THESIS

THE ASSOCIATION BETWEEN POLITICAL ENVIRONMENT AND COVID-19 MORTALITY IN SELECTED COLORADO COUNTIES

Submitted by

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ABSTRACT

THE ASSOCIATION BETWEEN POLITICAL ENVIRONMENT AND COVID-19 MORTALITY
IN SELECTED COLORADO COUNTIES

The SARS-CoV-2 virus spread worldwide triggering a global Coronavirus (COVID-19) pandemic. COVID-19 remains a public health threat today and may continue to do so into the future dependent on the emergence of variants and our ability to mitigate harm through vaccines and other public health measures. The COVID-19 pandemic struck the United States during a time of great political tension and divide under the administration of President Donald Trump. State-level variation in mitigation measures may have been influenced by political views. COVID-19 mortality rates also varied by county. This paper seeks to investigate whether the county-level political environment was associated with differences in COVID-19 mortality in the state of Colorado.

We examined the association between political environment and county-level age-adjusted COVID-19 mortality rates during 2020 and 2021. Political environment is measured using data from the 2016 and 2020 Presidential election vote distribution by county, obtained from the Colorado Secretary of State. Outcome data was obtained from the Colorado Department of Public Health and Environment (CDPHE), having already been age-adjusted using direct standardization based on the 2010 Census. Any counties with 3 of fewer deaths in a calendar year were excluded, leaving a total of 48 counties in 2020 and 56 in 2021. Rate ratios and 95% confidence intervals were estimated using Quasi-Poisson regression models, separately for 2020 and 2021 mortality data. The models were adjusted for population density, the percentage of county residents without health insurance, and the demographics percentile from the Colorado EnviroScreen Environmental Justice Tool. Models were further evaluated for the presence of effect modification by population density.

There are a total of 64 counties in the state of Colorado. In the 2016 election, 42 counties voted for Donald Trump. In the 2020 election, that dropped to 40 counties. Age-adjusted mortality rates ranged from 14.3-458.0 per 100,000 over the two years of data. For 2021 mortality data, the estimated mean adjusted mortality rate was 78% higher among counties where aggregated individual votes were highest in percentage for Donald Trump in 2016 as compared to counties with highest vote percentage for Hilary Clinton. (RR = 1.78; 95% CI: 1.26-2.59). For 2020, the estimated mean adjusted mortality rate was found to be 24% higher among counties voting in highest percentage for Donald Trump in 2016 as compared to counties voting in highest percentage for Hilary Clinton, though this association was not statistically significant. (RR=1.24; 95% CI: 0.81-1.94). Similar results were observed for the 2020 election data (comparing county-level voting results for Trump vs. Biden). We did not observe evidence that the association was modified by population density.

This study observed an association between county-level political environment and age-adjusted COVID-19 mortality rates, specifically finding an association that became statistically significant during the pandemic. These results build on a growing body of evidence studying the links between politics and COVID-19 outcomes. Strengths of this study include the use of publicly available datasets, state-wide analysis, multiple model options with similar results indicating robustness, and utilization of a novel environmental justice metric to adjust for multiple confounders simultaneously. As this was an ecological study, inference cannot be extended to individuals. Future research may want to further explore both the individual and community political exposures that may influence mortality. It may also be suggested to investigate election data as a continuous rather than binary variable to tease out the relationship in more detail. Studies such as this may be useful as the COVID-19 pandemic is still ongoing, and in preparation for any future pandemics.

ACKNOWLEDGEMENTS

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I would like to thank the serendipitous timing of the pandemic itself for getting me back into the field of public health. I am thankful for the opportunities given to me by the CDC Foundation through grant funded COVID-19 relief job placement, for the wonderful and tireless staff of Tri-County Health Department, for all the team leaders and coordinators I got to know in that time and space, and for all those out there still doing this work. Although the word unprecedented gets thrown around a lot these days, the position we were in was often just that – unprecedented. I thank you all for your hard work and dedication, for your quest for knowledge and curiosity in the face of a novel virus, for your flexibility and kindness during a time of great uncertainty. This has been difficult work, but it is work worth doing.

During the height of the pandemic, I was hired by the CDC Foundation to work on the COVID-19 response, part of the surge hiring that was done to address rising case numbers. I was assigned to a health department here in Colorado that spanned three diverse counties. The political tension ran so high that the county commissioners for one county voted to leave the health department. We were faced with daily changes, sometimes finding out about major decisions within the health department from the news before we were told directly. The outspoken disagreement the county level officials had with the policies of the health department in regard to the pandemic trickled out to the residents. County residents started asking more questions, started to push back more on isolation and quarantine guidance.

When I left this work to come back to school, I made a promise to my team that I would do this research. What we saw every day, the misinformation that we were combatting, the doubt towards those of us in public health are experiences that I struggle even now to put into words. It could easily be chalked up to anecdotal evidence and waved away, sure. I felt like it was bigger than that.

I also noticed pretty early on in the pandemic that counties that had similar population numbers here in Colorado were seeing what appeared to be huge differences in their case counts, in the number of hospitalizations, in the number of deaths. Knowing that I couldn't draw any conclusions without having all the data in front of me, without running age-adjusted rates, without controlling for confounding, I knew that I needed to do this research. I needed to see if there really was an association this larger idea of county-level political environment and COVID-19 mortality. This is that research.

I would be remiss if I did not hold a space here for all those we have lost to COVID-19. They are the true inspiration for this work. Each and every person lost to this virus, that we are still losing every day even now, they were all deeply loved and are greatly missed. Let us who are doing this work never lose sight of the truth that these numbers presented here today aren't just numbers: they were all individual people with friends and families, with passions and gifts, and with communities that weren't done needing them yet when they were taken. May we never stop looking for ways to keep people safe, my fellow epidemiologists.

I want to thank my friends and family near and far for nudging me to do this research, for insisting that I *needed* to do this research. I especially want to thank my brother, Gary, for the constant dose of reality checks in my life, Lynette for being on this wild long-distance ride with me, and Heather for always being the one encouraging me to keep swimming upstream.

I want to thank my children for encouraging me and pushing me and believing in me, for understanding when I needed to work on this project, for being patient enough to listen to me and sit

with me. For recognizing when I needed a hug or a long walk with one of my kids. You make me want to change the world (to infinity and beyond). I'm so proud of you all, and I hope you're proud of me too. Love you more first.

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CHAPTER 1 – INTRODUCTION

The intersecting fields of public health and epidemiology work endlessly trying to gather the most current, most scientifically accurate information about potential hazards and risks to health, on a joint mission to better inform the policy makers, the health care system, and ultimately, to protect the general public. We strive to find associations, to build evidence, to find the truth about all that ails us as human beings, and yet there are times that we may not have any idea what we are about to face.

In infectious disease, there are the agents known to us and a vast mystery in all those still unknown. Although we had known and become familiar with several different coronaviruses prior to 2019, the news out of China in the late fall that year was unsettling. This one was new, it was different, it was novel. It would come to be known as SARS-CoV-2.

International groups and individual nations had been preparing for an event such as this, including the United States. Influenza outbreaks in the 1970s led to the initiation of the Federal Interagency Working Group on Influenza, then a formal surveillance and planning recommendation came from the Institute of Medicine in the 1980s. These events led to the creation of the Council of State and Territorial Epidemiologists. Anthrax attacks upped the game and made people realize they needed to prepare for more than just influenza. An outbreak of SARS led to increased funding in the 1990s, and a more focused approach on preparation for potential outbreaks, and even pandemics (Iskander et al., 2013).

The past twenty years have seen more organized pandemic preparation, more surveillance, more data collection, more modeling. There were gaps that became critical, though, once the SARS-CoV-

2 virus arrived on our shores in early 2020. We clearly weren't ready. A stockpile of Personal Protective Equipment (PPE) that had been depleted during the H1N1 pandemic in 2009-10 and had not been restocked by then President Obama, not by Congress, and not by the President in 2020, Donald Trump. It simply had not been a funding priority for anyone with the legal authority to replenish it all. In addition to the shortages, we realized quickly that we did not seem to have the capacity to manufacture enough masks or testing materials domestically. Medical staff nationwide were forced to reuse N95 masks for quite some time, other protective equipment was in short supply, and tests were not widely available (*Depleted National Stockpile Contributed to COVID PPE Shortage*, n.d.).

The Global Health Security Directorate within the National Security Council charged with preparing for future pandemics was ended in May 2018, though it has since been claimed this decision did not affect the nation's response to the COVID-19 pandemic less than two years later (*Trump Disbanded NSC Pandemic Unit That Experts Had Praised*, 2021). President Trump proposed massive cuts to the Centers for Disease Control and National Institutes of Health as soon as he took office, continuing to press for cuts even during the height of the pandemic (*SBC Trump Budget Public Health Fact Sheet 2-12-20 FINAL.Pdf*, n.d.).

