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## The effect of politician denialist approach on COVID-19 cases and deaths

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### ABSTRACT

Concern over the high rate of contagion of COVID-19 has prompted world authorities to use the strategy of isolation and social confinement as the main non-pharmacological weapon against the disease that has rapidly killed millions of people worldwide. However, there is evidence that the denialist rhetoric of the Brazilian President has negatively influenced people's behavior in relation to obedience to confinement and social isolation measures. The aim of this study is to analyze the correlation between the Brazilian President's denialist rhetoric and the low adherence to social distancing measures and the subsequent increase of new coronavirus cases and deaths. Daily data on the level of contamination by COVID-19, social distancing and information from Brazilian states between the months of February and May 2020 were used. Taking into consideration the differences between the federal government of Brazil and state governors about the severity of the pandemic and the importance of social distancing, the article uses the Instrumented Difference-in-Differences approach, suggested by Duflo (2001), to obtain the causal impact of reduced social distancing, resulting from Presidential denialist rhetoric, in mitigating COVID-19 cases and deaths, taking into account the relationship between the president of the republic and the states as an instrument. The results suggest that the Brazilian average Social Isolation Index increased from 39.77% to 51% between February 1st and May 18th, 2020, the country would have had approximately 318,850.03 fewer cases of COVID-19, and more than 10,000 lives would have been saved.

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## 1. Introduction

The COVID-19 outbreak is one of the most devastating episodes in the history of public health. According to World in Data, in just one year, this virus led to the deaths of more than 2 million people worldwide, infecting 75 million.

Unfortunately, Brazil became conspicuous for its failure in the fight against the virus and had the highest number of deaths per 1 million inhabitants among the most populous countries (1900 deaths per 1 million inhabitants). In absolute terms, after one year of pandemic in its territory, there were more than 600 thousand fatal victims of COVID-19 and 17 million cases of contamination. Recently, the Brazilian Federal Senate investigation ([Senado Federal, 2021](#)) suggested that the incumbent Brazilian President's denialist behavior is responsible for the national COVID-19 tragedy.

Indeed, at the beginning of 2021, the world observed the second wave of COVID-19 and the emergence of new potential variants of the virus ([Sabino et al., 2021](#); [Wang et al., 2021b](#)). Recently published reports on Covid-19 responses in 21 countries ([Jasanoff, et. al., 2021](#)) categorized Brazil as one of these "Chaos Countries" because its sanitary policy was unable to conduct effective strategies to mitigate and contain Covid-19. Indeed, novel SARS-CoV-2 found in Manaus (Capital of Brazilian Amazon State) may be 1.4–2.2 times more transmissible compared to previous circulating variants, and it is making people around 25–61% more susceptible to reinfection and death ([Faria et al., 2021](#); [WHO, 2021](#)). This new and dangerous strain has spread over all of Latin America and overseas countries, aggravating the global pandemic.

Following [Da Silva R.G.L \(2021\)](#), coronavirus denialist approach could be defined as a range of doubts and skepticism with regards to public health interventions to mitigate and contain the further spread of SARS-CoV-2. This ranges from anti-lock-down protests, conspiracy theories about Covid-19, and skepticism over the need to wear a mask.

In spite of the dramatic increase in the number of deaths by COVID-19 in the country, the President of Brazil adopted a denialist rhetoric in order to encourage the continuity of economic and financial activities in the country and minimizing health risks, contributing significantly to a reduction in social distancing and resulting in higher COVID-19 contamination rates ([Ajzenman et al., 2020](#); [Da Silva R.G.L 2021](#); [Faria et al., 2021](#); [WHO, 2021](#)).

The objective of this paper is to evaluate the impact of social isolation on the number of cases and deaths from COVID-19 ([Da Silva R.G.L, 2021](#); [Richard and Medeiros, 2020](#); [Malinverni and Brigagão, 2020](#); [Paes-Sousa et al., 2020](#)), considering the harmful effect of the President's denialist approach ([Gollwitzer et al., 2020](#); [Ajzenman et al., 2020](#); [Adolph et al., 2021](#); [Allcott et al., 2020](#); [Barrios and Hochberg, 2020](#)). The underlying argument is that the behavior of the President of the Brazilian Republic, encouraging social agglomeration, reduced the rates of social isolation and therefore promoted the proliferation of the virus in the country.

[Anderson et al., 2020](#) stated that a high rate of COVID-19 infections in a population with no previous immunity and no vaccine against the virus tends to result in exponential growth in case numbers. Therefore, non-pharmacological actions are needed to reduce transmission and slow the spread of the disease. Among these measures, isolation and social confinement are the main nonpharmacological policies for reducing the transmission of infectious respiratory diseases.

According to [Costa et al. \(2020\)](#), social isolation is a tool that can reduce and flatten the curve of cases and thus protect people at the greatest risk, reducing the chances of serious conditions related to the disease, potential deaths and the collapse of the health system of the country ([Van Bavel et al., 2020](#); [Brzezinski et al., 2020](#)). Previous experience with H1N1 in 2009, which had a much lower transmission rate than the new coronavirus, had already shown that, in a globalized world, it is extremely difficult to prevent new diseases from reaching other countries.

Therefore, during the COVID-19 pandemic, most countries have decided to implement social distancing measures, enacting strategies to control population movement and suspend academic activities and nonessential trade ([HALE and WEBSTER, 2020](#)). However, despite the WHO recommendation and empirical evidence ([Briscese et al., 2020](#); [Douglas et al., 2020](#); [Kraemer et al., 2020](#); [Nicola et al., 2020](#)), some leaders in the US, Europe, and Latin America are skeptical about the effectiveness of social distancing policies. These leaders have criticized these policies, arguing that social distancing aggravates the economic crisis without necessarily alleviating the pandemic.

The purpose of this article is to identify the effects of Social Isolation Index (SII), in mitigating COVID-19 cases and deaths in Brazil using as identification strategy the fact that the Brazilian President's denialist rhetoric is an exogenous phenomenon correlated with SSI because it weakened the states social-distancing policy reducing the effectiveness of social distancing. An intriguing aspect of this problem is that, due to omitted variable problems as the number of infections has grown, there has been a natural trend toward self-confinement irrespective of whether social distancing is implemented as a policy. Therefore, social distancing and the number of cases of COVID-19 are simultaneously determined phenomena. To capture the causal effect of social distancing on the COVID-19 pandemic, in this research, we adopt a difference-in-difference instrumented (DDIV) strategy ([DUFLO, 2001](#)).

Many studies have argued that the power of political discourse affects decision making and the behavior of society. There are numerous examples in the literature of how political leaders can motivate their followers to behave in certain ways through speeches and behavior ([Lazear and Rosen, 1981](#); [Hermalin, 1998](#); [Acemoglu and Jackson, 2015](#)). Political corruption scandals can also render citizens more dishonest ([Ajzenman et al., 2020](#)). In contrast, good examples of care for the public and a perception of effective leadership on the part of elected leaders, encourage widespread appropriate voluntary action ([Jack and Recalde, 2015](#)). Recently, [Briscese et al. \(2020\)](#) showed the importance of public authorities in managing people's expectations during public health emergencies.

