Health Policy OPEN 5 (2023) 100107

Contents lists available at ScienceDirect

Health Policy OPEN

journal homepage: www.elsevier.com/locate/hpopen

The politics of COVID-19: Differences between U.S. red and blue states in COVID-19 regulations and deaths

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ARTICLE INFO

Keywords:
COVID-19
Policies
COVID deaths

ABSTRACT

The study investigated infection variables and control strategies in 2020 and 2021 and their influence on COVID-19 deaths in the United States, with a particular focus on comparing red (Republican) and blue (Democratic) states. The analysis reviewed cumulative COVID-19 deaths per 100,000 by year, state political affiliation, and a priori latent factor groupings of mitigation strategies (lockdown days in 2020, mask mandate days, vaccination rates), social demographic variables (ethnicity, poverty rate), and biological variables (median age, obesity). Analyses first identified possible relationships between all assessed variables using K-means clustering for red, blue, and purple states. Then, a series of regression models were fit to assess the effects of mitigation strategies, social, and biological factors specifically on COVID-19 deaths in red and blue states. Results showed distinct differences in responding to COVID infections between red states to blue states, particularly the red states lessor adoption of mitigation factors leaving more sway on biological factors in predicting deaths. Whereas in blue states, where mitigation factors were more readily implemented, vaccinations had a more significant influence in reducing the probability of infections ending in death. Overall, study findings suggest politicalization of COVID-19 mitigation strategies played a role in death rates across the United States.

1. Introduction

The COVID-19 pandemic has had a profound and expansive impact on numerous facets of human existence, resulting in millions of lives being lost and countless others being changed forever. On the surface, the pandemic initially presented as a significant public health crisis; however, numerous disruptions to global operations including supply chain issues, economic instability, workforce imbalances, and inconsistent government response strategies amplified the difficulty of containing the disease. In the first year of managing the disease, 2020, effort focused on limiting exposure through social distancing, wearing masks, and mandatory lockdowns. The second year, 2021, gave way to advancements in understanding the virus and the development of several vaccines and antiviral options. On a global level, COVID-19 has been handled with mixed results, but the following study examines factors and outcomes exclusive to the United States COVID-19 landscape.

1.1. Sociopolitical and legislative influence

COVID-19 numbers in the United States surpassed all other reporting countries for both cumulative cases and deaths, making its use of mass behavioral mitigation measures of particular interest. While many nations focused on a federal mandate process to manage their response to the pandemic [1,2], the United States adopted a jurisdictional state-based approach. This approach created a unique Petri dish to examine a spectrum of containment strategies across a multitude of demographic and sociopolitical factors.

With the emergence of COVID-19 and each new viral variant, such as Delta and Omicron, mass mitigation measures were reintroduced in varying capacities and success rates to limit new exposures. The need for these daily habit changes were justified based on historical precedent and modern research related to epidemiology [3], but the efficacy of mass behavioral changes was questioned by some scientists and sections of society [4]. While skepticism, especially among the general public, can be conspiratorial or bizarre in nature [5,6], there is a genuine and

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https://doi.org/10.1016/j.hpopen.2023.100107
Received 21 October 2022; Received in revised form 3 September 2023; Accepted 3 November 2023
Available online 11 November 2023

appropriate concern regarding the effectiveness of mass-behavioral methods [7]. Analyzing state policies across 2020 and 2021, with a specific focus on success in reducing the number of pandemic deaths, can provide valuable insight on successful mass behavioral mitigation strategies and inform early intervention protocol for future viral outbreaks.

In the United States, COVID-19 and efforts to quell the outbreak were largely politicized (e.g., proposed bill against requiring the wearing of masks, 117th Congress 2021–2022, as well as media coverage [8]). Federal actions related to behavioral mitigation measures during the pandemic were largely suggestive and mostly consisted of recommendations and guidelines for social interactions [9], brief travel restrictions, or were exclusive to federal employees [10]. Federal actions focused more on resource production and economic stimulus than behavior efforts [11,12]. Whereas, states were responsible for outlining specifications of mask mandates, as well as the degree and length of enforcement [13]. This begs the question whether there is a divide between state political affiliations in terms of COVID-19 deaths.

In general terms, a state's legislative efforts are influenced by the overall political affiliation of a state and its sitting governance. As such, the dominant political affiliation for each state can be derived from its gubernatorial party affiliation, state senate affiliation, and state house of representative affiliation. Whether a state is blue or red may influence the types of legislation instated, which in turn may affect the overall spread of COVID-19. In essence, a state's legislative measures on COVID-19 and consequential changes in viral patterns, provide a natural experiment to evaluate strategy efficacy. This study seeks to investigate if a state's political affiliation, herein labeled as republican-affiliated (red) or democratic-affiliated (blue), plays a significant role in the efficacy of mitigation measures and resulting number of COVID-19 deaths.

1.2. Pre-pandemic demographics

In a similar vein to a state's political affiliation, a state's demographic context prior to the pandemic is likely to play a role in overall deaths due to COVID-19. Assessments of at-risk groups have identified the elderly and those with underlying health issues, especially those with diabetes or obesity, as most likely to be both infected by and die due to complications related to COVID-19 [14,15].

Racial disparities in infections, deaths, and healthcare equity are of utmost concern given the diverse demographics of the United States [16]. Previous research conducted during the pandemic indicated that COVID-19 infections and deaths disproportionally affect racial and ethnic minorities in the United States [17,18]. The Center for Disease Control's page on "Health Equity Considerations and Racial and Ethnic Minority Groups" summarizes a number of studies to determine primary factors which likely cause the observed racial and ethnic differences in COVID-19 cases: discrimination, healthcare access, occupational hazards, exposure, and socioeconomic gaps [19]. In further addressing healthcare access and usage disparities, people of color are less likely to have received at least one dose of a COVID-19 vaccine, compared to white counterparts [20].

1.3. Existing research

The academic community responded to the need for COVID-19 research; however, this left some notable early deficiencies in the literature [21]. Due to the breadth of pandemic factors, as well as the infeasibility of traditional study methods while remaining socially distanced, early works focused on opinion, single-state or single-behavior observations, sub-grouping populations across behaviors, or the efficacy of well-being factors [22]. This pointed approach is evidenced by the targeted examination of single-state/single-behavioral measure studies, such as infection rates post-vaccination in Kentucky [23]; assessment of a single-state and efficacy of several mitigation measures, such as trends in mitigation measures within Arizona [24]; and examination of a single-behavioral measure, such as mask adherence, across all states [25].