It could be argued that there was never not a time when the COVID-19 pandemic was politicized. Rather, from even before cases were first detected on our shores, there was a rhetoric that emerged about the virus. The collision between politics and public health was on display on the news every day.

President Trump downplayed the threat of the virus in the early months with statements such as, *"It's going to disappear. One day, like a miracle, it will disappear."* (Goldberg, n.d.). The suggestion that the virus was not a threat gave many Americans a false sense of security and put mitigation efforts at odds with the level of the threats many people perceived.

Masks were a contentious issue from the start, and the initial guidance was that they may not be effective, when in reality it was known that the stockpile had been depleted and the most pressing concern was ensuring an adequate supply for healthcare providers. Perhaps greater transparency about that from the beginning would have reassured the public. As scientists learned more about the virus, that guidance changed and masks were recommended for everyone, mandated in many places. Some communities saw that shift in guidance as evidence that those in charge of making decisions did not know what they were doing, or that perhaps were not being fully honest. In truth, though, this was a rare opportunity for the general public to witness the scientific process playing out in real time. This disconnect contributed to undermining trust in public health institutions for some communities (*Face Masks in the US: Why Guidance Has Changed so Much | CNN*, n.d.).

Many people in positions of leadership began to push back openly on mask mandates, working from home and limiting social interaction, advocating for individual freedom and liberty instead. Some saw the threats to their jobs and restrictions on gatherings as worse than the existential threat of the virus. Early in the pandemic, masks were one of the few mechanisms we had at the time to reduce the spread of the virus (Victor et al., 2020), but it was not something that everyone ever agreed upon. It became evident quickly that a political divide was emerging in regard to masks, social distancing, and the virus in general. Those dividing lines followed closely along with who someone voted for in the 2016 election (Atske, 2020).

From the beginning of the pandemic, President Trump made clear that he was not going to issue any stay-at-home orders, insisting those decisions were best left to the states. States were left to make their own decisions about mitigation measures, which varied widely. Colorado's steps are detailed in the next Chapter, leading to the basis for this research. County level decisions and control took center stage early on in the pandemic. The stay-at-home order issued in Colorado lasted only 30 days, after which time the state shifted to a metric of guidelines that were intended to help counties make decisions about reopening, in person work and school, restaurant and bar reopening, and gathering. Some counties enacted even stricter guidance than the state metric suggested, while others elected to not enforce many restrictions, if any (Swidler, n.d., Duggan, n.d.).

The aim of this research has been to evaluate the association between the variation in county level political environment and COVID-19 mortality, while adjusting for the percentage of the population without insurance, population density, and the various county-level demographic characteristics as captured by the demographics percentile from the Colorado EnviroScreen Environmental Justice tool (*Colorado EnviroScreen | Department of Public Health & Environment*, n.d.).

Resources

Atske, S. (2020, March 18). U.S. Public Sees Multiple Threats From the Coronavirus – and Concerns Are Growing. *Pew Research Center - U.S. Politics & Policy*. https://www.pewresearch.org/politics/2020/03/18/u-s-public-sees-multiple-threats-from-the-coronavirus-and-concerns-are-growing/

Collier, R. (2017). Massive cuts to science and medicine in Trump budget. *CMAJ : Canadian Medical Association Journal*, *189*(23), E812–E813. https://doi.org/10.1503/cmaj.1095437

Depleted National Stockpile Contributed to COVID PPE Shortage. (n.d.). FRONTLINE. Retrieved January 31, 2023, from https://www.pbs.org/wgbh/frontline/article/depleted-national-stockpile-contributed-to-covid-ppe-shortage/

Duggan, P. F. and K. (n.d.). *Weld County adopts "safer-at-work" guidelines in defiance of state's safer-at-home guidelines*. Fort Collins Coloradoan. Retrieved January 25, 2023, from https://www.coloradoan.com/story/news/2020/04/24/coronavirus-colorado-weld-county-defies-state-recommendation-safer-at-work/3018852001/

Face masks in the US: Why guidance has changed so much | CNN. (n.d.). Retrieved February 13, 2023, from https://www.cnn.com/2020/07/19/health/face-masks-us-guidance/index.html

Goldberg, D. (n.d.). *'It's going to disappear': Trump's changing tone on coronavirus*. POLITICO. Retrieved January 25, 2023, from https://www.politico.com/news/2020/03/17/how-trump-shifted-his-tone-on-coronavirus-134246

Iskander, J., Strikas, R. A., Gensheimer, K. F., Cox, N. J., & Redd, S. C. (2013). Pandemic Influenza Planning, United States, 1978–2008. *Emerging Infectious Diseases*, *19*(6), 879–885. https://doi.org/10.3201/eid1906.121478

Maxmen, A. (2021). Has COVID taught us anything about pandemic preparedness? *Nature*, *596*(7872), 332–335. https://doi.org/10.1038/d41586-021-02217-y

SBC Trump Budget Public Health Fact Sheet 2-12-20 FINAL.pdf. (n.d.). Retrieved January 31, 2023, from https://www.budget.senate.gov/imo/media/doc/SBC%20Trump%20Budget%20Public%20Health%20Fact%20Sheet%202-12-20%20FINAL.pdf

Swidler, F. (n.d.). *What The Different Color Levels Of 'Safer At Home' Mean For Coronavirus In Colorado*. Colorado Public Radio. Retrieved January 25, 2023, from https://www.cpr.org/2020/10/27/safer-at-home-colorado-level-3/

Trump disbanded NSC pandemic unit that experts had praised. (2021, April 20). AP NEWS. https://apnews.com/article/donald-trump-ap-top-news-virus-outbreak-barack-obama-public-health-ce014d94b64e98b7203b873e56f80e9a

Victor, D., Serviss, L., & Paybarah, A. (2020, October 2). In His Own Words, Trump on the Coronavirus and Masks. *The New York Times*. https://www.nytimes.com/2020/10/02/us/politics/donald-trump-masks.html

CHAPTER 2 - MANUSCRIPT

The Association Between Political Environment and COVID-19 Mortality in Selected Colorado Counties

Kelly DeBie

Abstract

Background: *The SARS-CoV-2 virus spread worldwide triggering a global COVID-19 pandemic. COVID-19 remains a public health threat today and may continue to do so into the future dependent on the emergence of variants and our ability to mitigate harm through vaccines and other public health measures. The COVID-19 pandemic struck the United States during a time of great political tension and divide under the administration of President Donald Trump. State-level variation in mitigation measures may have been influenced by political views. COVID-19 mortality rates also varied by county. This paper seeks to investigate whether county-level political environment was associated with differences in COVID-19 mortality in the state of Colorado.*

Objectives: *We examined the association between political environment and county-level age-adjusted COVID-19 mortality rates during 2020 and 2021, with political environment measured by election results in the 2016 Presidential election in the state of Colorado.*

Methods: *We examined the association between political environment and county-level age-adjusted COVID-19 mortality rates during 2020 and 2021. Political environment is measured using data from the 2016 and 2020 Presidential election vote distribution by county, obtained from the Colorado Secretary of State. Outcome data was obtained from the Colorado Department of Public Health and Environment (CDPHE), having already been age-adjusted using direct standardization based on the 2010 Census. Any counties with 3 of fewer deaths in a calendar year were excluded, leaving a total of 48 counties in 2020 and 56 in 2021. Rate ratios and 95% confidence intervals were estimated using Quasi-Poisson regression models, separately for 2020 and 2021 mortality data. The models were adjusted for population density, the percentage of county residents without health insurance, and the* *demographics percentile from the Colorado EnviroScreen Environmental Justice Tool. Models were further evaluated for the presence of effect modification by population density.*

Results: *There are a total of 64 counties in the state of Colorado. In the 2016 election, 42 counties voted for Donald Trump. In the 2020 election, that dropped to 40 counties. Age-adjusted mortality rates ranged from 14.3-458.0 per 100,000 over the two years of data. For 2021 mortality data, the estimated mean adjusted mortality rate was 78% higher among counties where aggregated individual votes were highest in percentage for Donald Trump in 2016 as compared to counties with highest vote percentage for Hilary Clinton. (RR = 1.78; 95% CI: 1.26-2.59). For 2020, the estimated mean adjusted mortality rate was found to be 24% higher among counties voting in highest percentage for Donald Trump in 2016 as compared to counties voting in highest percentage for Hilary Clinton, though this association was not statistically significant. (RR=1.24; 95% CI: 0.81-1.94). Similar results were observed for the 2020 election data (comparing county-level voting results for Trump vs. Biden). We did not observe evidence that the association was modified by population density.*