This study is divided into 5 sections, including the introduction. The next section provides useful context for the public health situation in Brazil at the time of the COVID-19 pandemic and a discussion of the importance of political discourse to

**Table 1**

Date of social distancing measures decreed by Brazilian states and percentage of vote in states for president.

States	Social Distancing Decree	% of vote	Governors supporting the President*
Distrito Federal	February 29, 2020	70	Yes
Goiás	March 13, 2020	65.5	No
Minas Gerais	March 13, 2020	58.2	Yes
Paraíba	March 13, 2020	35	No
Pernambuco	March 14, 2020	33.5	No
Acre	March 16, 2020	77.2	Yes
Ceará	March 16, 2020	28.9	No
Espírito Santo	March 16, 2020	63.1	No
Rio de Janeiro	March 16, 2020	68	No
Rio Grande do Norte	March 17, 2020	36.6	No
Santa Catarina	March 17, 2020	75.9	No
Tocantins	March 18, 2020	49	No
Amapá	March 19, 2020	50.2	Yes
Bahia	March 19, 2020	27.3	No
Maranhão	March 19, 2020	26.7	No
Mato Grosso do Sul	March 19, 2020	65.2	No
Paraná	March 19, 2020	68.4	Yes
Piauí	March 19, 2020	23	No
Rio Grande do Sul	March 19, 2020	63.2	No
Alagoas	March 20, 2020	40.1	No
Pará	March 20, 2020	45.2	No
Rondônia	March 20, 2020	72.2	Yes
Sergipe	March 20, 2020	32.5	No
São Paulo	March 21, 2020	68	No
Roraima	March 22, 2020	71.6	No
Amazonas	March 23, 2020	50.3	Yes
Mato Grosso	March 23, 2020	66.4	No

Source: Official Journals of Brazilian States and the Brazilian Electoral Corte (*Supremo Tribunal Eleitoral* -TSE). \*States with governors who did not sign a manifesto against the President, Open Letter in Defense of Democracy, on April 19, 2020.

social behavior. In the third section, the study describes the database and the empirical strategy used to estimate the causal effects of the lockdown. In the fourth section, we present and discuss the results of the DDIV model. Finally, we offer some concluding remarks and suggestions for future research in the fifth section.

## 2. Background

Following WHO recommendations, the governors of the 27 Brazilian states, including the Federal District, on different days decreed social-distancing restrictions, with some decrees starting as early as February 29, 2020 (Table 1). Although Brazil's Ministry of Health declared a Public Health Emergency of National Importance in the country (Ordinance no. 188, BRASIL, 2020) on February 3, 2020, the federal government, represented by the figure of the incumbent Brazilian President of the Republic, encouraged the continuity of commercial activities and advocated for business as usual.

According to the Fiscal Decentralization Theorem (Oates, 1997), local authorities have an advantage over central governments in terms of knowing their citizens' preferences. In addition, since local governments are closer to society, local processes should take priority over central government bodies. Local governments can obtain better information by interacting much more easily with the locality and meeting regional demands more efficiently (Krugman, 1991, Krugman, 1997). Conversely, local governments are not necessarily equipped to address situations that transcend their borders and that require coordination at a higher level of aggregation.

The new public management paradigm developed by the Organization for Economic Cooperation and Development (OECD) in 1995 and suggested replacing centralized management structures with decentralized management models, in which public policy proposals regarding resource management and decision making are built in an environment much closer to the service location and where conditions are created for the return of interest groups.

In spite of social isolation being one of the main non-pharmacological measures to fight COVID-19 contamination and is widely adopted by public policy makers concerned with combating the proliferation of the virus (TOBIÁS, 2020) some world leaders have denied the importance of this practices to contain the pandemic.

Indeed, the President of Brazil, in speeches and by modeling behavior, encouraged his supporters not to follow social-distancing restrictions issued by the states. On March 15, 2020, despite general recommendations on self-isolation, demonstrations occurred across the country on behalf of the President that brought thousands of supporters into large agglomerations.<sup>1</sup> The President himself participated in the demonstrations in the Federal District, having contact with the protesters.<sup>2</sup> In

<sup>1</sup> For more details, see <https://g1.globo.com/politica/noticia/2020/03/15/cidades-brasileiras-tem-atos-pro-governo.ghtml>. Available on April 28, 2020.

<sup>2</sup> For more details, see <https://agenciabrasil.ebc.com.br/bolsonaro-participa-de-manifestacao-de-simpatizantes-em-brasilia>. Available on April 28, 2020.

addition, a statement made on national television on March 24 positioned the President in opposition to most of the state governments in terms of policies for reducing the spread of COVID-19.<sup>3</sup>

Table 1 shows for each Brazilian State the day on which social distancing measures were decreed, the percentage of the vote for incumbent President in the second round of presidential elections in each state and the states with governors supporting the President. We define “supporting” based on signing a manifesto against the President, called the Open Letter in Defense of Democracy, on April 19th, 2020.

One way to investigate the influence of the President's denialist rhetoric on compliance with social distancing is to divide Brazilian states by *support* (states with governors who are pro-President) and *nonsupport* (otherwise). Since January 2019, when he assumed the Presidency of the Republic of Brazil, the President has lost support from the governors of Brazilian states, including the leaders of the two most important states: Rio de Janeiro and São Paulo. In fact, on April 18, 2020, 20 of the 27 governors signed a document formalizing their discontent (Open Letter in Defense of Democracy<sup>4</sup>). Therefore, this article defines as pro-President (*support*) the 7 states with governors who did not sign the letter.<sup>5</sup>

Fig. 1 presents the trajectory of the Social Isolation Index (SII) of the states with governors in the *support* and *nonsupport* groups. The SII was developed by INLOCO<sup>6</sup> to assist in combating the COVID-19 pandemic by monitoring the coronavirus in Brazil. It shows the percentage of the population respecting the isolation recommendation. As expected, the SII grew substantially after the isolation decrees for both the President *support* and *nonsupport* states.

Fig. 2 describes the growth in COVID-19 infections in the *support* and *nonsupport* states during the analyzed period. In every period after state decrees of isolation and social confinement, it is clear that the growth in COVID-19 incidence (number of cases per 100,000 inhabitants) is higher in *support* states than in *nonsupport* states.

This evidence goes on to recent papers that correlated the Presidents' denialist rhetoric with low adherence to social distancing (Allcott et al., 2020; Gadarian et al., 2021; Barrios and Hochberg, 2020). These authors argue that the denialist discourse about virus dissemination, presented by some authorities, has strongly influenced many people not to obey the isolation and social confinement decrees. Indeed, denialist behavior has hampered the fight against the pandemic and, in general, increased the number of cases and deaths caused by COVID-19 (Faria et al., 2021).

Allcott et al. (2020) aimed to show how the partisan difference between Republicans and Democrats influences the behavior of American citizens in relation to the new coronavirus pandemic. To do this, they applied combined epidemiological models with economic models to optimize behavior for heterogeneous agents. The difference in people's behavior regarding adherence to social distancing policies may reflect the opportunity costs that distancing imposes. The authors found a statistically significant effect of political party on social isolation index.