However, recent studies are branching out beyond direct examination of COVID-19 medical consequences to review the nationwide aftermath of the pandemic within constructs of mental wellness [26], economic infrastructure [27], and the context of collateral health concerns such as post-pandemic weight gain [28] and alcohol use [29]. Researchers are beginning to examine the political polarization of COVID-19 preventative measures [30] and treatments [31] but the majority of studies appear to be on a representative subset of the population. Few studies have examined larger scale public data against political affiliations, health constructs, and infection/death rates, but there have been notable exceptions, such as a review of the relationship between partisan affiliations, obesity, and death rates [32]. The imparting lesson being that health is a multifaceted concept which must be analyzed through well-aimed examination of controlled constructs and **as** the sum of its parts to derive genuine understanding of complexities [33–35]. To this point, the current study accounts for the majority of states and a dynamic assessment of variables to create a more comprehensive picture of COVID-19 deaths in the US.

1.4. Study objectives

The current study has four objectives:

1) to differentiate naturally occurring clusters based on all the variables assessed (biological, social demographic, and mitigation strategies), and to assess if these clusters differentiate between red, blue, and purple states;

2) to investigate whether the states' political affiliation as red or blue is associated with COVID-19 deaths in 2020 and 2021;

3) to investigate to what extent COVID-19 deaths are predicted by biological, social, and behavioral/political mitigation variables overall.

4) to investigate to what extent COVID-19 deaths are predicted by biological, social, and behavioral/political mitigation variables in red and blue states.

We focused on COVID-19 cases and deaths of 2020 and of 2021 separately, considering the Delta variant and the availability of vaccines.

2. Method

Data was gathered from all fifty states within the United States, including data for bio-demographic, socio-political, and behavioral mitigation variables to measure the effects of COVID-19 deaths from previously documented data. Specific data sources are identified below.

2.1. Criterion variables

COVID-19 Cases and Deaths per 100,000 for 2020 and for 2021

COVID-19 cases and deaths were categorized per state for 2020 and 2021 by the "CDC Data Tracker" and organized per 100,000 instances. The Center of Disease Control and Prevention (CDC) Data Tracker collects surveillance measurements on confirmed COVID-19 deaths from hospitals, healthcare systems, and laboratory data from various community, state, and territorial public health departments [36]. The COVID-19 cases and deaths count for this study were assessed from January 21, 2020, to December 31, 2020, for the year 2020 and from January 1, 2020, to October 25, 2021, for the year 2021. The years 2020 and 2021 are separated because of the impact and presence of vaccine in 2021. Additionally, within the CDC Data Tracker, New York State and New York City were separately recorded for 2020 and 2021. For the purposes of this study, New York State and New York City data was combined to provide the most accurate picture of the overall population.

2.2. Predictor variables

Bio-demographic

Adult Obesity Rate. The adult obesity rate for 2020 was published by the Robert Wood Johnson Foundation project and reported the data collection from the Behavioral Risk Factor Surveillance System (BRFSS) conducted in 2020. The BFRSS is a cross-sectional survey administered to each state in the United States that investigates behavioral health risk factors for individuals 18 and older in each state, which includes state obesity rate measured by the body mass index, BMI [37]. The data recorded for the BRFFS in 2020 on the obesity rate per state was measured by the percentage of adults with a BMI of 30 or higher.

Median Age. Median age by state in 2019 was collected from Statista [38] by collecting the ages of the population for each state and reporting the median age.

Minority Population. The minority population per state variable was identified by the data from the 2020 Census on Race and Ethnicity in the United States [39]. The population percentage per state calculates the total population for minorities and does not include those of Hispanic Origin. The total population count for each state was categorized as Black, American Indian or Alaskan Native, Asian American, Native Hawaiian or Other Pacific Islander, Some Other Race, and 2 or More Races. In our analyses, however, we only focused on the two largest groups, Black and Asian American. Hispanic minority status per state was operationalized as the percentage of the population by state identified as Hispanic Origin and was also included in the analyses.

Poverty Rate. The poverty rate, defined as the percentage of the population for each state that is in poverty, was collected from the 2019 Census in the U.S. with the 2019 American Community Survey [40].

Socio-political

The socio-political affiliation for each state was derived from collecting the Gubernatorial Party affiliation, State Senate affiliation, and State House of Representatives affiliation within the year 2021 [41,42]. Overall political affiliation within the context of this study was measured as Democratic/blue or Republican/red. States with mixed political affiliations, commonly referred to as purple states, were excluded from the regression analysis for extreme comparison. This study defined the state's political affiliation by the governor's political affiliation and if either state senate or state house had the same political affiliation as the governor. If the governor's party affiliation was different from both state senate and state house, then we coded this state as purple. There were 22 red, 16 blue, and 10 purple states. The two states, Montana and West Virginia, where state governors changed in 2020 were also excluded from state comparisons.

Often in research, the presidential election results are used to determine red, blue and purple states in studies [32]. Since COVID-19 related measures in states are often initiated by the state's executive branch, i.e., the governor, this study primarily relied on the governor's political affiliation. A state was defined as blue if the governor was a Democrat and either state senate or state house are democratic. A state was defined as red if the governor was a Republican and either state senate or state house are republican. If the governor's political affiliation is different from the dominant affiliation of state house and state senate, then the state was defined as purple.

Behavioral / political regulations

State Lockdown Days for Year 2020. The behavioral variables measured for the year 2020 for this study included the number of lockdowns by state. The number of lockdowns per state was defined by the state lockdown order issued by state government officials [43], where each state is listed with the dates of the lockdown order, state lockdown report, and title of the order. The numerical count for the amount of lockdown duration reported in days was calculated by taking the difference between the start date of a lockdown order and the end date of a lockdown order by the state documented on state orders.

Mask Mandate Days for Years 2020 and 2021. Mask mandate by state, measured by the number of days the mask mandate was issued until lifted by state officials, was reported for 2020 and 2021. The mask mandates were identified as those reported on U.S. News and World Report [13]. The number of mask mandate days for each state was calculated by counting the days from when the mandates were initiated and lifted. Mask mandates were categorized for the year 2020 and year 2021 as active mask mandates or no mask mandates. The active status of mask mandates was documented for 2020 with the dates January 1, 2020, to December 31, 2020, and 2021 dates were January 1, 2020, to October 25, 2021.