Discussion: *This study observed an association between county-level political environment and age-adjusted COVID-19 mortality rates, specifically finding an association that became statistically significant during the pandemic. These results build on a growing body of evidence studying the links between politics and COVID-19 outcomes. Strengths of this study include the use of publicly available datasets, state-wide analysis, multiple model options with similar results indicating robustness, and utilization of a novel environmental justice metric to adjust for multiple confounders simultaneously. As this was an ecological study, inference cannot be extended to individuals. Future research may want to further explore both the individual and community political exposures that may influence mortality. It may also be suggested to investigate election data as a continuous rather than binary variable to tease out the relationship in more detail. Studies such as this may be useful as the COVID-19 pandemic is still ongoing, and in preparation for any future pandemics.*

Introduction

The first case of COVID-19 was detected in the United States in late January 2020 (CDC, 2022). The first case in the state of Colorado was identified March 5, 2020 (*Colorado Has First Positive Case of COVID-19 | Colorado COVID-19 Updates*, n.d.). There was no stay-at-home order issued at the federal level. Instead, President Trump communicated his thoughts early on that the virus was not a very serious threat, minimizing the risk to the population with statements such as*, "It's going to disappear. One day, it's like a miracle, it will disappear*", (Goldberg, n.d.).

Due to the fact that there were no nationwide decisions made regarding the issuance of stay-at-home orders, those decisions were left to the states and territories. Between March and May, forty-two states and territories issued stay at home orders (Moreland, 2020). States with Democratic Governors were quicker to adopt stay at home orders and other mitigation efforts at the state level, which was connected to slower increasing case rates (Shvetsova et al., 2022).

In the state of Colorado, Governor Jared Polis issued a stay-at-home order on March 26 which was set to last only for 30 days (Swidler, n.d.). Upon expiration of that order, the state shifted to a Safer-at-Home metric of guidelines that counties were intended to use to make decisions about in-person reopening of businesses, restaurants and bars, schools, and workplaces. The metric was also intended to serve as guidance for implementation of mitigation measures such as mask requirements, capacity limitations, and restrictions on in-person gatherings. There was near immediate variation statewide in terms of how those guidelines were used to shape decisions in each county. Some counties such as Denver County implemented more stringent restrictions than the state metrics recommended, while other counties like Weld County openly and publicly expressed intent to ignore the guidelines and to fully reopen businesses instead (Swidler, n.d., Duggan, n.d.). County level decisions consequently became particularly important.

During this time, the local health departments in Colorado also came under fire for COVID-19 work, with many being targeted for vandalism, threats of violence, and doxxing of employees, primarily done by people unhappy with the reality of the pandemic, those who were refusing isolation and quarantine orders, and people who were generally not believing that the virus was a real threat *(Birkeland, n.d.).* The political rhetoric about the virus itself or mitigation measures to control the spread of the virus eventually led to such disunity in some areas that health departments lost funding, had high level resignations or terminations. In one Colorado case, the health department dissolved entirely after multiple member county commissioners voted to leave (Daley, n.d*., Tri-County Health Department Set to Completely Dissolve on Dec. 31*, 2022).

As this has been a rapidly changing experience with a novel virus, the number of studies on factors influencing COVID-19 outcomes were few in the beginning but grew over time. Given the highly charged political environment, it did not take long for researchers to start finding ways to study the connections between politics and COVID-19.

An early study focused on trying to ascertain what groups of people were most likely to die evaluating socioeconomic factors and the political party the county voted for in a given jurisdiction. At that time, very early in the pandemic, counties voting for Hilary Clinton in the 2016 election had a significantly higher mortality rate (Feinhandler et al., 2020). Those early results would gradually begin to shift into the summer of 2020, and trend the other direction. By July and August, the counties voting in largest percentage for Trump started to see their death rates rise (Morris, 2021, Chen & Karim, 2021).

Early studies found partisan differences in social distancing with more conservative areas retaining a higher level of mobility using geotracking data (Gollwitzer et al., 2020, Ingram et al., 2021, Desmet & Wacziarg, 2022, Jalali et al., 2022). Conservatism was also found to be associated with lower mask usage (Gonzalez et al., 2021), and declined early vaccine doses even among healthcare workers (Toth-

Manikowski et al., 2022). One study found that areas later to adopt mitigation measures were more conservative, and that the mitigation measures once installed were less likely to be successful (Amuedo-Dorantes et al., 2021).

Differences found in the variety and depth of information published on local government websites about COVID-19 associated with the overall partisanship of a county (Hansen et al., 2021). Behaviors aligning with rugged individualism were found to impact the degree of collective action taken to mitigate the effects of the pandemic (Bazzi et al., 2021). A long and detailed article published in early 2021 by *The Lancet* laid out the failings of the Trump administration in the management of the pandemic (Woolhandler et al., 2021). Higher rates of conservative voters in a county were found to be associated with lower perceptions of pandemic related risks (Barrios & Hochberg, 2021).

More recent studies have sought to study the relationships between politics and COVID-19 outcomes. One linked individual level political party by registration to excess mortality rates during the pandemic (Wallace et al., 2022). A Florida study found that counties voting Republican had overall worse COVID-19 outcomes data (Bernet, 2021), though this study only utilized data through March 2021 and may not have considered overdispersion in the model used. A study was done on the degree of change between 2016-2020 voting patterns and how that change was associated with the NY Times COVID-19 mortality data set (Parzuchowski et al., 2021).

This research was done with the intention to study the relationship between political environment and COVID-19 mortality. County level analysis was chosen here for several reasons related to political environment. First, the reality that in a pandemic with a respiratory pathogen, our exposure and risk were not only defined by individual behaviors but also by the people in the community around us. Second, decisions about mitigation and belief in COVID-19 conspiracy theories generally followed in line with who someone voted for in the election (Atske, 2020, Parker & Stern, 2020). Party affiliation alone was not selected here to be utilized as a predictor because there is a high percentage of unaffiliated voters in Colorado with unaffiliated voters ranking higher in percentage statewide than both Democrats and Republicans (“Policy”, n.d.). It would also be nearly impossible to draw any conclusions about the influence of political affiliation from county level elected officials, including those who held great decision-making power in this timeframe, because those positions are officially non-partisan. County level decisions regarding masking requirements and other mitigation measures were thus made on an officially, even if perhaps not effectively, non-partisan basis. Thus, presidential vote data was a good proxy for political environment at the county level.

In this volatile and varied environment, and in the context of highly politicized pandemic for a respiratory pathogen, different approaches taken by different counties may have made a difference in terms of COVID-19 outcomes. We aimed to explore whether differences in political environment, measured by the 2016 Presidential election vote distribution, were associated with county-level COVID-19 mortality in 2020 and 2021 in Colorado.

Methods

Study Design and Population

The aim of this ecological study was to explore the association between age-adjusted COVID-19 mortality rates and political environment at the county level within the state of Colorado.

Colorado resides in the Mountain West region of the United States, but contains deserts, plains, and urban areas in addition to the mountains. The Front Range area of Colorado runs from the Wyoming border on the North side down and along the Eastern slope of the mountains until it reaches Colorado Springs. The most densely populated counties are found along the Front Range.

There are a total of sixty-four counties in the state of Colorado. Sixteen counties lacked outcome data for 2020, eight lacked outcome data for 2021. Counties were excluded from the analysis for missingness in the data. The largest county excluded from the dataset for missingness over both years was Pitkin County in 2021, with a total population of 17,349. All other excluded counties had significantly smaller populations.

Outcome

The outcome of interest was age-adjusted COVID-19 mortality rates in 2020 and 2021. Inclusion was dependent on the use of ICD-10 Code U07.1 and pertains only to death certificates where COVID-19 was listed as the primary or underlying cause of death. Data obtained from the Colorado Department of Public Health and Environment (CDPHE) only reflected counties that had more than 3 deaths per calendar year. Although this was intended to be a statewide analysis, a total of forty-eight counties in 2020 and fifty-six in 2021 were included based on outcome data availability. The purpose of the CDPHE redaction was to limit any potential identification of individual cases. Any county with 3 or fewer deaths annually from COVID-19 thusly was not used in the calculation of the age-adjusted mortality rates obtained from CDPHE. Although this exclusion basis primarily impacted counties with very small absolute population numbers, there were still several counties fully included in the analysis with fewer than 5,000 residents. Mortality rates were adjusted by CDPHE using direct standardization and the 2000 United States census population.

