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Messias' Influence? Intra-Municipal Relationship between Political Preferences and Deaths in a Pandemic♦

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Abstract

Previous studies have shown that the percentage of votes for Jair Messias Bolsonaro in the 2018 presidential elections, at the municipal and state levels, is related to the severity of the COVID-19 pandemic in terms of the number of deaths. We find the same effects at the intra-municipal level in the city of São Paulo. Using geolocation, we associate voting data with number of deaths for the 96 districts in the city. We analyze excess mortality to mitigate under-reporting issues and to account for exogenous determinants of mortality, as well as control for age structure and several indicators of socioeconomic vulnerability. The results are significant and indicate the existence of a relationship between votes for Bolsonaro and deaths during the pandemic — between one and five additional deaths per 100k people for each percentage point of votes. Several robustness checks support our findings.

Keywords

COVID19; Political persuasion; Political polarization; Ideology.

Resumo

Estudos anteriores mostraram que a porcentagem de votos para Jair Messias Bolsonaro nas eleições presidenciais de 2018, nos níveis municipal e estadual, está relacionada à gravidade da pandemia de COVID-19 em termos de número de mortes. Encontramos os mesmos efeitos no nível intramunicipal na cidade de São Paulo. Usando geolocalização, associamos dados de votação ao número de óbitos dos 96 distritos da cidade. Analisamos o excesso de mortalidade para mitigar problemas de subnotificação e controlar para determinantes exógenos de mortalidade, além de controlarmos pela estrutura etária e diversos indicadores de vulnerabilidade

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socioeconômica. Os resultados são significativos e indicam a existência de relação entre votos em Bolsonaro e mortes durante a pandemia — entre uma e cinco mortes a mais por 100 mil pessoas para cada ponto percentual de votos. Vários testes de robustez balizam nossos achados.

Palavras-chave
COVID19; Persuasão política; Polarização política; Ideologia.

Classificação JEL
D70, H40, I12.

1. Introduction

Brazil is one of the countries most affected by the COVID-19 pandemic. As of January 15st, 2023, the country had 695,410 confirmed deaths and 36,640,787 confirmed cases of the disease.[1] The municipality of São Paulo, in turn, accumulated 2,424,954 cases and 44,467 confirmed deaths in the same period.[2]

Considering this scenario, the performance of the federal government was harshly criticized for its inefficiency in implementing coordinated non-pharmacological measures, widespread disorganization, and slow vaccine roll-out (Castro et al., 2021; Touchton et al., 2021). In addition to this discreditable performance of the federal government at the institutional level, specific actions taken by former President Bolsonaro were also opposite to the guidelines of global health authorities. On several occasions, the president encouraged crowds, undermined the seriousness of the pandemic, promoted treatments with unproven efficacy, and belittled the need for social distancing (Hallal, 2021; Londoño et al., 2020). Such speeches have great potential to influence the behavior of the president's voters, due to the populist stance of his government and the strength of the ideological base among his supporters, who have specific political-cultural positions and demographic characteristics (Rennó, 2020).

[1] Coronavirus Panel of the Ministry of Health. Available at: https://covid.saude.gov.br/. Accessed 01/16/2023.
[2] São Paulo City Government. COVID-19 Weekly Bulletin of January 12, 2023. Available at: https://www.prefeitura.sp.gov.br/cidade/secretarias/upload/saude/20210331_boletim_covid19_diario.pdf. Accessed 01/16/2023.

Thus, the context is conducive to investigating the existence of relationships between support for the former president, as measured by his performance in the 2018 elections, and voter behavior during the coronavirus pandemic. Ajzenman et al. (2023) showed that, after Bolsonaro's main demonstrations against social distancing, isolation rates dropped in places with the highest number of voters for the president. Other analyses also identified that municipalities with the highest percentage of votes for Bolsonaro had more confirmed cases and deaths by COVID-19 when taking into account socioeconomic factors of the population (Razafindrakoto et al., 2022; Xavier et al., 2022), and experienced an acceleration in the incidence of the disease and in hospitalizations and deaths after the president delivered speeches (Mariani et al., 2020). Furthermore, it was identified that there are differences even between the cities where he won: municipalities where Bolsonaro's margin of victory was greater had more cases and deaths than municipalities where the margin was narrower (Cabral et al., 2021). Finally, Rache et al. (2021) documented the existence of a correlation between acceleration of deaths during the second wave in 2021 and the percentage of votes for Bolsonaro in the 2018 elections, for state and municipal levels. The studies mentioned above were all carried out on a municipal scale or larger. In order to contribute to the literature that analyzes the relationship between support for President Bolsonaro and pandemic severity metrics, we aimed to investigate whether the correlation is present at the intra-municipal level. As these data are not available for many cities at this level of disaggregation, we chose to analyze the city of São Paulo, which is the most populous in the country.