COVID-19 Vaccination Rate 2021. The COVID-19 vaccination rate was gathered from the CDC datasheet from October 25, 2021, for each state. It was defined as the total number of individuals 12 years of age and older fully vaccinated with the second dose of a two-dose vaccine or one dose of a single-dose vaccine [44]. No vaccination information was reported for the state of Idaho.

COVID-19 Vaccination Mandates 2021. COVID-19 vaccination mandates were recorded in four settings: public schools, universities, hospitals, and places of employment in all 50 states. This study categorized the COVID-19 vaccination mandate active for each state on a scale from 0 to 4 (0 = no vaccination mandate in all 4 settings to 4 = vaccination mandates in all four settings).

Public school COVID-19 vaccination mandates for each state were collected from Wong et al. [45] which reported secondary COVID-19 vaccination data derived from the CDC with a virtual map display. This study defined public school COVID-19 vaccinations per state with three measures. Responses were scored as (0 = no, and 1 = yes).

University COVID-19 vaccination was reported by states that required vaccinations for on-campus or residential students for the 2021–2022 academic year but does not identify individual requirements issued by particular academic institutions [46]. Many institutions had separate vaccination guidelines for students and employees. Vaccination requirements issued by universities in this study only applied to student populations. This study defined University COVID-19 vaccination status with a dichotomous coding (0 = no, and 1 = yes).

Hospital COVID-19 vaccination mandates were collected from the National Academy for State Health Policy [47], which reported state mandates requiring hospital workers and healthcare employees to receive the COVID-19 vaccine. For this study, Hospital COVID-19 vaccination mandates were coded as zero and one (0 = no, 1 = yes).

Employee COVID-19 vaccination mandates were gathered from a listing of reported mandates by each state of vaccination requirements for employees [48]. This study categorized the employee COVID-19 vaccination mandate between 0 and 3 (0 = no, 1 = yes, state employees).

2.3. Statistical analysis

In a first step we used Cluster Analysis to analyze if all the variables assessed (COVID-19 cases and deaths, biological, social demographic, and mitigation strategies) would create meaningful naturally occurring clusters. We also included the purple states to see in which groups they might fall. K-means clustering was used to identify clusters for all variables.

For the regression analyses we only focused on the red and blue states. A series of regression models were fit to examine the number of COVID-19 deaths per 100 k between red and blue states. Three separate models were fit to the data to assess the influence of political/behavioral mitigation measures, demographics, and biological factors when controlling for political affiliation. A combined model incorporating variables from each domain was then constructed using a stepwise procedure. Each model was compared to a baseline model controlling the number of cases in the state, political affiliation, percentage of population vaccinated, and the total population of the state. The models were constructed by adding appropriate terms to the baseline model and were compared using a general linear F-test. These same models were then refit exclusively to the data subset by Republican and Democratic affiliation to compare effect estimates between political affiliation. All variables were mean centered and standardized in the models. Descriptive plots and tables are provided for additional context.

The Cluster analyses were conducted in the IBM SPSS [49] and the regression analyses were conducted in R [50]. A priori 0.05 level of significance, 2-sided, was used for hypothesis testing.

3. Results

3.1. Cluster analyses for total combined COVID-19 deaths

K-means clustering was used to investigate different clusters. Convergence was achieved after 5 iterations for 2 clusters. The two-cluster solution is preferred because other k-means clustering analyses with 3 or more clusters result in clusters with uneven numbers of members. ANOVAs comparing each of the 11 scales (z-scores) among the two final clusters were significant with all *ps* < 0.02, except for Black population ($p = 0.23$) and Hispanic population ($p = 0.06$).

Out of all 50 states, 27 fall into cluster 1 (54 %), and 22 fall into cluster 2 (44 %), and one state was missing (2 %). The final cluster centers for the instruments and the two-cluster solution are shown in Fig. 1. Fig. 2 shows the percentage distribution of the two clusters within each of the three political groups (blue, purple, red).

Cluster 1: High Number of COVID-19 Deaths, Fewer Political Mitigation Measures, Fewer Vaccinations, and Higher Demographic Risk Factors

The first cluster, the bigger cluster, is characterized by states that have high number of COVID-19 deaths per 100,000 people, implementing fewer mitigation efforts (e.g., lockdown days, mask mandate in days, and vaccine mandates), lower vaccination rates for ages 12 and up, lower median age, and higher risk factors such as obesity and poverty rate.

Cluster 2: Low Number of COVID-19 Deaths, More Political Mitigation Measures, More Vaccinations, and Lower Demographic Risk Factors

The second cluster, the smaller cluster, is characterized by states that have low numbers of COVID-19 deaths per 100,000 people, implementing more mitigation efforts (e.g., lockdown days, mask mandate in days, and vaccine mandates), higher vaccination rates for ages 12 and up, higher median age, and lower risk factors such as low obesity and low poverty rate.

Regarding race and ethnicity, there were more African Americans and fewer Asian Americans and fewer Hispanics in the cluster with more COVID-19 deaths.

Comparing cluster membership among blue, purple, and red states (see Fig. 2), blue states fall significantly more often into cluster 2 with fewer COVID-19 deaths, and red states fall significantly more often into cluster 1. Purple states fall almost equally often into cluster 1 and 2. There is a significant relationship between political state affiliation and cluster membership, Cramer's V $= 0.840$, $p < 0.001$.

To replicate the findings, we also conducted K-means cluster analysis for cumulative COVID-19 cases. Also, convergence was achieved after 5 iterations for 2 clusters. ANOVAs comparing each of the 11 scales (z-scores) among the two final clusters were significant with all *ps* < 0.04, except for Black population ($p = 0.28$). The cluster centers and the percentage distribution of the two clusters within each of the three political groups (blue, purple, red) were similar to the ones obtained for the cluster analysis of the COVID-10 deaths.

Comparing cluster membership among blue, purple, and red states, blue states fall significantly more often into cluster 2 with fewer COVID-19 cases, and red states fall significantly more often into cluster 1 with more COVID-19 cases. Purple states fall almost equally into cluster 1 and 2. There is a significant relationship between political state affiliation and cluster membership (Cramer's V $= 0.843$, $p < 0.001$).