Exposure

The primary exposure variable in this analysis was the binary 2016 Presidential election vote outcome in each county, based on raw election data from the Secretary of State of Colorado. Data was selected from the publicly available dataset specific to the number of votes for the Republican and Democratic candidates as well as the total number of votes cast in each county. Counties that voted with the highest percentage for the Republican candidate, Donald Trump, were considered exposed. Counties that voted with the highest percentage for the Democratic candidate, Hilary Clinton, were considered unexposed. Models were also run using the 2020 Presidential election vote outcome, considering counties voting in highest percentage for Donald Trump to be exposed and counties voting in highest percentage for Joe Biden to be unexposed.

Covariates

Additional variables included in the analysis were population density, the uninsured rates in each county, and the Demographics Percentile metric designed for the EnviroScreen Environmental Justice tool (*Colorado EnviroScreen | Department of Public Health & Environment*, n.d.).

Population Density: Population density is included for two related reasons. First, the idea that transmissibility of a contagious respiratory virus would be higher in a more densely populated area. Second, to reflect the diversity in land use throughout the state, one with urban, rural, mountainous, desert, and suburban areas. Population density data was obtained from the Colorado Department of Local Affairs, State Demography Office in raw numbers of people per square mile. This was used further to construct a binary variable for high- and low-density counties for the secondary analysis.

Uninsured Rates: The uninsured rates represent the percent of the county population that lacks any form of insurance coverage. Those with Medicare and Medicaid are considered insured for the purpose of this metric. This data was obtained from The Colorado Health Institute.

EnviroScreen Demographics Percentile: EnviroScreen is an interactive mapping tool created by CDPHE (*Colorado EnviroScreen | Department of Public Health & Environment*, n.d.). Metrics incorporate information on income and demographics into one measurement useful for comparing counties in Colorado, downloadable from their website directly. EnviroScreen models environmental risk and disparate impact at the county level. The inclusion of this metric allows for the simultaneous consideration of a multitude of variables, and potentially demonstrates the utility of this measure as used in epidemiologic research. Higher percentile scores in this metric are indicative of a higher impact on communities at risk. Alternatively, a lower score means that a county is less burdened.

Statistical Analysis

To account for overdispersion in the data, Quasi-Poisson regression models were run separately for mortality data in 2020 and 2021. Data was only available on an aggregate annual basis. The models were run separately due to differences in the mechanisms in which political environment may be related to mortality outcomes. In the earlier year of the pandemic, politics seemed to play a larger role in mitigation measures, social distancing, mask mandates, closures, and remote schooling decisions (Gollwitzer et al., 2020). In the second year of the pandemic, the influence of political ideation appears to have switched more to vaccination status. The relationship between county level vaccination rates and mortality has been demonstrated (McLaughlin et al., 2022).

The primary model utilized a binary predictor based on the presidential election data in a Quasi-Poisson regression with Republican and Democrat set at the binary options. There were no counties that had a candidate from another party with more votes than the Republican and Democratic candidates. The highest percentage of votes received by any other party candidate was 6.4% in Mineral County, for the Libertarian candidate, Gary Johnson. A likelihood ratio test was used to determine whether the inclusion of presidential vote in the model against a reduced model was statistically significant.

Effect modification by population density was also explored through the introduction of a product term for the election data with a binary representation of population density. High density populations were those with more than 100 people per square mile. Low density populations were those counties with 100 or fewer people per square mile. Rate ratios were obtained along with 95% confidence intervals and p-values. Secondary analysis was done using the 2020 Presidential election data as the predictor versus 2016.

We considered negative binomial regression models in a separate sensitivity analysis as comparison to the Quasi-Poisson models. Likewise, there was also a comparison model constructed utilizing a broader Health and Social Factors Percentile Score from the EnviroScreen dataset.

Statistical analyses were primarily performed in R, version 4.2.1, with some preliminary data cleaning conducted using Microsoft Excel.

Results

There are sixty-four counties in the state of Colorado. Forty-eight counties had data available for the 2020 mortality rates, and fifty-six had available data for the year 2021. Missingness in the data occurred as the result of censoring counties with a small number of deaths to avoid any possibility of identification of individuals. Although those excluded counties were generally among the least populated in the total sample, there were five counties included in both years of the analysis that have fewer than 5,000 residents each: Cheyenne, Sedgwick, Costilla, Phillips, and Washington. Distribution of characteristics among those selected counties are shown in Table 1. Data on all 64 counties included in the Supplemental Material, Table S1.

Approximately 10% of the county residents measured here were found to be lacking health insurance coverage. The lowest percentage of uninsured residents statewide was 3%, the highest 17%.

Population density has a substantial range in the state of Colorado, reflecting the wide range of land types and use within the state. The least densely populated counties fall below one person per square mile. Notably, the population density 75th percentile is reflected by 48.35 people per square mile, primarily because the highest populated counties are few in number. The maximum density is found in Denver County at 4,586.68 people per square mile, quite a departure from even the 75th percentile value.

The Demographics Percentile is a constructed metric designed by CDPHE for EnviroScreen with the purpose of allowing comparison between and among the counties within Colorado. It is intended to be a way to show disproportionate impact within the state scaled from 0-100. The higher the percentile score is, the greater the disproportionate impact for the residents of that particular county. The lower the demographics percentile score is, the lower the disproportionate impact experienced by residents of that county as a whole.

Table 1
Characteristics of Selected Counties in Colorado for 2020 & 2021
Counties selected for each year based on availability of mortality data from CDPHE.

	Mean	Standard Deviation	Median	25th-75th Percentile
2020, n=48				
Age-adjusted COVID-19 mortality rate per 100,000	78.3	47.0	69.1	38.8-97.3
Percentage of the County that is Uninsured	10.0	3.9	10.0	7.0-13.0
Population Density (people per square mile)	225.5	733.9	16.3	5.6-47.4
Demographics Percentile from EnviroScreen Tool	55.9	29.0	58.6	35.2-80.1
2021, n=56				
Age-adjusted COVID-19 mortality rate per 100,000	111.96	76.92	97.70	58.18-147.58
Percentage of the County that is Uninsured	10.0	3.7	10.0	7.0-13.0
Population Density (people per square mile)	194.3	682.8	12.7	4.4-35.7
Demographics Percentile from EnviroScreen Tool	55.2	28.2	57.0	35.2-78.5

Mapped data regarding population density of the counties in Colorado presented in Figure 1.

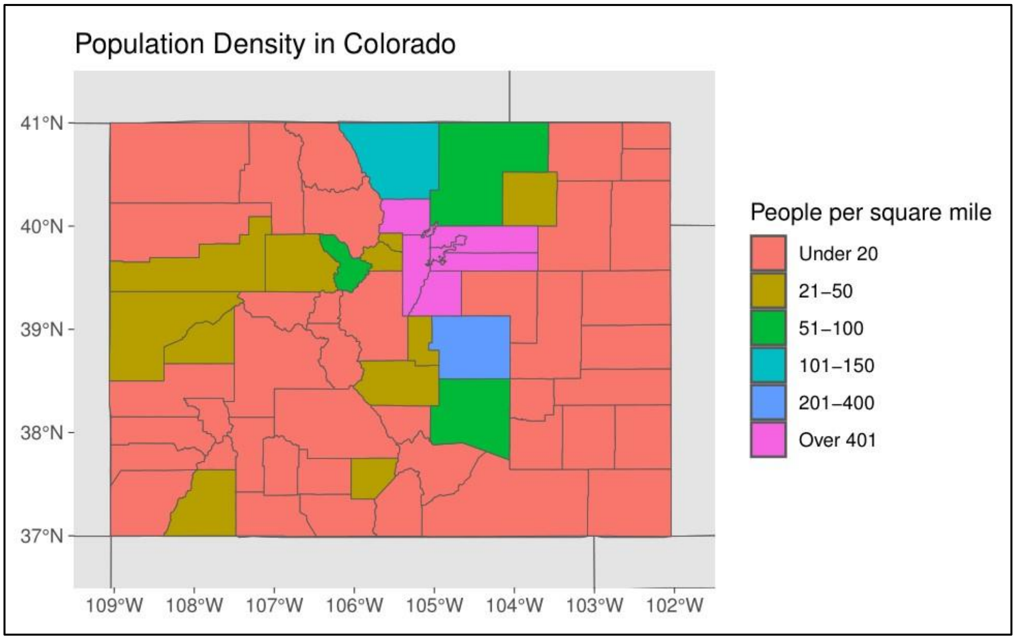

Figure 1: Population Density of Counties in Colorado

The most densely populated areas of Colorado reside along the Front Range, with the less densely populated areas spanning the mountain, desert, and plains regions.

Results for both the 2016 and 2020 data are presented visually in Figure 2.