Gadarian et al. (2020) investigated how party ideology influences the behavior of the American population regarding the current COVID-19 pandemic. To do this, the authors studied a survey of 3000 adult Americans on March 20–23, 2020, when the pandemic was still in its early stages. Thus, using LASSO regression, they controlled the effects of the individual and geographic characteristics of the study sample. The results indicated that Republicans were less willing to follow health care recommendations and were less concerned about the current COVID-19 pandemic when compared to Democrats.

Barrios and Hochberg (2020) argue that, as Trump voter share rises, individuals search less for information on the virus, and engage in less social distancing behavior, as measured by smartphone location patterns. These patterns persist in the face of state-level mandates to close schools and businesses or to “stay home,” and reverse only when conservative politicians are exposed and the White House releases federal social distancing guidelines. In addition, Ajzenman et al. (2020) and Mariani et al. (2020) found the similar results working with Brazilian data set.

Ajzenman et al. (2020) investigated the impact of the position of the Brazilian President regarding the non-stoppage of services during the Covid-19 pandemic, on the index of social distancing in the Brazilian states. They argued that the actions and words of leaders can influence people's behavior in several ways. Indeed, due to the asymmetry of information the population may ignorantly overlook recommendations from medical authorities in the event of a pandemic. In this way, the leader's performance is of paramount importance. Eventually, they show that the social distancing index decreased in all municipalities where the President's supporters are the majority as a result of his behavior contrary to the social distancing policies recommended by various health agencies.

Mariani et al. (2020) also investigated the influence of the Brazilian President on the number of Covid-19 cases and they concluded that his behavior increases Covid-19's rate of contagion. More specifically, cities where the majority of voters supported the president in the last election had a 19% increase in the number of Covid-19 cases compared to those where the majority of their voters voted for the opposition party.

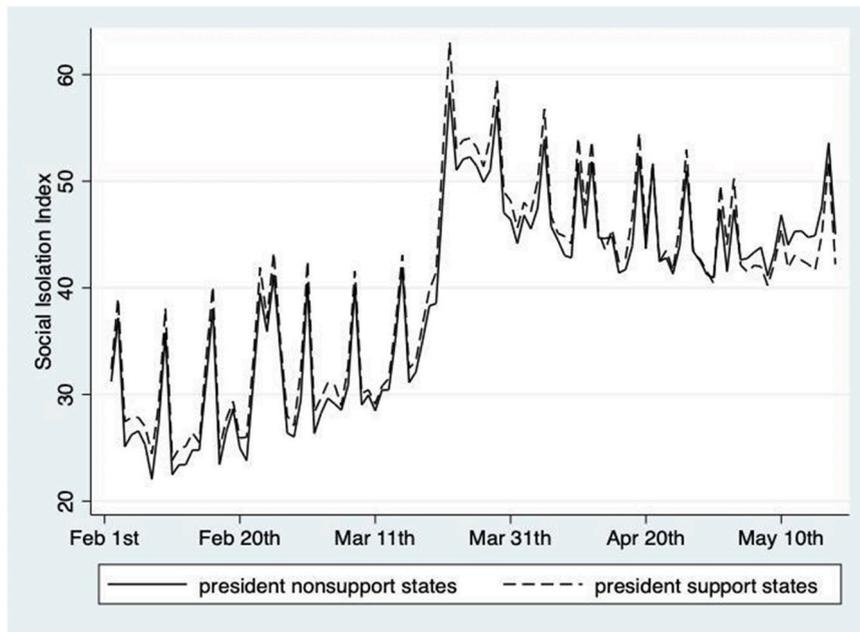
In this paper we are showing the impact of social-distancing on COVID-19 no. of cases and death and we are using as an instrument the fact that states that support the president have a population more sympathetic to his denialist behavior and therefore, have a low adherence to social-distancing policies.

<sup>3</sup> For more details, see <https://www1.folha.uol.com.br/equilibrioesaude/2020/03/ao-contrario-do-que-disse-bolsonaro-passado-de-atleta-nao-e-garantia-de-protecao-contra-coronavirus.shtml>. Available on April 28, 2020.

<sup>4</sup> <https://g1.globo.com/politica/noticia/2020/04/19/em-carta-governadores-de-20-estados-manifestam-apoio-a-maia-e-alcolumbre.ghtml>.

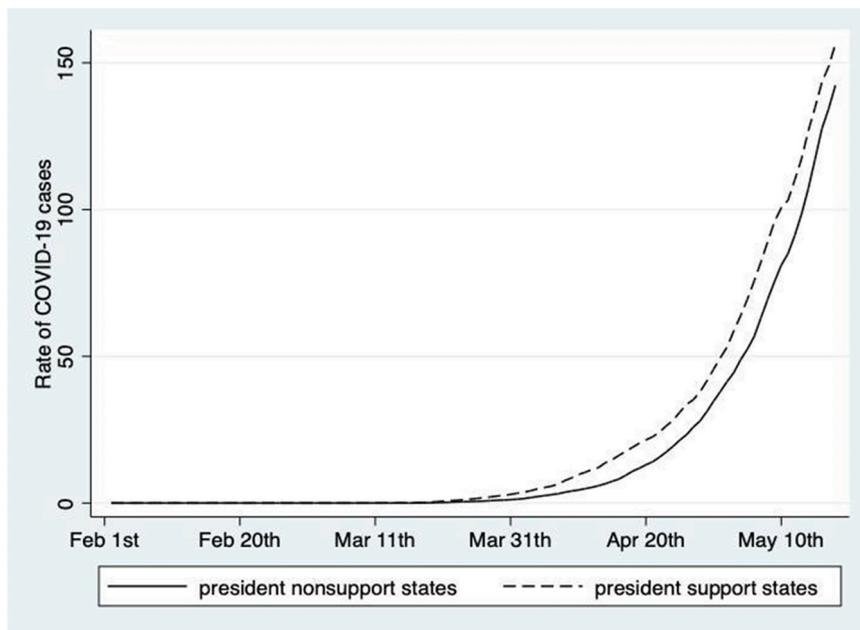
<sup>5</sup> Paraná, Minas Gerais, Federal District, Rondonia, Acre, Amazonas and Amapá.

<sup>6</sup> Brazilian Company founded in 2010 and based on the Recife Company founded in Recife, with branches in São Paulo, New York and San Francisco: <https://mapabrasileirodaCOVID.inloco.com.br/en/>.



**Fig. 1.** Social Isolation Index Trajectory. Election information comes from TSE. Dashed Line represents *support* states, and Continuous Line represents *nonsupport* states; Social Isolation Index (SII).

Sources: COVID-19 cases come from Kaggle's database.



**Fig. 2.** Case Rate Of Covid-19 Trajectory. Election information comes from TSE. Dashed Line represents *support* states, and Continuous Line represents *nonsupport* states; Social Isolation Index (SII).

Sources: COVID-19 cases come from Kaggle's database.