3.2. Regression analysis of COVID-19 deaths per 100 k: Differences across blue and red states

Descriptive plots of the number of COVID-19 cases and deaths per 100 k by political affiliation are given in Figs. 3-6. Fig. 3, which shows the simple boxplot of deaths by year and political affiliation, indicates that in the first year of the pandemic there was no difference in the number of deaths between red and blue states. However, by 2021 blue states significantly reduced the number of deaths per 100 k ($\Delta = -29.74$, $t = -2.398$, $p = 0.011$) relative to red states. A plausible explanation for this reduction is visible in Figs. 4 and 5: blue states had both fewer cases per 100 k and higher vaccination rates relative to red states. Fig. 4 shows the relationship between cases and deaths per 100 k in 2020 and 2021; similarly Fig. 5 shows the relationship between deaths per 100 k and vaccination rates in 2020 and 2021. Both figures (except the 2020 panel of Fig. 5) show the presence of linear trends indicating a positive association of deaths and cases ($r = 0.533$, $p < 0.001$), and a negative association with deaths and vaccination in 2021 ($r = -0.486$, $p = 0.002$).

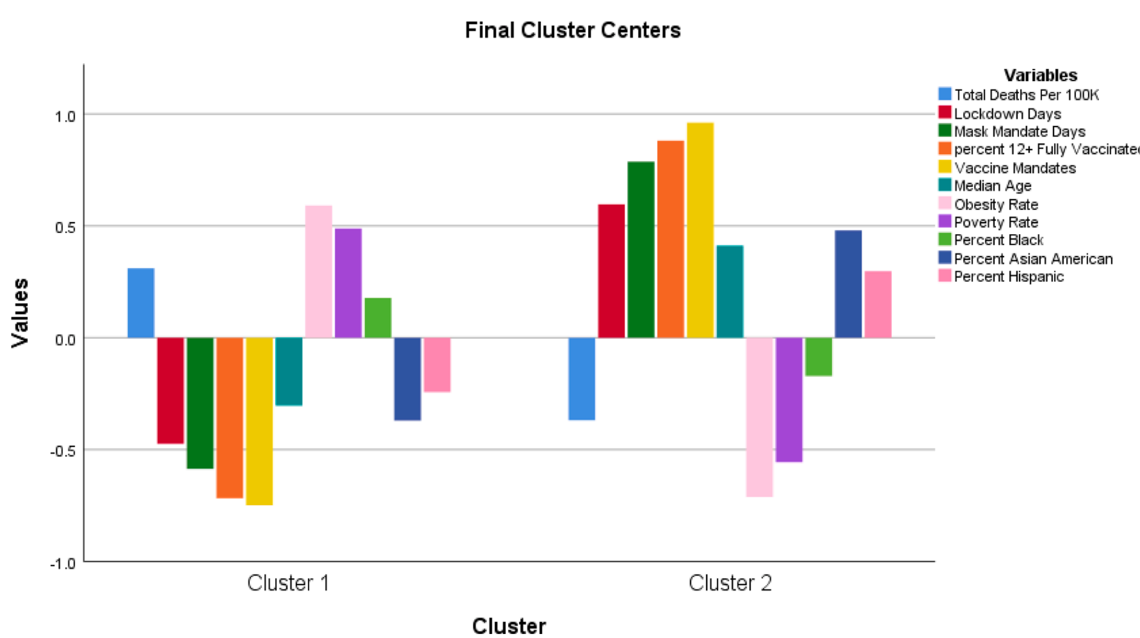

Fig. 1. Final Cluster Centers for COVID-19 Deaths, COVID-19-Related Regulations, Vaccination Rates, Demographic and Ethnic Variables for the Two-Cluster Solution.

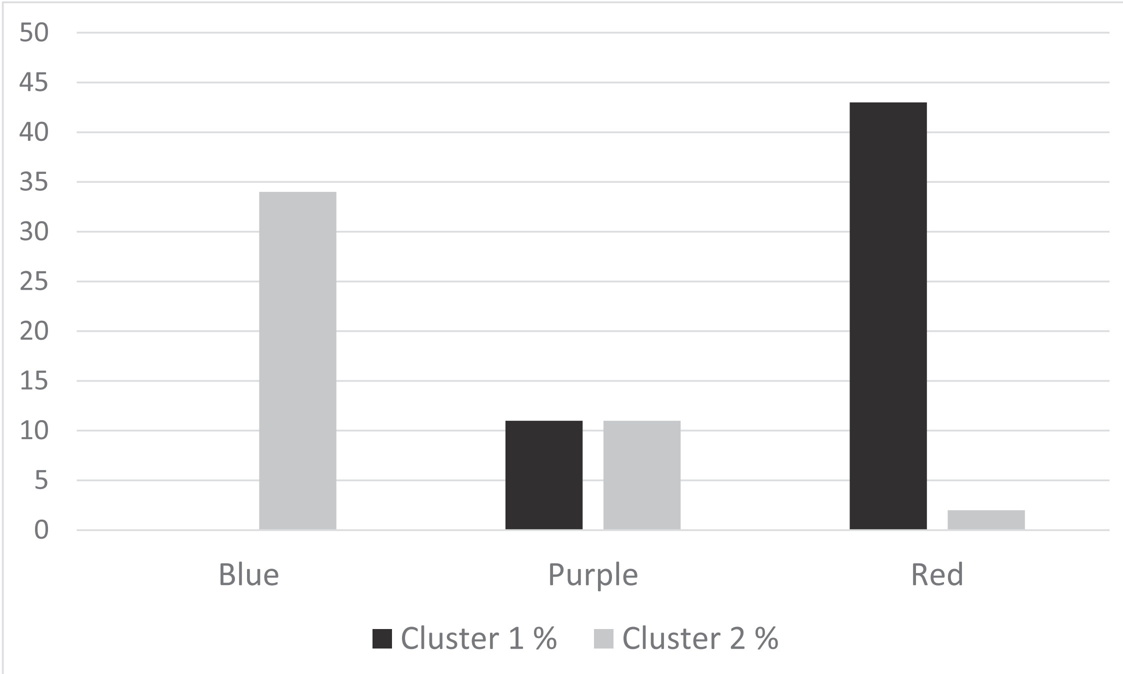

Fig. 2. Percentages of the Two Clusters per Political State Governance. Note. Cluster 1: High Number of COVID-19 Deaths, Fewer Political Mitigation Measures, Fewer Vaccinations, and Higher Demographic Risk Factors. Cluster 2: Low Number of COVID-19 Deaths, More Political Mitigation Measures, More Vaccinations, and Lower Demographic Risk Factors.