The primary model utilized election data from the 2016 Presidential election. For 2021, the rate ratio was *1.78 (95% CI: 1.26-2.59),* meaning that counties with the highest percentage of votes for Trump experienced a 78% higher adjusted COVID-19 mortality rate in 2021 when compared to counties that voted for Clinton*.* For 2020, the adjusted rate ratio for age-adjusted COVID-19 mortality was found to be *1.24 (95% CI: 0.81-1.94).* Effect modification was assessed and found not to be statistically significant. The inclusion of political environment in the model was tested using a likelihood ratio test and found to be significant for 2021, but not for 2020.

As the primary model utilized 2016 election data, the secondary model used 2020 election data for comparison. For 2021, the rate ratio was *1.85 (95% CI: 1.33-2.62)*, again meaning that Trump voting counties experienced an 85% higher adjusted COVID-19 mortality rate as compared to counties that voted for Biden. For 2020, the rate ratio for age-adjusted COVID-19 mortality was found to be *1.31 (95% CI: 0.88-1.99).* The choice of year for election data ultimately did not make that much of a difference in the results. Both options showed a non-significant association in 2020, both showed a significant association in 2021.

To evaluate the significance of including election data in the model, a likelihood ratio test was used to compare the full primary model with a reduced model not including election data. The inclusion was found to be significant in 2021 (p=0.0008), but not in 2020 (p=0.32).

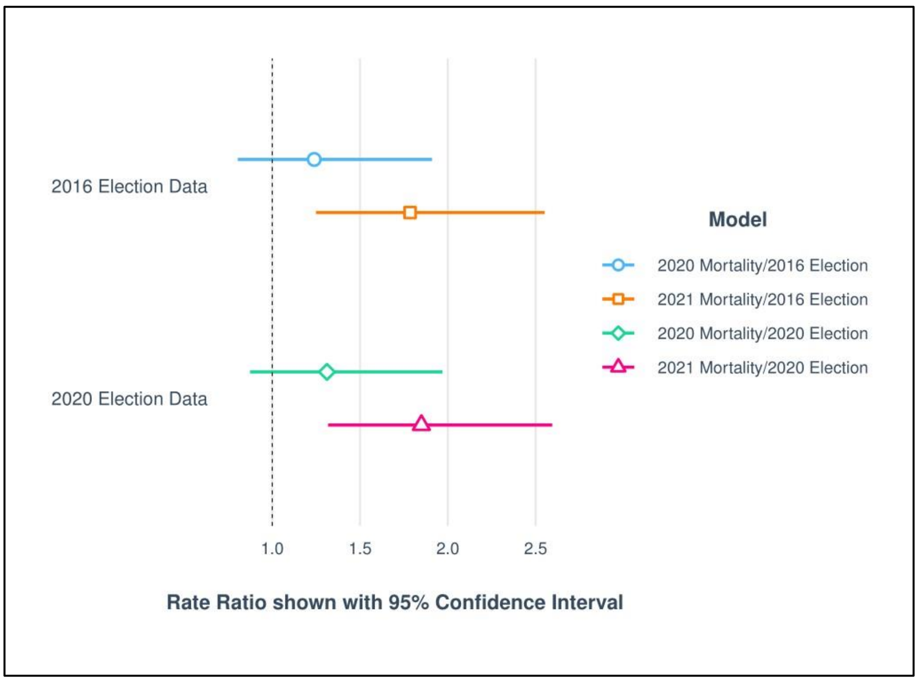

Figure 2: Rate ratios (95% CI) from Quasi-Poisson adjusted models showing the association between political environment, measured by 2016 & 2020 Presidential election outcome data, and the age-adjusted COVID-19 mortality rates for 2020 & 2021.

The product term between the election data and a binary indicator of population density was found not to be statistically significant (results not shown).

Sensitivity Analyses

As a sensitivity analysis, the models were also run as negative binomial regressions. Those models aligned very closely with the results of the Quasi-Poisson regression results with significance found in 2021, but not in 2020. Negative binomial model results shown in Supplemental Material, Table S2.

The broader Health and Social Factors metric from the EnviroScreen tool was not employed in the primary analysis because included in the calculation of this metric are information on life expectancy and age distribution for each county and it would be preferred not to include those metrics when the outcome of interest is a measure of mortality. The comparison models using the full Health and Social Factors Percentile from the EnviroScreen tool resulted in the association under study remaining in the same direction as it was using the narrower-in-scope Demographics Percentiles, though the strength of the association was a bit smaller resulting in attenuated effect estimates. Again, significant associations were found in 2021, but not in 2020. Results of this sensitivity analysis are shown in Table 2.

Table 2: Estimated (attenuated) Rate Ratios and 95% Confidence Intervals for sensitivity models utilizing broader EnviroScreen Health and Social Factors Percentile instead of Demographics Percentile.

	Rate Ratio (95% CI)
2016 Election Data/2020 Mortality	1.17 (0.74-1.89)
2016 Election Data/2021 Mortality	1.46 (1.03-2.12)
2020 Election Data/2020 Mortality	1.26 (0.83-1.97)
2020 Election Data/2021 Mortality	1.58 (1.15-2.24)

Discussion

The findings from the current study show positive associations between county-level political environment and age-adjusted COVID-19 mortality rates. All of the various models presented here found comparable results, with the association between the election data, our proxy for political environment, and mortality found in 2021. There was not a significant association between the election data and age-adjusted COVID-19 mortality rates found for the year 2020. These findings add to the growing body of evidence that political environment is associated with COVID-19 outcomes.

The primary analysis here utilized 2016 Presidential election data. 2020 Presidential election data was not selected for the primary model due to the possibility of reverse causation, if there was something about the pandemic itself that led to a change in voting behavior among the study population. The pandemic was already underway when the 2020 election occurred as well, introducing another avenue for potential reverse causation with the 2020 mortality data since they were happening simultaneously. It was run here as a comparison to the 2016 data to see if there were any meaningful differences. The point estimate for 2021 mortality using the 2020 election data was a bit stronger and does not have the issue of potential reverse causation, so it would be appropriate to use that model structure to define the true association here as well. Generally, though, the results were similar for both Presidential election year predictors.

Tests for including the election data in the models were found to be statistically significant in 2021, but not 2020, which suggest that something might have shifted during the pandemic in terms of what influenced mortality outcomes. This significance supports the idea that political environment may have become a factor in county level analysis *during* the pandemic. Whether this change is something permanent remains to be seen, but research such as the present study might help guide and inform what we include as potential covariates and social determinants of health moving forward. The reality of depletion of susceptibles may begin to surface as well regarding COVID-19, both in the realm of vaccination status and mortality from the virus (Kahn et al., 2022, Oh et al., 2022). This could eventually impact any trends we see currently in the data as we move forward in time.

For the purposes of this research, it was impossible to separate out what the role of individual level political views might have been and how that factors into the county-wide environment since there was not individual level data utilized here. The individual level association of political affiliation and excess deaths during the COVID-19 pandemic has been demonstrated, only emerging as a difference after COVID-19 vaccines were available nationwide (Wallace, et al.,2022). This research correlates with those findings in regard to county-level age-adjusted mortality rates rather than excess mortality. Future research may want to simultaneously explore the contribution of both individual and collective political ideology on health outcomes, including COVID-19 specific mortality and excess mortality.

It is entirely possible that limiting the mortality counts to those specifically coded for COVID-19 as a cause of death resulted in substantially undercounting actual deaths. Rural areas are more likely to have coroners versus medical examiners, which have been found to be associated with more errors made in cause of death determinations (McGivern et al., 2017). Coroners are also frequently elected positions and would be open to influence from regional politics as a result. In the state of Colorado, nearly all of the county coroners are elected (Sherry, n.d.). We cannot rule out the possibility of some misclassification of the outcomes here, and the possibility that misclassification would be differential. The directionality of this misclassification would lead us, perhaps, to an even stronger association. There is also a strong likelihood that the undercounting of deaths was even higher in 2020 than in 2021 due to the evolving status of COVID-19, partially due to the lack of availability of tests in the earliest months of the pandemic. There is some debate as to whether it might be a more accurate measure to utilize data on excess mortality rather than focus solely on deaths specifically coded for COVID-19 to fully capture the mortality effects of the pandemic (Weinberger et al., 2020, Aron & Muellbauer, 2022).

The demographics percentile score was utilized as a covariate in this analysis for several reasons. It is a novel environmental justice tool within the state of Colorado, created primarily for use by the public and advocacy organizations. The utility of this tool may extend to application in epidemiological and other research, in part because it succinctly summarizes a wide variety of exposures geographically, allowing for adjustment of multiple variables at once. Here, the use of the broader Health and Social Factors metric in sensitivity analyses revealed attenuated, though still statistically significant, effect estimates, meaning it may be worth exploring those additional factors to further tease out the relationships between the predictors and COVID-19 mortality. Any residual confounding that might have been captured in this broader metric did not explain away the findings. Additionally, the hope is that this project demonstrating the usefulness of this type of constructed data metric will encourage other jurisdictions to consider implementing a system such as EnviroScreen.