As stated, measuring the social-distancing restrictions by a self-reported index (SII) is endogenous because, as the pandemic worsens, self-isolation can take place even in the absence of social distancing policies. Therefore, Ordinary Least Square (OLS) coefficients are biased. To address this problem, we used Two Stage Least Squares (2SLS). In doing so, we follow [Duflo \(2001\)](#) and run a Differences-in-Differences (DID) model in the first stage, in which the outcome is SII, and the treated variable is the interaction between *support* and *decreed* (the data for social-distancing restrictions decreed by Brazilian states, [Table 1](#)). In the

second stage, the predicted values of SII from the first stage (which are now exogenous) become the variable of interest in regressions on the outcomes. Our identification hypothesis is that the President's behavior is able to explain COVID-19 cases and deaths only because it explains the population's social isolation adherence. This idea is discussed further in the next section.

### 3. Methods

In this section, the current study presents information from the database used, as well as the empirical strategy Instrumented Difference-in-Differences used to investigate the causal impacts of SII on COVID-19 cases and deaths in Brazil.

#### 3.1. Database

We worked with 27 Brazilian states, including the Federal District, over 108 days between February 1st and May 18th, 2020, checking cases of and deaths from COVID-19 obtained from the Kaggle platform.<sup>7</sup> The choice of this time period for analysis follows the work of Merow and Urban (2020) and Wang et al. (2021a). According to these authors, during the initial stage of the outbreak in America and China there were fewer interventions on the contagion rates of COVID-19, therefore it possible to estimate the effect of public policy.

The influence of climatic factors on contamination with viral respiratory diseases was investigated in the literature. It can be concluded through these studies that the average temperature, the hours of sunshine and the precipitation of rain are important aspects when studying the determinants of the spread of these diseases (Paez et al., 2020; Sun et al., 2020; Kudo et al., 2019; Casanova et al., 2010; Makinem et al., 2009; Liener et al., 2003). To control for these characteristics, we use Brazilian states' climate daily data for period under analysis from the National Institute of Meteorology (INMET).

To control for greater traffic of people, such as cities with airports, we used information about on the number of people entering the country through airports for each Brazilian state from the National Civil Aviation Agency (ANAC).

Socioeconomics of Brazilian states and characteristics such as population size, average income, proportion of employed persons, life expectancy and births come from the Brazilian Institute of Geography and Statistics (IBGE). In addition, the percentage of votes that the candidate for President of the Republic had received during the second round of the 2018 elections comes from the Superior Electoral Court (TSE).

In addition, the information about mortality rates from COVID-19 comorbidities (respiratory diseases, hypertension and diabetes), the number of hospitalizations in public hospitals and the bed rate per 100 inhabitants came from DATASUS. All of these variables are described in Table 2.

#### 3.2. Empirical strategy

The main study goal is to verify the impact of social isolation and confinement on the contamination rate of COVID-19. It is supposed that the results can be displayed with  $Y_{it} = F(I_{it})$  and that

$$F(I_{it}) = \pi_0 + \pi_1 SII_{it} + \eta_{it}, \quad (1)$$

where  $Y_{it}$  is our outcome (the COVID-19 confirmed cases and death) in state  $i$  on day  $t$ , and  $SII_{it}$  is the social isolation index of state  $i$  on day  $t$ . In addition,  $\eta_{it}$  is the error term of state  $i$  on day  $t$ . It is also believed that  $\eta_{it}$  is represented by

$$\eta_{it} = X'_{it}\gamma_1 + W'_{it}\gamma_2 + H'_{it}\gamma_3 + v_{it}, \quad (2)$$

where  $X'_{it}$  is a vector of the socioeconomic characteristics of state  $i$  on day  $t$ ,  $W'_{it}$  is a vector of the climatic characteristics of state  $i$  on day  $t$ , and  $H'_{it}$  is a vector of health information about state  $i$  on day  $t$ . Finally,  $v_{it}$  is, by construction, not correlated with  $X'_{it}$ ,  $W'_{it}$  and  $H'_{it}$ . Therefore, it is believed that  $E[SII_{it}, v_{it}] = 0$ . If these vectors are observables, then

$$Y_{it} = \alpha + \rho SII_{it} + X'_{it}\gamma_1 + W'_{it}\gamma_2 + H'_{it}\gamma_3 + v_{it}, \quad (3)$$

Eq. (3) is a version of the linear causal model. The error term,  $v_{it}$ , in the equation is the random portion of the potential results that remains after the inclusion of the three vectors mentioned ( $X'_{it}$ ,  $W'_{it}$  and  $H'_{it}$ ). However, a problem arises when resources in  $X'_{it}$  or  $W'_{it}$  or  $H'_{it}$  are not observed. Such state information can determine both  $Y_{it}$  and  $SII_{it}$  and violate the assumptions that describe the Ordinary Least Squares (OLS) estimator as consistent ( $COV(v_{it}, SII_{it}) = 0$ ) and nonbiased ( $E[SII_{it}|v_{it}] = 0$ ).<sup>8</sup> Thus, the OLS estimates in Eq. (3), in case these hypotheses are violated, would not provide the correct causal interpretation of the effect of the level of social isolation on the COVID-19 contamination rate.

To address this problem we can apply the Instrumental Variable approach. The instrument is a variable that must be correlated with a causal variable of interest,  $SII_{it}$ ; however, it is not correlated with the dependent variable. The Instrumental Variable literature calls this hypothesis the Exclusion Restriction since the instrument can be excluded from the causal model of interest (Wooldridge, 2010).

<sup>7</sup> Data from <http://www.kaggle.com/unanimad/corona-virus-brazil>. Accessed on April 28, 2020.

<sup>8</sup>  $COV(v_{it}, SII_{it})$  is the covariance between  $v_{it}$  and  $SII_{it}$ , and  $E[SII_{it}|v_{it}]$  is the mathematical expectation of  $SII_{it}$  given  $v_{it}$ .

**Table 2**  
Definitions and statistical variables.

VARIABLE		MEAN	SD	MIN	MAX
Cases	Cases of COVID-19 per 100 thousand inhabitants of state $i$ on day $t$	19.73	50.12	0	504.66
Death	Death from COVID-19 per 100 thousand inhabitants of state $i$ on day $t$	91.24	376.7	0	4823
SII	Social Isolation Index of state $i$ on day $t$	0.4	0.1	0.14	0.73
Decree	Dummy that assumes a value equal to 1 if state $i$ decreed social isolation on day $t$	0.56	0.5	0	1
Support	Dummy that assumes a value equal to 1 if the governor of the state supports the president	0.26	0.44	0	1
SOCIOECONOMIC CONTROLS					
Wage	Mean formal worker wage (in R\$) of state $i$ in 2019	3537.36	643.6	2694	5389.2
Employed	Employed population of state $i$ in 2019	0.4	0.12	0.24	0.66
Foreign	Number of foreigners who entered state $i$ during the month for day $t$	39,712.9	128,475	0	695,071
Density	Demographic density of state $i$ in 2019	75.92	118.3	2.66	523.41
CLIMATE CONTROLS					
Average Temperature	Average temperature of state $i$ on day $t$	26.18	3.11	13.4	49.7
Insolation	Sunlight hours of state $i$ on day $t$	5.94	2.81	0.1	20.4
Precipitation	Rain precipitation of state $i$ on day $t$	7.3	15.16	0	195.6
HEALTH CONTROLS					
Hospitalization	Number of hospitalizations of state $i$ in month for day $t$	517,081	586,579	45,665	2,900,000
Respiratory	Mortality tax of respiratory diseases of state $i$ in the month for day $t$	3635	3994	263	18,905
Hypertension	Mortality tax of hypertension of state $i$ in the month for day $t$	158	185	5	759
Diabetes	Mortality tax of diabetes of state $i$ in the month for day $t$	414	418	23	1824
Bed Tax	Bed tax in hospitals per 100 thousand inhabitants of state $i$ in the month for day $t$	204	33	130	274