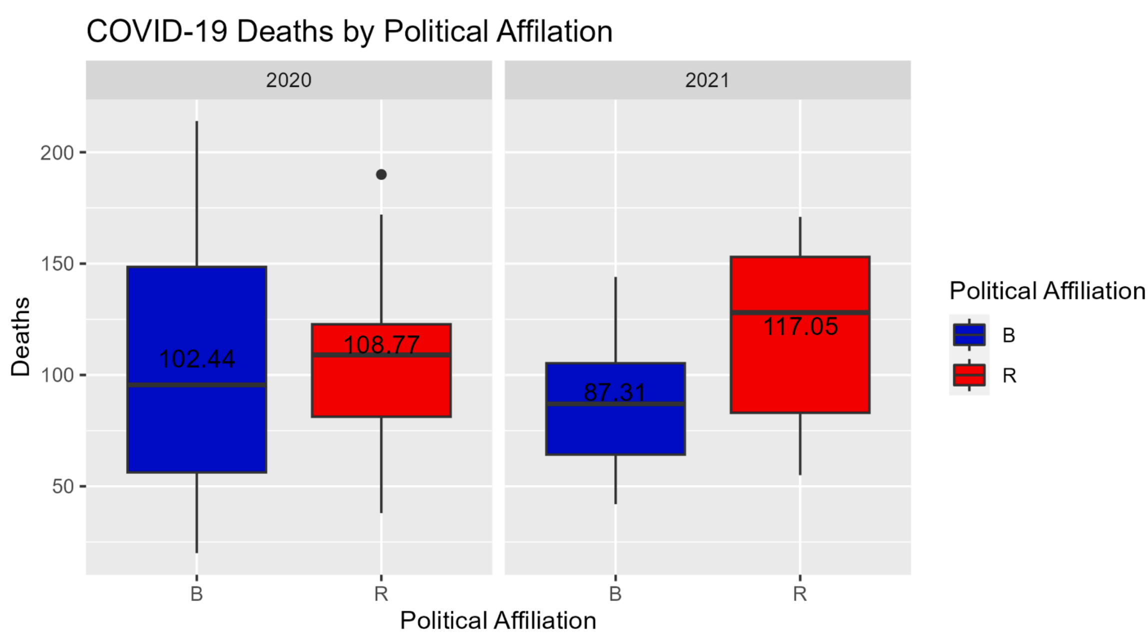

Fig. 3. COVID-19 Deaths by Political Affiliation for 2020 and 2021

Tables 1 and 2 summarize the results of the regression models controlling for political affiliation. Table 1 indicates the number of cases per 100 k is significant across the models considered, with effect sizes all approximately equal. Similarly, higher median ages and obesity; greater percentage of African American or Hispanic populations; and greater number of mask mandate days appear to be independently associated with increased incidence of COVID-19 deaths per 100 k. When controlling for biological or social variables, political affiliation is not significant. However, when the number of mask mandate days are included as a covariate, political affiliation is significant, with an estimated 25.17 more deaths ($p < 0.05$, stepwise model) associated with Republican affiliation. This effect size is consistent with the marginal effect seen for the 2021 data in Fig. 3. In Table 2, the results of the general linear F-tests are given in an abbreviated ANOVA table. This table indicates that each model significantly explains a greater portion of variation relative to the baseline model.

Overall, the results in Table 1 indicate prominent first order effects that appear to be associated with COVID-19 deaths. However, the differing effect sizes for political affiliation across the various models could indicate a multicollinearity or identifiability issue [51]. The descriptive plots indicate that this is likely the case, with the root cause being the incongruity between red and blue states' virus mitigation