We extracted COVID-19 mortality data for each of the city's 96 districts from the City of São Paulo government. As this district division is specific to the municipality's government, we had to adopt a strategy to obtain electoral data by district. For this, we use electoral data by polling location of the Superior Electoral Court (TSE) and, using the Google Geocoding API service, we associate the coordinates of each polling place with the corresponding district. We also collect other information by district, such as population distribution by age group, average household income and various indicators associated with vulnerability and social inequality.

Initially, we observed that there is a strong positive correlation between the percentage of votes for Bolsonaro in the first round and confirmed deaths of COVID-19 per inhabitant. However, as votes are also correlated with other factors that may be determinant for deaths, we used controls by income and performed the main analyses with excess deaths during the pandemic, rather than using the number of deaths confirmed by the disease. This approach is often used in studies on the topic (Brandily et al., 2021; Orellana et al., 2021; Wang et al., 2022), as it alleviates the problems of under-reporting and also serves to control for exogenous determinants of mortality in comparative analyses. Importantly, in all our analyses we included controls for the age structure of each district, in order to avoid the results being influenced by the heterogeneous distribution of the population by age groups. Still, to consider other social inequalities between districts, we used the intra-municipal São Paulo Social Vulnerability Index (IPVS) to exclude from the analysis the most unequal districts that have high average income while also having a high percentage of people living in vulnerability. Additionally, we included other controls for socioeconomic characteristics, such as access to the water network, travel time on public transport and basic medical care coverage.

In addition to adding controls, we conducted several robustness checks to support our results. We restricted the sample to deaths of patients under 60 years of age, excluded districts with a high disparity between income and social vulnerability, compared samples with selected districts according to Bolsonaro's margin of victory, and created a variable that uses votes for other right-wing candidates to take into account predetermined ideologies. We also estimated OLS and negative binomial models with data on confirmed deaths by COVID-19 instead of excess deaths and disaggregated the analysis in sub-periods. The results remain positive and significant under all these specifications, suggesting the existence of a relationship between support for the president measured by votes in the election and mortality during the pandemic. We also found a positive correlation when using the same metric as Rache et al. (2021), considering a second wave severity measure as the dependent variable — votes for Bolsonaro are associated with a greater acceleration of deaths from COVID-19 in 2021.

However, despite all the controls considered, there may be other relevant factors for which data is not available, or which are unobservable variables, and therefore it is not simple to infer causality from these observations. Still, the documentation of correlation at various geographic levels — states, municipalities, districts — relies on evidence from the aforementioned quasi-experimental studies that support the proposed channel to explain this relationship. Our contribution to the literature that investigates the effects of leaders on the behavior of the electorate is due to the innovation of focusing on a much smaller unit of analysis that allows for comparisons less influenced by inter-municipal heterogeneities. Though our approach uses a more granular level than previous studies, there still remain ecological fallacy concerns that arise when using aggregated data to infer individual behaviors. Hence, also considering we do so at the cost of restricting sample size, our results must be interpreted carefully. Yet, in broader terms, the employment of our method of using geolocation to associate electoral data at the infra-municipal level with official databases is innovative, and may be useful for studies on several topics within political economy and other fields.

In the following sections, we contextualize some important information about the COVID- 19 pandemic and briefly discuss the relevant political economy literature and the results already found in similar studies in Brazil. We then present our results and discuss the limitations and implications of our findings.