Source: We are working with Brazil daily information on the number of confirmed cases of infected people; the socioeconomic characteristics are provided by the Brazilian Institute of Geography and Statistics (IBGE) and the National Civil Aviation Agency (ANAC), and the climate information is collected at the National Institute of Meteorology.

The instrumental variable used in this study is developed using an Instrumented Difference-in-Differences (DDIV) approach (Duflo, 2001). The analysis treatment group is composed of the states that support the current President of Brazil (state governors who did not sign the Open Letter in Defense of Democracy). The time-related variable is a dummy that assumes a value of 1 when the state is exposed to the decree of isolation and social confinement and 0 in the period prior to this state decree (as shown in Table 1).

Thus, the instrument used is the Difference-in-Differences estimator built from the interaction between the treatment dummies and time variable exposed above ( $DID = support * degree$ ). The specifications of the first and second stage equations follow the empirical strategy of Duflo (2001). To be a valid instrument, the variable  $DID_{it}$  must obey two conditions: first, it must be correlated with the index of social isolation of the Brazilian states; and second, it should not be correlated with the characteristics of the states that determined the incidence of contamination with COVID-19.

Biderman et al. (2010) suggested that, by discarding the purely cross-section and time series variations and controlling for the estimates by the effects of non-observable characteristics invariant in the states' time, the design of the Diff-in-Diff mitigates problems caused by endogenous adoption, corroborating the suggestion for an instrumental variable in the current study. In addition, according to Angrist and Pischke (2008), the character of gradual adoption ensures the comparison of the first and last adopters, which in fact can reduce endogeneity.

This study works with the belief that, despite the social-distancing restrictions decreed in some states with governors supporting the President, their management and population adherence have had a smaller magnitude. We argue that the Brazilian President's rhetoric and behavior to minimize the importance of social distancing for the reduction of cases and deaths due to COVID-19 weakened not only the population's adherence to social distancing measures but also reduced the efforts of states' governors who support the President to implement this strategy. Such points explain the strong correlation between the instrumental variable  $DID_{it}$ , which represents support of the President, and our interest variable, the Social Isolation Index ( $SII_{it}$ ).

The second hypothesis for a valid instrument ( $COV(\eta_{it}, DID_{it}) = 0$ ) is guaranteed by the decision on who the next President of the Republic would be, not being correlated with the determinant aspects of the spread of contamination with COVID-19. The first information about the disease dates from the period after the second round of the presidential election in 2018 in Brazil. It can be said, thus, that  $DID_{it}$  is exogenous in relation to the observable and unobservable characteristics that influenced the number of COVID-19 cases. The current literature on the contagion of communicable respiratory diseases points to temperature, vitamin D concentrations and social agglomerations as the main determinants of these types of diseases. It is certain that such contemporary information did not affect the individuals' decisions to support the incumbent President in his presidential campaign in 2018. In addition, the control of non-observable characteristics is invariant over time by the Difference-in-Differences approach, and the contingency of the controls used in the analysis contributes to reducing the endogeneity involved in this type of investigation. It follows, from Eq. (3), that

$$\rho = \frac{\{COV(Y_{it}, DID_{it})\}}{\{COV(SII_{it}, DID_{it})\}} = \frac{\{COV(Y_{it}, DID_{it})/VAR(DID_{it})\}}{\{COV(SII_{it}, DID_{it})/VAR(SII_{it})\}}, \quad (4)$$

**Table 3**  
Impact of presidential support on social isolation index by Brazilian states. first stage of ddiv. dependent variable (social isolation index).

	(1)	(2)	(3)	(4)
DID	-1.34*** (-4.82)	-1.33*** (-5.07)	-1.28*** (-4.95)	-1.19*** (-4.68)
Lockdown	15.56*** (15.20)	15.57*** (15.23)	15.83*** (15.42)	15.96*** (15.46)
Support	1.75*** (11.28)	1.59*** (10.30)	1.86*** (8.38)	2.73*** (12.00)
Socioeconomic Controls	No	Yes	Yes	Yes
Weather Controls	No	No	Yes	Yes
Health Controls	No	No	No	Yes
Observations	2727	2727	2727	2727

Sources: Kaggle's database; INLOCO; ANAC; IBGE; INMET; TSE; Official Journals of Brazilian states. \*\*\*Statistically significant coefficient at the 1% level. \*\*Statistically significant coefficient at the 5% level. \*Statistically significant coefficient at the 10% level. Robust errors in heteroscedasticity were noted. Coefficient standard errors appear in parentheses.

The coefficient of interest,  $\rho$ , is the ratio between the population regression of  $Y_{it}$  on  $DID_{it}$  (referring to the reduced form) and the population regression of  $SII_{it}$  on  $DID_{it}$  (first stage). The model is called 2-Stage Least Squares (2SLS) because it is performed in two stages. First,  $SII_{it}$  is estimated using the following equation:

$$SII_{it} = X'_{it}\gamma_1 + W'_{it}\gamma_2 + H'_{it}\gamma_3 + \theta_1 Decree_{it} + \alpha_1 President_i + \beta_{it} DID + \epsilon_{it}. \tag{5}$$

The  $Decree_{it}$  variable is a dummy related to the state  $i$  social isolation decree period on day  $t$ , and  $President_i$  is a dummy variable referring to state  $i$  support for the President in the 2018 elections and summarizing the treatment of the specification. Then, in the second stage, the Eq. (5) predicted variable,  $\hat{SII}$ , is substituted in Eq. (3), and the following equation is estimated:

$$Y_{it} = X'_{it}\gamma_2 + W'_{it}\gamma_2 + H'_{it}\gamma_3 + \theta_2 Decree_{it} + \alpha_2 President_i + \rho \hat{SII}_{it} + \epsilon_{2it}. \tag{6}$$

The interested variable,  $\rho$ , represents the impact of social isolation on COVID-19 cases. Thus, the hypotheses of the model are not biased.

#### 4. Results and discussion

All of the analyses considered the socioeconomic, climatic, and public health characteristics of the states presented in the previous section. A total of 108 days were investigated between the months of February and May 2020, and a panel was developed with the 26 Brazilian states, plus the Federal District. The level of social isolation and the other control variables of the study determined the contamination rate of subsequent days, given that the virus incubation period varies between 1 and 14 days. Thus, the study uses the contamination rate of 7 days ahead of the independent variables.