Strengths of this study include state-wide analysis, the utilization of publicly available data sources, an interdisciplinary approach, and the comparison of statistical methods and sensitivity analyses showing similar findings which lends robustness to the results.

Additional Limitations

As this was an ecological study by design, these findings cannot be extrapolated to the individual level. This analysis did not seek to investigate individual level associations, but instead focused on the county level with intention. County level analysis here was chosen because there was such a high degree of variation in mitigation measures at the county level within the state of Colorado, and because of the mechanisms involved in the transmission of a contagious respiratory pathogen.

Additional limitations here could include unmeasured confounding, although every attempt was made to control for factors that are traditionally considered influential in observational studies. There is an inability here to adjust for people who live near or work in different counties than they reside in. There is also the potential of some selection bias due to exclusion of counties with missingness in their data, though it is not likely to be very influential given that most counties, and the vast majority of the population of the state (98.4%), were still included in the analysis. Information on the predictor variables for all counties excluded from the analysis is available in the Supplemental Materials, Table S3.

Vaccination rates were not included separately as a predictor in the model because of the high degree of association with mortality from COVID-19, and because the degree of protection varies greatly depending on the number of doses, when doses were administered, and when someone contracted COVID-19 relative to those doses, all of which would need to be assessed at the individual level for accuracy. Significantly, one study found that during the Delta and the start of the Omicron surge, unvaccinated people were between 13.9 and 53.2 times more likely to die of COVID than fully vaccinated individuals (Johnson et al., 2022). As it is possible that vaccination status works as a mediator on the association between politics and COVID-19 mortality, future research may want to study those relationships in depth.

This research also should motivate those of us in public health and epidemiology to find ways to address the gaps in the system that allowed these results to emerge. There are things that should be done to restore and build faith and trust in the public health system. One important step would be to ensure that there is always a stockpile of PPE if and when it is needed. We should learn from the issues we faced sourcing needed materials and encourage domestic production of those necessary supplies. Strong outreach to communities and establishment of ongoing cohesive working relationships both while the pandemic is still ongoing and when it recedes will be necessary to establish good connections within governmental agencies, non-profit organizations, and other community groups. We have an obligation within our field to focus on clear communication with political leaders and the community members they serve, and it behooves us to be transparent when there are answers we may not have yet in the face of a novel threat. As knowledge is gained, it should be shared willingly with the public. Likewise, we should be encouraging strong science instruction and robust critical thinking skills as part of all levels of our education system. We need to be good stewards of the science and be able to push back on misinformation with clarifying information as needed. We have a real opportunity here to learn from this experience, and to address some of the most critical needs in the wake of the COVID-19 pandemic, so that when the next one arrives, we are better prepared.

Conclusion

The current research demonstrates that the county-level political environment among Colorado counties is associated with age-adjusted COVID-19 county-level mortality and finds that this relationship may have arisen during the pandemic. Given the realities of climate change and of living in a global economy, this likely will not be our last pandemic. If politics are indeed a risk factor for mortality, then we should ensure that the community is aware of that truth and take the steps that are necessary to build community connectedness and trust before the next threat arrives. Research such as this will help to inform the public about considering potential health factors that we may not have traditionally included in the past.

Author Statement

The author declares that they have no known financial interests or personal relationships that have influenced the work on this paper.

References

Amuedo-Dorantes, C., Kaushal, N., & Muchow, A. N. (2021). Timing of social distancing policies and COVID-19 mortality: county-level evidence from the U.S. *Journal of Population Economics*, *34*(4), 1445–1472. https://doi.org/10.1007/s00148-021-00845-2

Aron, J., & Muellbauer, J. (2022). Excess Mortality Versus COVID-19 Death Rates: A Spatial Analysis of Socioeconomic Disparities and Political Allegiance Across U.S. States. *The Review of Income and Wealth*, *68*(2), 348–392. https://doi.org/10.1111/roiw.12570

Atske, S. (2020, March 18). U.S. Public Sees Multiple Threats From the Coronavirus – and Concerns Are Growing. *Pew Research Center - U.S. Politics & Policy*. https://www.pewresearch.org/politics/2020/03/18/u-s-public-sees-multiple-threats-from-the-coronavirus-and-concerns-are-growing/

Barrios, J. M., & Hochberg, Y. V. (2021). Risk perceptions and politics: Evidence from the COVID-19 pandemic. *Journal of Financial Economics*, *142*(2), 862–879. https://doi.org/10.1016/j.jfineco.2021.05.039

Bazzi, S., Fiszbein, M., & Gebresilasse, M. (2021). "Rugged individualism" and collective (in)action during the COVID-19 pandemic. *Journal of Public Economics*, *195*, 104357. https://doi.org/10.1016/j.jpubeco.2020.104357

Bernet, P. (2021). COVID-19 Infections and Mortality in Florida Counties: Roles of Race, Ethnicity, Segregation, and 2020 Election Results. *Journal of Racial and Ethnic Health Disparities*, 1–11. https://doi.org/10.1007/s40615-021-01135-z

Birkeland, B. (n.d.). *Lawmakers Line Up Behind Anti-Doxxing Bill To Protect Colorado Health Workers*. Colorado Public Radio. Retrieved January 25, 2023, from https://www.cpr.org/2021/03/03/lawmakers-line-up-behind-anti-doxxing-bill-to-protect-colorado-health-workers/

Chen, H.-F., & Karim, S. A. (2021). Relationship between political partisanship and COVID-19 deaths: future implications for public health. *Journal of Public Health (Oxford, England)*, fdab136. https://doi.org/10.1093/pubmed/fdab136

Colorado EnviroScreen | Department of Public Health & Environment. (n.d.). Retrieved February 7, 2023, from https://cdphe.colorado.gov/enviroscreen

Daley, J. (n.d.). *Douglas County Commissioners Unanimously Vote To Exit Tri-County Health Department*. Colorado Public Radio. Retrieved January 25, 2023, from https://www.cpr.org/2021/09/08/douglas-county-votes-to-exit-tri-county-health-department/

Desmet, K., & Wacziarg, R. (2022). JUE Insight: Understanding spatial variation in COVID-19 across the United States. *Journal of Urban Economics*, *127*, 103332. https://doi.org/10.1016/j.jue.2021.103332

Duggan, P. F. and K. (n.d.). *Weld County adopts “safer-at-work” guidelines in defiance of state’s safer-at-home guidelines*. Fort Collins Coloradoan. Retrieved January 25, 2023, from https://www.coloradoan.com/story/news/2020/04/24/coronavirus-colorado-weld-county-defies-state-recommendation-safer-at-work/3018852001/

Feinhandler, I., Cilento, B., Beauvais, B., Harrop, J., & Fulton, L. (2020). Predictors of Death Rate during the COVID-19 Pandemic. *Healthcare*, *8*(3), 339. https://doi.org/10.3390/healthcare8030339

Goldberg, D. (n.d.). *‘It’s going to disappear’: Trump’s changing tone on coronavirus*. POLITICO. Retrieved January 25, 2023, from https://www.politico.com/news/2020/03/17/how-trump-shifted-his-tone-on-coronavirus-134246

Gollwitzer, A., Martel, C., Brady, W. J., Pärnamets, P., Freedman, I. G., Knowles, E. D., & Van Bavel, J. J. (2020). Partisan differences in physical distancing are linked to health outcomes during the COVID-19 pandemic. *Nature Human Behaviour*, *4*(11), 1186–1197. https://doi.org/10.1038/s41562-020-00977-7

Gonzalez, K. E., James, R., Bjorklund, E. T., & Hill, T. D. (2021). Conservatism and infrequent mask usage: A study of US counties during the novel coronavirus (COVID-19) pandemic. *Social Science Quarterly*, *102*(5), 2368–2382. https://doi.org/10.1111/ssqu.13025

Shvetsova, O., Zhirnov, A., Giannelli, F. R., Catalano, M. A., & Catalano, O. (2022). Governor’s Party, Policies, and COVID-19 Outcomes: Further Evidence of an Effect. American Journal of Preventive Medicine, 62(3), 433–437. https://doi.org/10.1016/j.amepre.2021.09.003

Hansen, M., Johansson, I., Sadowski, K., Blaszcynski, J., & Meyer, S. (2021). The Partisan Impact on Local Government Dissemination of COVID-19 Information: Assessing U.S. County Government Websites. *Canadian Journal of Political Science*, *54*, 150–162. https://doi.org/10.1017/S0008423920000918