2. Context and background

2.1. The COVID-19 pandemic in Brazil

In Brazil, the first case of the disease caused by the new coronavirus was confirmed in São Paulo on February 26th, 2020. A little less than a month later, on March 17th, the first death from the disease was reported.[3] Since then, the country was one of the most affected by the pandemic, having suffered a significant worsening in the number of cases and deaths in 2021.

In this scenario, several possibilities for combating and preventing the new coronavirus were studied and adopted as public policies around the world. In addition to potential drug interventions and immunization through vaccines, essential actions were social isolation and the use of masks (Chu et al., 2020). Such measures are called non-pharmacological interventions, and were the main prophylaxis mechanism recommended by medical

[3] G1 - Globo. Coronavirus: see the chronology of the disease in Brazil. Available at: https://g1.globo.com/bemestar/coronavirus/noticia/2020/04/06/coronavirus-veja-a-cronologia-dadoenca-no-brasil.ghtml. Accessed 05/01/2021.

authorities in the beginning of the pandemic.[4] These measures were extremely necessary to fight the pandemic, considering the limited supply of vaccines and the limited scientific knowledge about the virus, especially in regard to new variants.

Therefore, several studies have investigated the determining factors for the severity of the disease. In one of the first and most extensive studies on hospital survival by COVID-19 in the country, Baqui et al. (2020) characterized the main risk factors for the disease in Brazil. The main factor observed was age, which brings a pattern of expressive increase in mortality, especially for patients over 60 years of age. Further, the next most relevant were ethnicity and existence of obesity or neurological and pulmonary medical conditions. Importantly, the authors mention that most of the effects of race and pre-existing conditions were associated with regional socioeconomic inequalities. Many other studies have also identified differences in access to testing and quality of hospital care among black, mixed and white populations (Li et al., 2021). Most of these racial disparities, however, were caused by socioeconomic differences that affect the likelihood of gaining access to private ICU beds, rather than racial discrimination by hospitals per se (Bruce et al., 2020).

Regarding specifically the city of São Paulo, Ribeiro et al. (2021) compared age-standardized mortality rates and identified effects on mortality of numerous indicators associated with socioeconomic inequality, such as differences in education, low income, household density and presence of subnormal agglomerates. São Paulo, as well as large Brazilian cities in general, has huge intra-municipal income disparities, in addition to a very complex distribution of demographic characteristics between the city's subregions that affects health outcomes (Chiavegatto Filho et al., 2013). Taking these differences into account, Bermudi et al. (2021) showed that, at the beginning of the pandemic, areas with better socioeconomic conditions in the capital had a worse performance in terms of disease severity indicators, but this pattern changed throughout the pandemic as there was a shift of high risk of death to the most vulnerable places in the city.

4 World Health Organization. Coronavirus disease (COVID-19) advice for the public. Available at: https://www.who.int/emergencies/diseases/novel-oronavirus-2019/advice-for-public.Accessed 05/01/2021

2.2. From votes to deaths

A recurrent theme in recent political economy literature has been investigating the effects that politicians, through example and discourse, can have on the behavior of their voters. Empirical evidence from different scenarios supports the theory that attitudes and beliefs are largely shaped by dynamic social norms, in turn affected by the actions and positions of leading figures in each community (Acemoglu and Jackson, 2015). For example, Bursztyn et al. (2020) identified that Donald Trump's election affected the likelihood of individuals to publicly express their xenophobic views. Likewise, in assessing the role of leadership influence through example, Ajzenman (2021) demonstrated that revelations of corruption scandals in Mexico were followed by significant increases in cheating among high school students. A similar study in Italy found increases in supermarket thefts: the probability of costumers to under-report items in a self- service checkout system rose as corruption scandals were made public (Gulino and Masera, 2022).

Along these lines, when rulers' speeches carry anti-scientific views, there can be effects on behaviors directly related to public calamities. With an increasing polarization in the United States, partisanship affected important individual decisions amid Hurricane Irma, with Republican voters more likely to remain skeptical of the risks and thus more likely not to follow evacuation guidelines (Long et al., 2020). Therefore, it is not surprising that similar impacts have been found in numerous studies in the context of the COVID-19 pandemic.