Table 3 describes the Difference in Difference estimation corresponding to the first stages of 2SLS. In Table 3, columns (1) to (4), the DID coefficients are negative and significant, meaning that, in states with governors supporting the President, the SII is one percentage point less than SII in states that do not support the President. This result goes on to argue that the President's approach against social isolation weakened the population's willingness to quarantine, converging with Ajzenman et al. (2020) and Mariani et al. (2020). Another important result is that the estimated coefficients do not change substantially with the inclusion of states' characteristics, as described in columns (1) to (4). Table 4 describes the second stage of this strategy. In it, we analyze the impact of SII on COVID-19 cases and deaths.

The second stage of the DDIV specification is described in Table 4, columns (1) to (4). Panels A and B show the impact of the Social Isolation Index on both outcomes, respectively: COVID-19 cases and deaths per 100.000 inhabitants. After controlling for all characteristics (Table 4, Panel A (Panel B), column (4)), we found that increasing social isolation by 1% point reduces the number of cases (deaths) due to COVID-19 by 13.51 (0.42) per 100.000 inhabitants.

To explain the net impact of the President's speech on outcomes, we can calculate the effect of the SII increase on our outcomes (Table 5). Therefore, we estimated the differences between the state SII (Table 5, column (A)) and a hypothetical ideal value of SII = 51% (Table 5, column (B)). Multiplying column (B) by the estimated coefficient in Table 4, column (4), Panel A (Panel B), we found that the number of cases (deaths) decreased in each state per 100.000 inhabitants, as described in column (C) (column (D)). Table 5, column (E), shows the proportion of COVID-19 cases (deaths) that decreased in relation to the total COVID-19 cases (deaths) by state during the period of analysis.

The results shown in Table 5 suggested that, by increasing the social isolation to 51%, the Brazilian states will have different benefits depending on how far they are from the hypothetical index and on their population. For example, São Paulo, the largest Brazilian state, had an average SII equal to 40.22% between February 1 and May 18, 2020. If its SII increases on average to 51%, the number of COVID-19 cases will be reduced by 5.57%, and the number of deaths will decrease by 2.4%, i.e. around 66,901.02

**Table 4**  
Impact of social isolation on outcomes by Brazilian states. second stage of ddiv.

	(1)	(2)	(3)	(4)
<i>Panel A: COVID19 cases rates per 100.000 inhabitants</i>				
SII	-11.39*** (-3.61)	-12.04*** (-3.82)	-12.68*** (-3.70)	-13.51*** (-3.58)
Decreed	212.8*** (4.18)	223.2*** (4.37)	236.9*** (4.18)	251.1*** (4.03)
Support	20.05*** (4.08)	12.41*** (3.43)	16.43** (3.19)	32.94*** (3.60)
Observations	2727	2727	2727	2727
<i>Panel B: COVID19 death rates per 100.000 inhabitants</i>				
SII	-0.276** (-3.05)	-0.340*** (-3.40)	-0.371** (-3.19)	-0.425** (-3.18)
Decreed	6.458*** (4.04)	7.487*** (4.28)	8.092*** (3.98)	9.000*** (3.91)
Support	0.486** (3.26)	0.433** (3.19)	0.503** (2.75)	1.459*** (3.74)
Observations	2592	2592	2592	2592
Socioeconomic	No	Yes	Yes	Yes
Climate	No	No	Yes	Yes
Health	No	No	No	Yes

Sources: Kaggle's database; INLOCO; ANAC; IBGE; INMET; TSE; Official Journals of Brazilian states. \*\*\*Statistically significant coefficient at the 1% level. \*\*Statistically significant coefficient at the 5% level. \*Statistically significant coefficient at the 10% level. Robust errors in heteroscedasticity were noted. Coefficient standard errors appear in parentheses.

**Table 5**  
The impact of social isolation index increase of up to 51% on COVID-19 cases and deaths in Brazilian states from February 1 to May 18.

States	(A)	(B)	(C)	(D)	(E)	(F)
	Social Isolation Index (%)	Increase in state SII up to 51%	COVID-19 no. of cases decreased per 100.000 inh	COVID-19 no. of deaths decreased per 100.000 inh	% of reduction in number of COVID-19 cases	% of reduction in number of COVID-19 death
	51% - (A)	(B)*coef (cases)	(B)*coef (deaths)	(C) / COVID-19 cases	(D)/ COVID-19 death	
Tocantins	35.58	15.42	-208.34	-6.55	-23.81	-36.69
Sergipe	37.39	13.61	-183.87	-5.78	-12.03	-17.31
Goias	37.43	13.57	-183.36	-5.77	-40.96	-30.16
Rio Grande do Norte	37.95	13.05	-176.38	-5.55	-11.89	-8.29
Mato Grosso	38.06	12.94	-174.85	-5.50	-41.47	-41.04
Roraima	38.27	12.73	-172.00	-5.41	-3.81	-6.18
Mato Grosso do Sul	38.40	12.60	-170.24	-5.35	-41.54	-43.39
Bahia	38.52	12.48	-168.63	-5.30	-18.27	-16.43
Minas Gerais	38.63	12.37	-167.13	-5.26	-39.48	-35.40
Paraíba	38.78	12.23	-165.18	-5.20	-13.00	-6.88
Alagoas	38.93	12.07	-163.10	-5.13	-10.97	-6.33
Piauí	39.11	11.89	-160.60	-5.05	-18.45	-14.65
Espirito Santo	39.31	11.69	-158.01	-4.97	-5.77	-4.78
Paraná	39.44	11.56	-156.19	-4.91	-30.32	-17.81
Maranhão	39.86	11.14	-150.51	-4.73	-6.44	-4.05
São Paulo	40.22	10.78	-145.69	-4.58	-5.57	-2.24
Paraíba	40.38	10.63	-143.56	-4.52	-7.52	-2.81
Rondônia	40.50	10.50	-141.87	-4.46	-9.11	-8.58
Amapá	40.59	10.41	-140.65	-4.42	-2.05	-2.24
Distrito Federal	40.62	10.38	-140.31	-4.41	-5.68	-10.09
Santa Catarina	40.93	10.07	-136.04	-4.28	-10.77	-15.41
Rio Grande do Sul	41.20	9.80	-132.47	-4.17	-21.00	-19.32
Pernambuco	41.55	9.45	-127.66	-4.02	-4.06	-1.56
Ceará	42.51	8.49	-114.78	-3.61	-2.71	-1.32
Rio de Janeiro	42.80	8.20	-110.82	-3.49	-4.46	-1.46
Acre	43.00	8.00	-108.07	-3.40	-3.38	-3.23
Amazonas	43.98	7.02	-94.85	-2.98	-1.37	-0.57

Sources: Kaggle's database; INLOCO; ANAC; IBGE; INMET; TSE; Official Journals of Brazilian states. \*\*\*Statistically significant coefficient at the 1% level. \*\*Statistically significant coefficient at the 5% level. \*Statistically significant coefficient at the 10% level. Robust errors in heteroscedasticity were noted. Coefficient standard errors appear in parentheses.

and 2104.30 cases of and deaths from COVID-19, respectively, could be avoided if social distance had been respected, between February and May 2020.