Ingram, M., Zahabian, A., & Hur, C. (2021). Prediction of COVID-19 Social Distancing Adherence (SoDA) on the United States county-level. *Humanities and Social Sciences Communications*, *8*(1), 1–7. https://doi.org/10.1057/s41599-021-00767-0

Jalali, N., Tran, N. K., Sen, A., & Morita, P. P. (2022). Identifying the Socioeconomic, Demographic, and Political Determinants of Social Mobility and Their Effects on COVID-19 Cases and Deaths: Evidence From US Counties. *JMIR Infodemiology*, *2*(1), e31813. https://doi.org/10.2196/31813

Johnson, A. G., Amin, A. B., Ali, A. R., Hoots, B., Cadwell, B. L., Arora, S., Avoundjian, T., Awofeso, A. O., Barnes, J., Bayoumi, N. S., Busen, K., Chang, C., Cima, M., Crockett, M., Cronquist, A., Davidson, S., Davis, E., Delgadillo, J., Dorabawila, V., … Scobie, H. M. (2022). COVID-19 Incidence and Death Rates Among Unvaccinated and Fully Vaccinated Adults with and Without Booster Doses During Periods of Delta and Omicron Variant Emergence- 25 U.S. Jurisdictions, April 4-December 25, 2021. *MMWR. Morbidity and Mortality Weekly Report*, *71*(4), 132–138. https://doi.org/10.15585/mmwr.mm7104e2

Kahn, R., Schrag, S. J., Verani, J. R., & Lipsitch, M. (2022). Identifying and Alleviating Bias Due to Differential Depletion of Susceptible People in Postmarketing Evaluations of COVID-19 Vaccines. *American Journal of Epidemiology*, *191*(5), 800–811. https://doi.org/10.1093/aje/kwac015

McLaughlin, J. M., Khan, F., Pugh, S., Swerdlow, D. L., & Jodar, L. (2022). County-level vaccination coverage and rates of COVID-19 cases and deaths in the United States: An ecological analysis. *The Lancet Regional Health – Americas*, *9*. https://doi.org/10.1016/j.lana.2022.100191

McGivern, L., Shulman, L., Carney, J. K., Shapiro, S., & Bundock, E. (2017). Death Certification Errors and the Effect on Mortality Statistics. *Public Health Reports*, *132*(6), 669–675. https://doi.org/10.1177/0033354917736514

Moreland, A. (2020). Timing of State and Territorial COVID-19 Stay-at-Home Orders and Changes in Population Movement — United States, March 1–May 31, 2020. *MMWR. Morbidity and Mortality Weekly Report*, *69*. https://doi.org/10.15585/mmwr.mm6935a2

Oh, J., Min, J., Kang, C., Kim, E., Lee, J. P., Kim, H., & Lee, W. (2022). Excess mortality and the COVID-19 pandemic: causes of death and social inequalities. *BMC Public Health*, *22*, 2293. https://doi.org/10.1186/s12889-022-14785-3

Parker, C. F., & Stern, E. K. (2022). The Trump Administration and the COVID-19 crisis: Exploring the warning-response problems and missed opportunities of a public health emergency. *Public Administration*. https://doi.org/10.1111/padm.12843

Parzuchowski, A. S., Peters, A. T., Johnson-Sasso, C. P., Rydland, K. J., & Feinglass, J. M. (2021). County-level association of COVID-19 mortality with 2020 United States presidential voting. *Public Health*, *198*, 114–117. https://doi.org/10.1016/j.puhe.2021.06.011

Policy: Independent Voters White Paper. (n.d.). *Denver Metro Chamber of Commerce*. Retrieved December 1, 2022, from https://denverchamber.org/policy/policy-independent-voters-white-paper/

Sherry, A. (n.d.). *A look behind Colorado's decentralized system of coroners who investigate death every day*. Colorado Public Radio. Retrieved February 14, 2023, from https://www.cpr.org/2023/01/16/colorado-coroners/

Swidler, F. (n.d.). *What The Different Color Levels Of 'Safer At Home' Mean For Coronavirus In Colorado*. Colorado Public Radio. Retrieved January 25, 2023, from https://www.cpr.org/2020/10/27/safer-at-home-colorado-level-3/

Toth-Manikowski, S. M., Swirsky, E. S., Gandhi, R., & Piscitello, G. (2022). COVID-19 vaccination hesitancy among health care workers, communication, and policy-making. *American Journal of Infection Control*, *50*(1), 20–25. https://doi.org/10.1016/j.ajic.2021.10.004

Tri-County Health Department set to completely dissolve on Dec. 31. (2022, December 27). Denver 7 Colorado News. https://www.denver7.com/news/local-news/tri-county-health-department-set-to-completely-dissolve-on-dec-31

Wallace, J., Goldsmith-Pinkham, P., & Schwartz, J. (2022). *Excess Death Rates for Republicans and Democrats During the COVID-19 Pandemic* (No. w30512; p. w30512). National Bureau of Economic Research. https://doi.org/10.3386/w30512

Weinberger, D. M., Chen, J., Cohen, T., Crawford, F. W., Mostashari, F., Olson, D., Pitzer, V. E., Reich, N. G., Russi, M., Simonsen, L., Watkins, A., & Viboud, C. (2020). Estimation of Excess Deaths Associated With the COVID-19 Pandemic in the United States, March to May 2020. *JAMA Internal Medicine*, *180*(10), 1–10. https://doi.org/10.1001/jamainternmed.2020.3391

Woolhandler, S., Himmelstein, D. U., Ahmed, S., Bailey, Z., Bassett, M. T., Bird, M., Bor, J., Bor, D., Carrasquillo, O., Chowkwanyun, M., Dickman, S. L., Fisher, S., Gaffney, A., Galea, S., Gottfried, R. N., Grumbach, K., Guyatt, G., Hansen, H., Landrigan, P. J., … Venkataramani, A. (2021). Public policy and health in the Trump era. *The Lancet*, *397*(10275), 705–753. https://doi.org/10.1016/S0140-6736(20)32545-9

APPENDIX

Table S1: Characteristics of Counties in Colorado, N=64

	MEAN	STANDARD DEVIATION	MEDIAN	25^{TH}-75^{TH} PERCENTILE
AGE ADJUSTED COVID-19 MORTALITY RATES PER 100,000^{+}				
2020	78.34	46.99	69.05	38.75-97.33
2021	111.96	76.92	97.70	58.18-147.58
UNINSURED PERCENTAGE *	10.17	3.79	10.00	7.00-13.00
POPULATION DENSITY (PEOPLE PER SQUARE MILE) *	171.10	641.01	11.09	3.57-32.74
DEMOGRAPHICS PERCENTILE *	50.78	29.09	50.78	26.17-75.39

+ Only counties with reported data for rate: 2020=48, 2021=56

* All counties in Colorado, including those excluded from the analysis for missingness of data

Table S2: Negative binomial adjusted model results showing the association between political environment, measured by 2016 & 2020 Presidential election outcome data, and the age-adjusted COVID-19 mortality rates for 2020 & 2021.

	Rate Ratio and 95% Confidence Interval
2016 Election Data/2020 Mortality	1.24 (0.84-1.78)
2016 Election Data/2021 Mortality	1.89 (1.42-2.48)
2020 Election Data/2020 Mortality	1.23 (0.85-1.78)
2020 Election Data/2021 Mortality	1.98 (1.53-2.55)

Table S3: Supplemental table of variables from all counties excluded from the analysis for missingness of outcome data. Total population of these counties: 94,227 (1.6% of the state population).

