Scale Functions for Visualization*. https://CRAN.R-project.org/package=scales.

Xie, Yihui. 2014. "Knitr: A Comprehensive Tool for Reproducible Research in R." In *Implementing Reproducible Computational Research*, edited by Victoria Stodden, Friedrich Leisch, and Roger D. Peng. Chapman; Hall/CRC.

Zhu, Hao. 2024. *kableExtra: Construct Complex Table with 'Kable' and Pipe Syntax*. https://CRAN.R-project.org/package=kableExtra.