Another example, Pernambuco state had one of the higher SIIs among Brazilian states (41.55%), although if its SII was 51%, the numbers of cases and deaths could be reduced, respectively, on average by 4.6% and 1.5%. It is a mean of approximately 12,000 people without COVID-19, and more than 383 deaths could be avoided, at the same period. Analyzing for Brazil, we can say that, if the Brazilian average SII increased from 39.77% to 51% just between February 1 and May 18, 2020, the country would have had approximately 318,850.03 fewer cases of COVID-19, and more than 10,000 lives would have been saved. Those results suggested that the Brazilian President's behavior explained the decrease in SII (Table 3) increasing the number of cases and deaths in the country (Table 4).

## 5. Conclusion

The second wave of COVID-19 infections has been more severe than the first one (WHO, 2021) and the new strain is significantly more contagious than the first one. Evidence from multiple countries has indicated that the implementation of physical distancing and health facilities has been effective in reducing COVID-19 case incidence, which has led to a reduction in hospitalizations and deaths among COVID-19 patients.

However, the success of social distancing policy depends on the awareness of the population and coordinated action by public authorities has proved to be a decisive factor for the engagement of the population. Unfortunately, the Brazilian President has called into doubt the effectiveness of social distancing to mitigate the virus' consequences (DA SILVA R.G.L, 2021; Richard and Medeiros, 2020; Malinverni and Brigagão, 2020; Paes-Sousa, 2020). Therefore, this paper aimed to measure the impact of the President's weak social distancing policy in contributing to the increase in COVID-19 cases and deaths.

Our identification hypothesis is based on the idea that the President's rhetoric negatively affected the respect and obedience to social distancing decreed by governors of Brazilian states, reducing the impact of social distancing on COVID-19 cases and deaths. As an estimation strategy we have applied the Difference-in-Differences Instrumental variable. Since the decree of social isolation and confinement was staggered between the units of the Brazilian Federation, the specification of Difference-in-Differences in the second stage further mitigates the problem of endogeneity caused by endogenous adoption by controlling for non-observable omitted variables.

The results agree with the literature on the topic and with the hypothesis suggested by this study (GOLLWITZER et al., 2020; Ajzenman et al., 2020; Adolph et al., 2020; ALLCOTT et al., 2020; BARRIOS and HOCHBERG, 2020). The estimated coefficients were consistent and significant, although they were controlled by several socioeconomic and climatic characteristics and information about the states' public health— factors disclosed by previous studies as relevant for determining the rate of contamination of the disease. In addition, we can say that, if the Brazilian average SII increased from 39.77% to 51% between February 1st and May 18th, 2020, the country would have had approximately 318,850.03 fewer cases of COVID-19, and more than 10,000 lives would have been saved. Those results to reveal that support for the President reduced the magnitude of the Social Isolation Index for instance increase the number of cases and death by COVID-19.

Finally, this study reveals the damage of the Brazilian president's negationist approach to control the health crisis and reduce deaths by COVID-19, and suggests that the alignment between the spheres of government in times of social crisis should be effectively expanded to be implemented as federal public policy.

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## References

- Acemoglu, D., Jackson, M.O., 2015. History, Expectations, and leadership in the evolution of social norms. *Rev. Econ. Stud.* 82 (2), 423–456.
- Adolph, C., Amano, K., Bang-Jensen, B., Fullman, N., Wilkerson, J., 2021. Pandemic politics: Timing state-level social distancing responses to COVID-19. *J. Health Politics, Policy Law* 46, 211–233.
- Ajzenman, N., Cavalcanti, T., Da Mata, D., 2020. More than words: Leaders' speech and risky behavior during a pandemic. Available at SSRN 3582908.
- Allcott, H., Boxell, L., Conway, J., Gentzkow, M., Thaler, M., Yang, D., 2020. Polarization and public health: Partisan differences in social distancing during the coronavirus pandemic. *J. Public Econ.* 191, 104254.
- Anderson, R.M., Heesterbeek, H., Klinkenberg, D., Hollingsworth, T.D., 2020. How will country-based mitigation measures influence the course of the COVID-19 epidemic? *Lancet* 395 (10228), 931–934.
- Angrist, J.D., Pischke, J.S., 2008. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
- Barrios, J.M., & Hochberg, Y., 2020. Risk perception through the lens of politics in the time of the covid-19 pandemic (No. w27008). National Bureau of Economic Research.
- Biderman, C., De Mello, J.M., Schneider, A., 2010. Dry laws and homicides: evidence from the São Paulo metropolitan area. *The economic journal* 120 (543), 157–182.
- Briscese, G., Lacetera, N., Macis, M., & Tonin, M., 2020. Compliance with covid-19 social-distancing measures in italy: the role of expectations and duration (No. w26916). National Bureau of Economic Research.
- Brzezinski, A., Kecht, V., Van Dijke, D., & Wright, A.L., 2020. Belief in science influences physical distancing in response to covid-19 lockdown policies. University of Chicago, Becker Friedman Institute for Economics Working Paper, (2020–56).