	Total Population of the County	2016 Presidential Vote Outcome in the County	Population Density (people per square mile)	Demographics Percentile Score from EnviroScreen	Percentage of the County Population that is Uninsured
Archuleta	13,359	R	9.86	54.69	10
Baca	3,506	R	1.37	70.31	13
Clear Creek	9,937	D	23.67	10.94	5
Custer	4,704	R	6.37	67.19	11
Dolores	2,326	R	2.16	18.75	3
Gilpin	5,808	D	38.72	9.38	5
Hinsdale	788	R	0.70	23.44	10
Jackson	1,379	R	0.85	26.56	17
Kiowa	1,446	R	0.81	25.00	7
Lake	7,436	D	19.36	85.94	11
Lincoln	5,675	R	2.20	51.56	7
Mineral	865	R	0.99	14.06	13
Ouray	4,874	D	8.99	4.69	12
Pitkin	17,358	D	17.89	20.31	17
Rio Blanco	6,529	D	2.02	39.06	16
San Juan	705	D	1.81	34.38	10
San Miguel	8,072	D	6.25	29.69	12
Mean/other relevant information		Roughly equal here	8.47	35.06	10.52

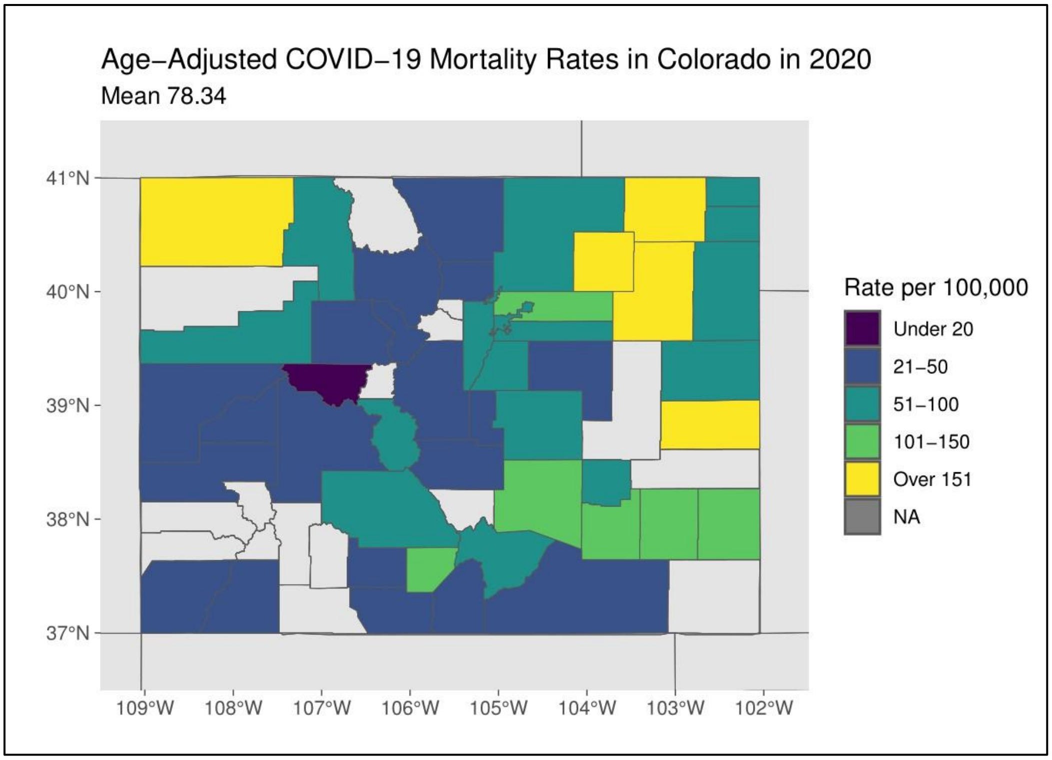

Figure S1: Mapped Mortality Rates for the year 2020.

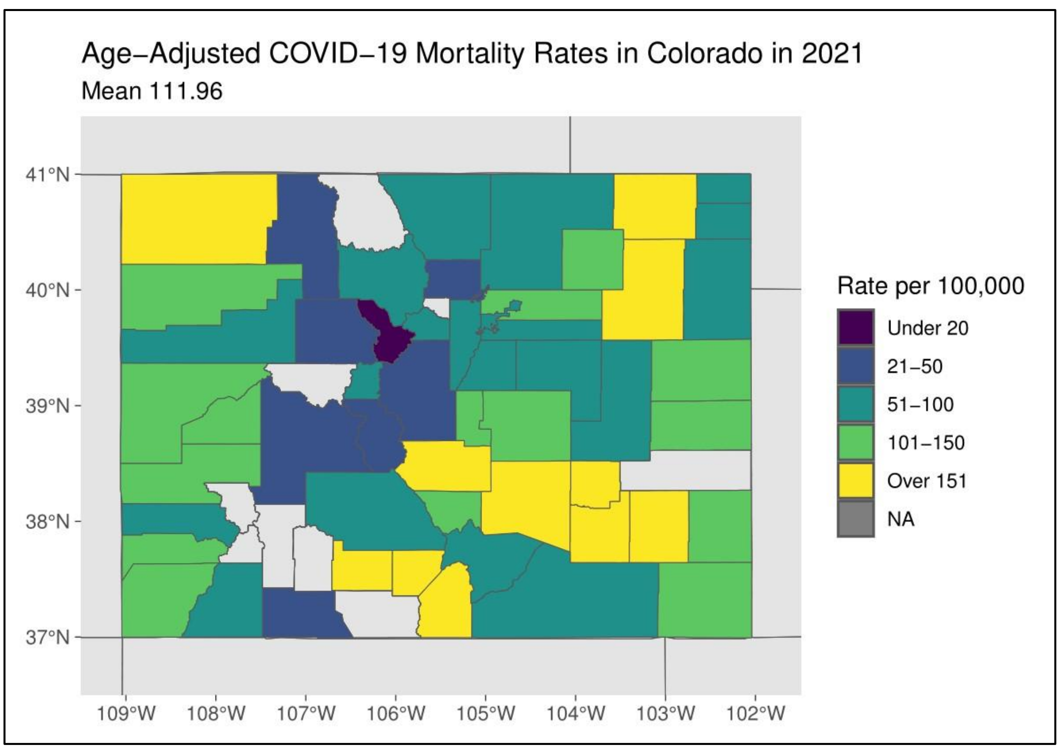

Figure S2: Mapped Mortality Rates for the year 2021.

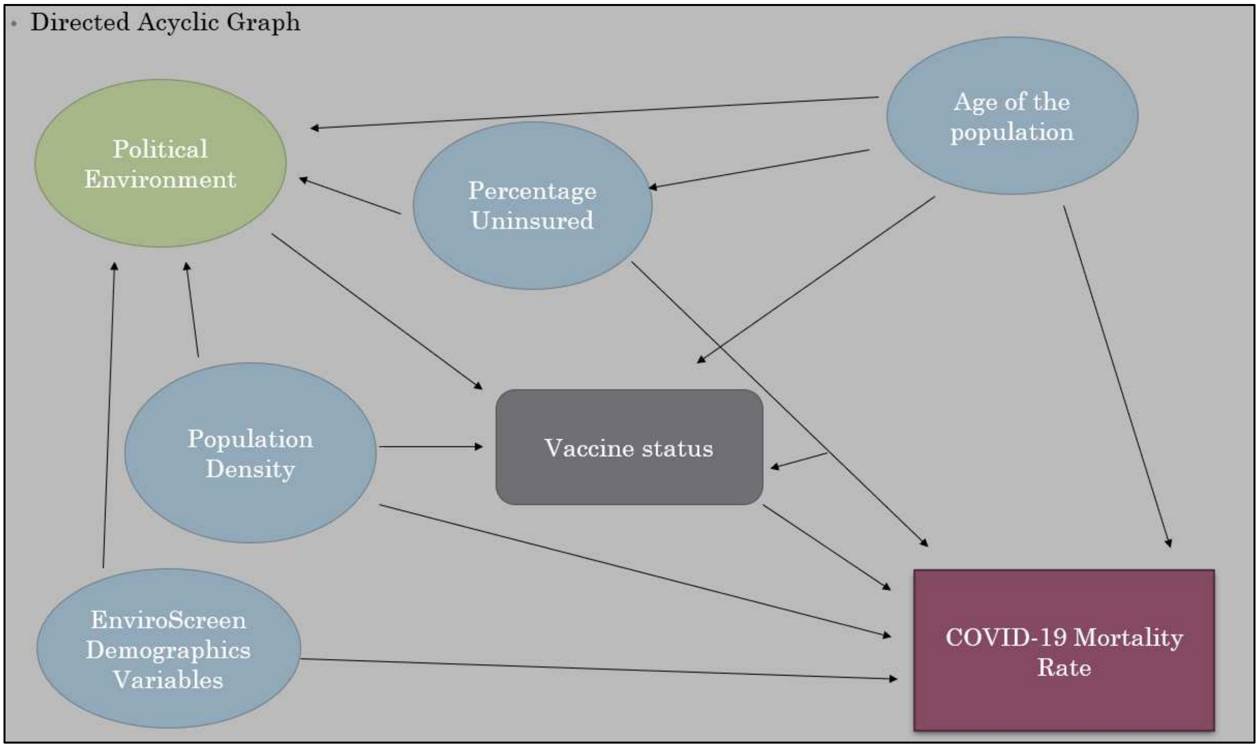

Figure S3: Directed Acyclic Graph (DAG): DAG shown here is a visual representation reflecting the relationships between all variables included in the model.