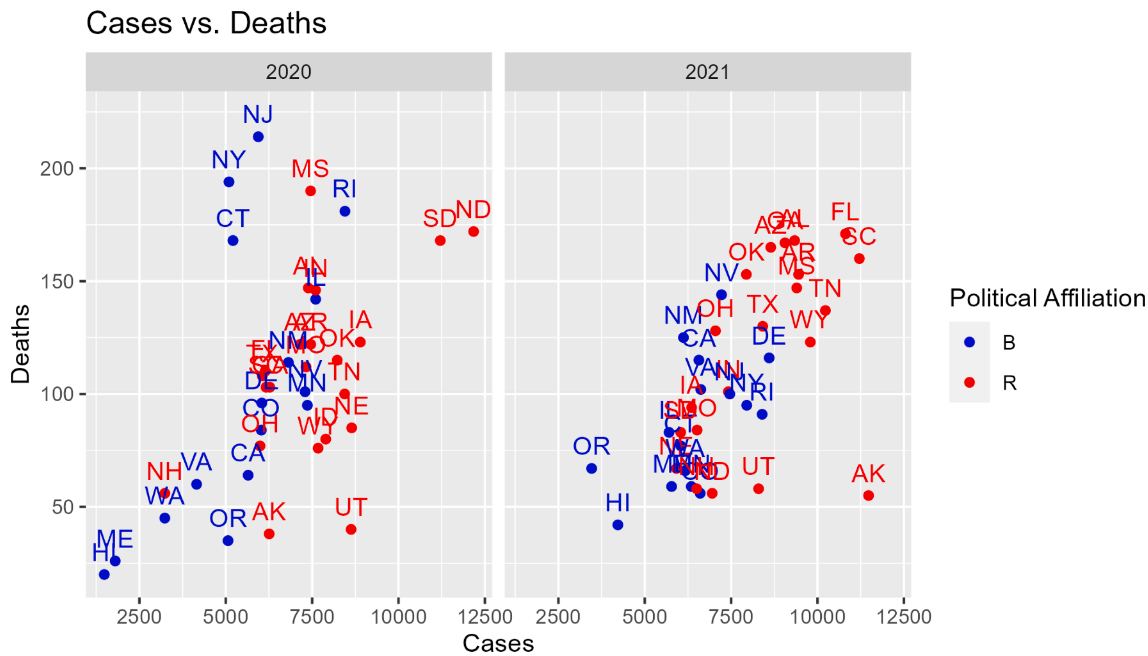

Fig. 4. COVID-19 Cases and Deaths by Political Affiliation for 2020 and 2021

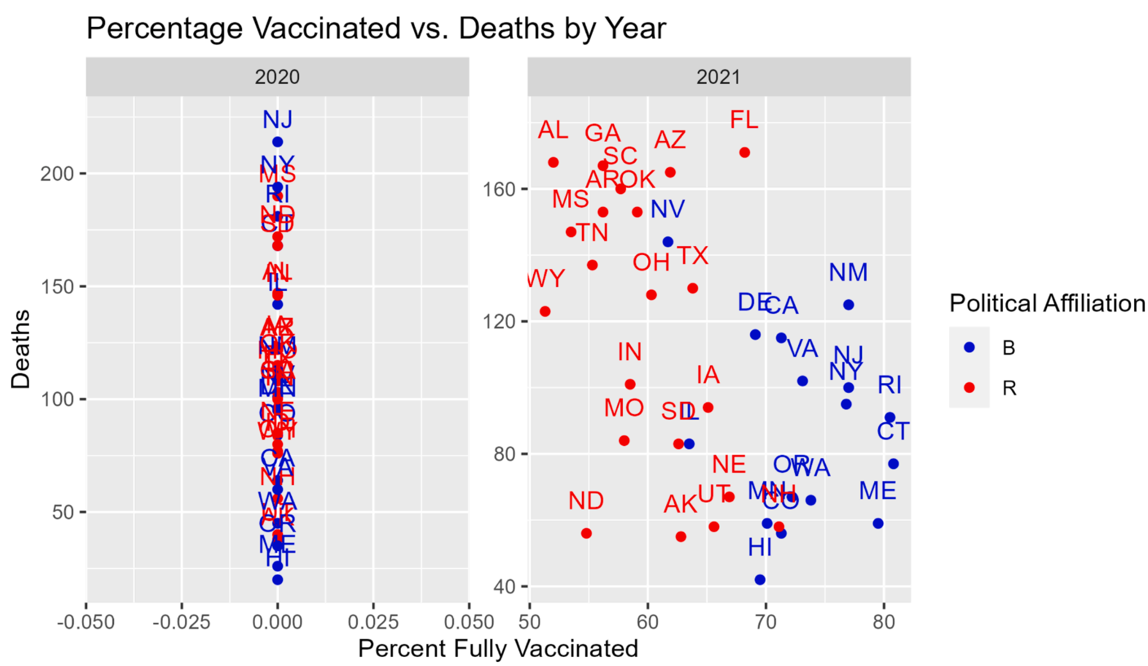

Fig. 5. Percentage Vaccinated versus COVID-19 Deaths by Political Affiliation for 2020 and 2021

efforts. To navigate the collinearity problem, the models were fit separately to the data for red and blue states. Table 3 summarizes the results. There it can be seen that none of the variables included in the social or biological models have significant effects for blue states, however there are large effect sizes for median age and percentage of African American and Hispanic populations for red states. As in Table 1, there is also a large positive effect associated with the number of mask mandate days, implying a greater number of deaths associated with longer mask mandates. Referencing Figure 6, it appears this is because of states with initial higher COVID-19 mortality rates (i.e., New York) adopting longer mask mandates, rather than longer mask mandates causing COVID-19 related deaths. For Red states, there were significant effects associated with higher median age, obesity, percentage of African American or Hispanic populations, as well as the total state population (for the baseline and biological models).

For the models fit to the blue states the effect of percentage vaccinated was only significant for Baseline and Biological models, but the effect sizes were roughly consistent across the models. Conversely, the percentage vaccinated was not significant for the red states, and the effect sizes across each of the models were consistently smaller than those from the associated models for blue states.

It should be noted that the effect of Year (i.e., 2020 or 2021) is confounded in the data with the percentage of the population vaccinated (see Fig. 5). That is, in 2020 no vaccines yet existed so the percentage vaccinated in each state was zero, whereas by 2021 vaccines had been made available and differentiation could be seen in vaccination rates.

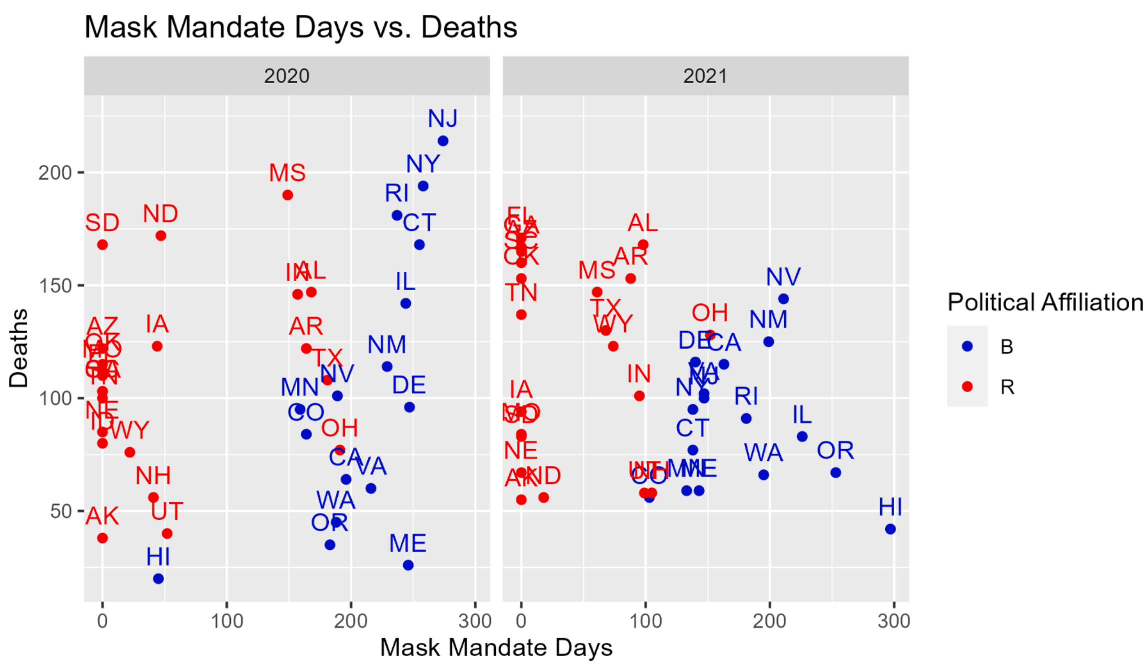

Fig. 6.

Table 1
Parameter estimates and standard errors for models predicting COVID-19 deaths and explicitly controlling for political affiliation.