- Casanova, L.M., Jeon, S., Rutala, W.A., Weber, D.J., Sobsey, M.D., 2010. Effects of air temperature and relative humidity on coronavirus survival on surfaces. *Appl. Environ. Microbiol.* 76 (9), 2712–2717.
- Costa, J.A., de Almeida Silveira, J., Dos Santos, S.C.M., & Nogueira, P.P., 2020. Cardiovascular Implications in Patients Infected with Covid-19 and the Importance of Social Isolation to Reduce Dissemination of the Disease.
- Da Silva R.G.L., 2021. Patogenic Imaginaries and Covid-19 Denialism. *EASST*, 22.
- Douglas, M., Katikireddi, S.V., Taubut, M., McKee, M., McCartney, G., 2020. Mitigating the wider health effects of covid-19 pandemic response. *Bmj* 369, 1557.
- Dufo, E., 2001. Schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment. *Am. Econ. Rev.* 91 (4), 795–813.
- Faria, N.R., Mellan, T.A., Whittaker, C., Claro, I.M., Candido, D., Mishra, S., Crispim, M., Sales, F., Hawrylyuk, I., McCrone, J.T., Hulsmit, R., Franco, L., Ramundo, M.S., de Jesus, J.G., Andrade, P.S., Coletti, T.M., Ferreira, G.M., Silva, C., Manuli, E.R., Pereira, R., Peixoto, P.S., Kraemer, M., Gaburo N, Jr, Camilo, C., Hoeltgebaum, H., Souza, W.M., Rocha, E.C., de Souza, L.M., de Pinho, M.C., Araujo, L., Malta, F., de Lima, A.B., Silva, J., Zauli, D., Ferreira, A., Schnekenberg, R.P., Laydon, D.J., Walker, P., Schlüter, H.M., Dos Santos, A., Vidal, M.S., Del Caro, V.S., Filho, R., Dos Santos, H.M., Aguiar, R.S., Proença-Modena, J.L., Nelson, B., Hay, J.A., Monod, M., Miskouridou, X., Coupland, H., Sonabend, R., Vollmer, M., Gandy, A., Prete CA, Jr, Nascimento, V.H., Suchard, M.A., Bowden, T.A., Pond, S., Wu, C.H., Ratmann, O., Ferguson, N.M., Dye, C., Loman, N.J., Lemey, P., Rambaut, A., Fraiji, N.A., Carvalho, M., Pybus, O.G., Flaxman, S., Bhatt, S., Sabino, E.C., 2021. Genomics and epidemiology of a novel SARS-CoV-2 lineage in Manaus, Brazil. *medRxiv*. 372, 815–821.
- Gadarian, Shana Kushner, Goodman, Sara Wallace, Pepinsky, Thomas B., 2021. Partisanship, health behavior, and policy attitudes in the early stages of the COVID-19 pandemic. *Plos One* 16, 0249596.
- Hale, T., & Webster, S., 2020. Oxford COVID-19 government response tracker.
- 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.
- Hermalin, B.E., 1998. Toward an economic theory of leadership: Leading by example. *Am. Econ. Rev.* 1188–1206.
- Jack, B.K., Recalde, M.P., 2015. Leadership and the voluntary provision of public goods: Field evidence from Bolivia. *J. Public Econ.* 122, 80–93.
- Jasanoff, S., Hilgartner, S., Hurlbut, J.B., Özgöde, O., & Rayzberg, M., 2021. Comparative Covid Response: Crisis, Knowledge, Politics. Accessed 20 January 2021. Available at (<https://www.ingsa.org/covidtag/covid-19-commentary/jasanoff-schmidt/>).
- Kraemer, M.U., Yang, C.H., Gutierrez, B., Wu, C.H., Klein, B., Pigott, D.M., Scarpino, S.V., 2020. The effect of human mobility and control measures on the COVID-19 epidemic in China. *Science* 368 (6490), 493–497.
- Krugman, P., 1991. History versus expectations. *Quart. J. Econ.* 106 (2), 651–667.
- Krugman, P.R., 1997. *Development, Geography, and Economic Theory* Vol. 6 MIT Press.
- Kudo, E., Song, E., Yockey, L.J., Rakib, T., Wong, P.W., Homer, R.J., Iwasaki, A., 2019. Low ambient humidity impairs barrier function and innate resistance against influenza infection. *Proc. Natl. Acad. Sci.* 116 (22), 10905–10910.
- Lazear, E.P., Rosen, S., 1981. Rank-order tournaments as optimum labor contracts. *J. Polit. Econ.* 89 (5), 841–864.
- Liener, K., Leiacker, R., Lidemann, J., Rettinger, G., Keck, T., 2003. Nasal mucosal temperature after exposure to cold, dry air and hot, humid air. *Acta otolaryngologica* 123 (7), 851–856.
- Mäkinen, T.M., Juvonen, R., Jokelainen, J., Harju, T.H., Peitso, A., Bloigu, A., Hassi, J., 2009. Cold temperature and low humidity are associated with increased occurrence of respiratory tract infections. *Respir. Med.* 103 (3), 456–462.
- Malinverni, C., Brigagão, J.I.M., 2020. COVID-19: Scientific arguments, denialism, eugenics, and the construction of the antisocial distancing discourse in Brazil. *Front. Commun.* 5, 92.
- Mariani, L., Gagate-Miranda, J., Rettl, P., 2020. Words can hurt: How political communication can change the pace of an epidemic. *Covid Economics Issue* 12.
- Merow, C., Urban, M.C., 2020. Seasonality and uncertainty in global COVID-19 growth rates. *Proc. Natl. Acad. Sci.* 117 (44), 27456–27464.
- Nicola, M., Alsaifi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M., Agha, R., 2020. The socio-economic implications of the coronavirus and COVID-19 pandemic: a review. *Int. J. Surg.* 78, 185–193.
- Oates, W.E., 1997. On the welfare gains from fiscal decentralization. *J. Public Finance Public Choice* 15 (2–3), 83–92.
- Sun, Z., Thilakavathy, K., Kumar, S.S., He, G., Liu, S.V., 2020. Potential factors influencing repeated SARS outbreaks in China. *Int. J. Environ. Res. Public Health* 17 (5), 1633.
- Paes-Sousa, R., Millett, C., Rocha, R., Barreto, M.L., & Hone, T., 2020. Science misuse and polarised political narratives in the COVID-19 response.
- Paez, A., Lopez, F.A., Menezes, T., Cavalcanti, R., Pitta, M.G.D.R., 2020. A spatio-temporal analysis of the environmental correlates of COVID-19 incidence in Spain. *Geogr. Anal.*
- Richard, J., Medeiros, J., 2020. Using misinformation as a political weapon: COVID-19 and Bolsonaro in Brazil. *Harvard Kennedy School Misinf. Rev.* 1 (3).
- Sabino, E.C., Buss, L.F., Carvalho, M.P., Prete, C.A., Crispim, M.A., Fraiji, N.A., Faria, N.R., 2021. Resurgence of COVID-19 in Manaus, Brazil, despite high seroprevalence. *Lancet* 397 (10273), 452–455.
- Senado Federal, 2021. Relatório Final da Comissão Parlamentar de Inquérito da Pandemia. Disponível em: ([http://estaticog1.globo.com/2021/10/26/relatorio\\_final\\_26102021\\_12h40.pdf?\\_ga=2.230407516.1771841033.1636584943-2712170323.1612973335](http://estaticog1.globo.com/2021/10/26/relatorio_final_26102021_12h40.pdf?_ga=2.230407516.1771841033.1636584943-2712170323.1612973335)). Acesso em: 11 de novembro.
- Tobías, A., 2020. Evaluation of the lockdowns for the SARS-CoV-2 epidemic in Italy and Spain after one month follow up. *Sci. Total Environ.* 725, 138539.
- Van Bavel, J.J., Baicker, K., Boggio, P.S., Capraro, V., Cichocka, A., Cikara, M., Willer, R., 2020. Using social and behavioural science to support COVID-19 pandemic response. *Nat. Hum. Behav.* 4 (5), 460–471.
- World Health Organization, 2021. COVID-19 weekly epidemiological update, 9 March 2021.
- Wang, P., Nair, M.S., Liu, L., Iketani, S., Luo, Y., Guo, Y., Ho, D.D., 2021W. Antibody resistance of SARS-CoV-2 variants B.1.351 and B.1.1.7. *Nature* 10.
- Wang, J., Tang, K., Feng, K., Lin, X., Lv, W., Chen, K., Wang, F., 2021b. Impact of temperature and relative humidity on the transmission of COVID-19: a modelling study in China and the United States. *BMJ Open* 11 (2), e043863.
- Wooldridge, J.M., 2010. *Econometric Analysis of Cross Section and Panel Data*. MIT Press, pp. 2010.