	Model				
Parameter	**Baseline**	**Mitigation**	**Social**	**Biological**	**Stepwise**
Intercept	110.62 (7.27)***	91.46 (9.24)***	110.61 (7.3)***	114.2 (7.5)***	90.73 (7.68)***
Cases/100 k	28.24 (5.11)***	30.03 (4.89)***	21.75 (4.82)***	29.81 (4.91)***	27.54 (4.27)***
Political Affil.	−10.3 (10.21)	23.33 (14.53)	−9.42 (11.05)	−16.73 (11.11)	25.17 (12.05)*
Percent Vaccinated	−8.64 (4.47)	−6.41 (4.31)	−6.91 (3.96)	−9.13 (4.13)*	−6.47 (3.58)
Total Population	6.89 (3.87)	4.95 (3.86)	−0.75 (4.67)	8.56 (3.59)*	–
Mask Mandate Days	–	19.94 (6.63)**	–	–	15.65 (5.55)**
Lockdown Days	–	3.78 (5.39)	–	–	–
Percent Afr. Amer.	–	–	16.74 (5.37)**	–	14.72 (3.66)***
Percent Hispanic	–	–	9.49 (5.87)	–	12.77 (3.8)**
Percent Asian Amer.	–	–	−2.67 (4.59)	–	–
Poverty Rate	–	–	4.56 (5.42)	–	–
Adult Obesity Rate	–	–	–	10.61 (5.11)*	–
Median Age	–	–	–	12.33 (4.4)**	12.01 (3.9)**

* $p < 0.05$.
** $p < 0.01$*** $p < 0.001$.

Table 2
ANOVA summary table of general linear F-tests of each domain-specific model relative to the baseline model.

model	residual df	RSS	df	SS	F	p-value
Baseline	70	95976.756	–	–	–	–
Mitigation	68	83607.507	2	12369.25	5.030	0.009
Baseline	70	95976.756	–	–	–	–
Social	66	70302.543	4	25674.21	6.026	3.40E-04
Baseline	70	95976.756	–	–	–	–
Biological	68	78618.527	2	17358.23	7.507	0.001
Baseline	70	95976.756	–	–	–	–
Stepwise	67	56657.786	3	39318.97	15.499	9.26E-08

Thus, it is not possible to disentangle the effect of Time and the effect of vaccinations. It is for this reason that the percentage vaccinated is included in the Baseline model rather than the Mitigation model.

4. Discussion

The main objective of the current study was to investigate whether the dominant political affiliation and governance of a state determines the behavioral and political mitigation efforts to fight COVID-19 in 2020 and 2021, and whether these political regulations are associated with COVID-19 deaths. We investigated four research questions.

The first question referred to differentiating naturally occurring clusters based on all the variables assessed (biological, social demographic, and mitigation strategies), and to assess if these clusters differentiate between red, blue, and purple states; K-means cluster analyses revealed two clusters among all states for COVID-19 cases. The larger first cluster includes states with high COVID-19 infections, which implemented fewer mitigation efforts (i.e., lockdown days, mask mandate days, and vaccine mandates), lower vaccination rates, lower median age, and higher risk factors such as obesity and poverty rate. These are also the states where there are fewer Asian Americans and fewer Hispanics. These findings indicate issues regarding health equity and ethnic make-up during the COVID-19 pandemic [52] and possibly that people of color are less likely to vaccinate [53]. These results also confirm how Blacks have the highest death rate due to COVID-19, which may be due to a genetic predisposition [54].

The second cluster contains states that have low numbers of COVID-

Table 3
Parameter estimates and standard errors for models individually fit to red and blue state subsets.

Political Affiliation	Parameter	Models Baseline	Mitigation	Social	Biological	Stepwise
B	Intercept	115.39 (8.96)***	84.13 (13.27)***	109.02 (14.75)***	108.65 (11.67)***	80.68 (12.67)***
	Cases/100 k	33.81 (8.81)***	33.97 (7.91)***	21.52 (11.49)	38.09 (10.04)***	24.93 (8.82)**
	Percent Vaccinated	−14.95 (6.78)*	−9.4 (6.4)	−11.97 (6.92)	−16.22 (7)*	−8.26 (6.1)
	Total Population	2.65 (5.52)	2.27 (5.28)	−2.29 (6.85)	5.51 (6.31)	–
	Mask Mandate Days	–	32.85 (11.57)**	–	–	27.35 (11.17)*
	Lockdown Days	–	2.32 (6.15)	–	–	–
	Percent Afr. Amer.	–	–	21.56 (11.75)	–	17.36 (9.79)
	Percent Hispanic	–	–	12.69 (13.37)	–	13.39 (7.28)
	Percent Asian Amer.	–	–	−0.58 (5.94)	–	–
	Poverty Rate	–	–	2.25 (14.87)	–	–
	Adult Obesity Rate	–	–	–	−6.71 (10.61)	–
	Median Age	–	–	–	11.49 (11.17)	8.2 (8.87)
R	Intercept	102.1 (5.94)***	112.89 (9.41)***	77.93 (10)***	93.78 (5.09)***	111.43 (6.17)***
	Cases/100 k	25.66 (6.16)***	28.48 (6.59)***	19.74 (5.1)***	28.14 (4.69)***	27.48 (4.83)***
	Percent Vaccinated	−2.84 (5.99)	−2.45 (6.02)	−0.29 (4.65)	−3.09 (4.45)	−2.09 (4.5)
	Total Population	11.82 (5.59)*	9.36 (5.82)	5.1 (7.89)	10.71 (4.16)*	–
	Mask Mandate Days	–	10.25 (8.2)	–	–	8.88 (6.19)
	Lockdown Days	–	10.32 (13.31)	–	–	–
	Percent Afr. Amer.	–	–	11.64 (6.55)	–	14.63 (3.7)***
	Percent Hispanic	–	–	11.35 (8.52)	–	10.47 (4.76)*
	Percent Asian Amer.	–	–	−66.7 (23.77)**	–	–
	Poverty Rate	–	–	7.75 (6.99)	–	–
	Adult Obesity Rate	–	–	–	21.01 (4.9)***	–
	Median Age	–	–	–	13.67 (3.9)**	12.89 (4.14)**

* $p < 0.05$.
** $p < 0.01$*** $p < 0.001$.

19 infections, which implemented more mitigation efforts (i.e., lockdown days, mask mandate in days, and vaccine mandates), higher vaccination rates, higher median age, and had lower risk factors such as low obesity and low poverty rate. Red states fall more often into Cluster 1 and blue states fall more often into Cluster 2.

Identical k-means cluster analysis results emerged for COVID-19 deaths. Red states fall more often into Cluster 1 – with for example high number of COVID-19 deaths, fewer mitigation efforts, lower vaccination rates, and higher risk factors - and blue states fall more often into Cluster 2.

The second question centered on investigating whether the states' political affiliation as red or blue is associated with COVID-19 deaths in 2020 and 2021; We focused on COVID-19 deaths of 2020 and of 2021 separately, considering the Delta variant and the availability of vaccines. In terms of COVID-19 related deaths, red and blue states in 2020 did not differ significantly. COVID-19 deaths in 2021, however, were significantly less in blue compared to red states.

The third question was to what extent COVID-19 deaths overall are predicted by a priori latent factor groups (biological, social demographic, and behavioral/political mitigation variables) when explicitly controlling for political affiliation. The overall regression models are significant indicating that biological—higher median ages and obesity; social–greater percentage of African American or Hispanic populations; and behavioral mitigation—greater number of mask mandate days predict increased incidence of COVID-19 deaths. When the number of mask mandate days are included as a covariate, political affiliation is significant, with an estimated 25.17 more deaths associated with Republican affiliation.

The fourth question analyzes the same a priori latent factor groups for COVID-19 deaths but for red and blue states separately. That way it is possible to tease out the effects of mitigation efforts, biological, and social factors due to political affiliation being clearly aligned with vaccination rates. None of the variables included in the social or biological models have significant effects for blue states, only mitigation in terms of mask mandate days. For red states, there were significant effects associated with higher median age, obesity, percentage of African American or Hispanic populations, as well as the total state population.

A similar, but very different, study explored the differences among various mitigation efforts (government interventions of physical distancing and restrictions) in states in the West and Northeast of the United States. Results showed to what degree they slowed down the outbreak of COVID-19 [55].

COVID-19 deaths in 2020 did not significantly correlate with mitigation efforts. In 2021, however, in the prevalence of the delta variant, fewer COVID-19 deaths were significantly associated with higher vaccination rates and more vaccine mandates.

Regarding COVID-19 cases in 2020, more lockdown days and more mask mandate days were significantly associated with fewer COVID-19 cases. These findings are supported by studies that observed the decreased trend in COVID-19 infections occurring after mitigation measures are implemented, such as social distancing and restricting large gatherings [56] and such as face mask mandates [57]. Specifically, for mask mandates in the year 2020, similar results were found - that for states that had high adherence to mask wearing, COVID-19 rates were low [25].

Findings are also relevant for minority groups and their access to treatment. The regression analyses suggest that states with higher median ages and/or larger percentage population of those of African descent tended to have a larger number of COVID-19 related deaths per 100 k. Additionally, for red states it was observed that greater levels of adult obesity were associated with more deaths per 100 k. The risk factor obesity for Covid-19 deaths has been also discussed in other research across coutnries [58]. These results appear to support the intuitive notion that COVID-19 had particularly disproportionate effects on those unable to receive the necessary resources or treatment to combat the spread of COVID-19.

5. Limitations

The limitations of this study follow organically from the process of aggregating data from secondary sources that report to governing bodies and the assumed reliability of each public report [36]. Additionally, in

2021, with the expansion of several at-home testing kits and diagnostics, it is widely acknowledged that many COVID-19 cases were not reported to a federal entity. Aside from non-reporting, potential fraudulent or otherwise misreporting of COVID-19 cases posed an equal threat to the actual mass-scale effects of the pandemic [59]. Furthermore, it is worth mentioning that we did not study adherence to mass-behavioral mitigation measures but the presence of the mitigating measures given by the state officials. Existing literature on actual adherence to mitigation strategies has observed substantial variability [25].

Regarding the regression modeling, ordinary least squares were used to fit each of the models under consideration. Consequently, a basic requirement is that the usual assumptions of independence, homoscedasticity, and normality of errors terms must apply. Strictly speaking, these assumptions are questionable for the models which explicitly control for political affiliation as 1) blue states in 2020, led mainly by New York and New Jersey, skew the distribution of deaths; 2) there was considerably more variation in the number of deaths in both red and blue states in 2020 vs. 2021; and 3) Shapiro-Wilk tests for all but the mitigation model ($W = 0.978$, $p = 0.215$) were rejected. Conversely, the models fit individually to red and blue states were much more well-behaved with Shapiro-Wilk tests for many of the models (stepwise included) being nonsignificant.

It should also be noted that the analyses do not (and cannot) explain why red states had lower vaccination rates compared to blue states. For example, one could speculate that this was due to differential access to vaccines in 2021 with blue states and densely populated areas getting priority access. An alternative speculation could be that red states have larger rates of vaccine hesitancy. In any case, a more targeted investigation operating within a casual framework would likely be needed to make the determination.

6. Conclusion

While the duration of the pandemic and its outcomes are only now becoming clear, this study shows an apparent association between mitigation efforts and lesser negative outcomes due to COVID-19. Despite the hesitancy of many, this work's key conclusion is that mass-behavioral changes prescribed through legislation do provide mass-scale dividends in areas that promote these strategies. In highlighting the political divide between COVID-19 legislative and mitigation efforts, researchers do not intend to proselytize one ideology to another but to expand on the notion that differences between dominant political affiliations are equally relevant to consider. Diseases have demonstrated no partisan allegiance, past or present. The individual role of citizens is not without consequence, but to ultimately lessen the aversive effects of COVID-19 and other viral threats in the United States, it is necessary to behave collectively. Given the compelling evidence of mass-behavioral mitigation efforts being successful in pandemic remediation, further legislation should focus on best communicating and implementing these strategies across political landscapes. Focusing on effectively implementing mitigation strategies across ideologies should be paramount if communities are to address disease-based threats with minimal loss and aversive outcomes.

- Funding statement: This study was supported by a Delaney Presidential Professorship to the first author.
- Patient consent statement: N.A.
- Permission to reproduce material from other sources: N.A.
- Clinical trial registration: N.A.

Authors' Note

This research was supported in part by a grant from the University of North Florida's Delaney Presidential Professorship to the first author.

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- Ethics approval statement: N.A., because secondary data analysis of publicly available data.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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