In the UK, political polarization related to Brexit was associated with skepticism regarding the need for a lockdown, as well as perceptions of risk regarding contamination by the virus (Sturgis et al., 2020; Maher et al., 2020). Similar results were seen in New Zealand, where people who identify as further right on the political spectrum were less likely to obey distancing measures, but no differences were found in European countries (Becher et al., 2020). As such, there is an ideological effect on opinion formation, but there are variations between countries on how much this effect translates into actual changes in behavior. Soderborg and Muhtadi (2020) theorize that a determining factor is the degree of ideological alignment in each region, and show that, in Indonesia, the intensity of variation in the adoption of disease prevention measures is proportional to the magnitude of political-party conflicts in local governments. That is, as long as denial is more associated with one of the political groups, areas with greater polarization in politics will also have clearer distinctions in behavior in response to the pandemic. Hence, it has been widely reported that, in the United States, Republican voters were more likely to neglect the risks of contamination and not adhere to isolation instructions (Painter and Qiu, 2021; Allcott et al., 2020), and this behavioral variation is followed by an increase in deaths and infections in pro-Trump regions (Gollwitzer et al., 2020).

Brazil has, therefore, all the factors that the literature shows are necessary for us to expect to see the same effects as in the countries mentioned above. First, the country has high rates of ideological polarization (Layton et al., 2021). The political orientation of the population varies regionally (Amaral, 2020) and support for the former Bolsonaro government was associated with very specific cultural profiles: his voters tended to be more conservative (Rennó, 2020) and were concentrated in areas with better socioeconomic and educational indicators (Gomes de Souza et al., 2019). Finally, Bolsonaro frequently engaged in anti-scientific attitudes, either through numerous denialist speeches (Chaib and Machado, 2021), or through institutional actions contrary to the recommendations of global health authorities (FSP/USP, 2021). Consequently, the same patterns of ideological alignment in issues related to the pandemic observed in other countries were also seen in Brazil. Individuals who consider themselves on the right of the spectrum declared having less support for isolation measures (Ramos et al., 2020), and the pro-government political orientation in the country was related to greater disbelief in the severity of the disease (Calvo and Ventura, 2021).

Therefore, the channel we intend to explore in our study seeks to associate votes with deaths through this behavioral variation explained by political position. The relationship on which we are based was also observed in previous publications (Rache et al., 2021) and had its mechanism explained in studies with different identification strategies (Ajzenman et al., 2023; Mariani et al., 2020; Cabral et al., 2021; Xavier et al., 2022).

3. Data and empirical strategy

We extracted electoral data from the repository of the Superior Electoral Court (TSE).[5] The database contains the absolute total of valid votes per candidate in both rounds of the 2018 presidential elections, disaggregated by polling station. Additionally, the addresses of the polling stations were obtained from the same source, with respective numbers of zones and sections in each address. Following the methodology of similar studies, we considered first-round votes in our main analysis — the literature argues that voters tend to vote with greater ideological sincerity during the first round (Piketty, 2000). However, we also estimated models with second--round votes as a robustness test.

Since health data are available by district, we obtained the geographic coordinates of each polling station to group votes appropriately (Figure 1 shows a comparison between the electoral zones defined by TSE and the district division used by the municipal government). Some locations already had coordinates disclosed by TSE, but we chose to geolocate them all to maintain consistency. In order to achieve this, we used Google's geocoding API.[6] With each location's name (school name, for example), street name and zip code, coordinates for 2039 of the city's 2041 polling stations were successfully assigned. For the remaining 2 cases there were name inconsistencies and for these we only used the address. From the repository of the city of São Paulo,[7] we obtained the shapefile with the official geographic limitations of the municipality and located each polling station in one of the 96 districts. Finally, we aggregated the totals, calculating the percentage of votes for Bolsonaro by district (see Figure 5b).

We then extracted, also from the city government,[8] monthly data on cases and deaths con- firmed by COVID-19 by age group (10-year intervals), as well as total deaths (from 2017 to 2022). From these numbers, we defined the variable of excess mortality, given by the difference between the total deaths from April 2020 to March 2021 or from April 2021 to March 2022, by age group, and the average of deaths in the period that ranges from April 2017 to March 2020. It is worth mentioning that the most

5 TSE. Electoral Data. Available at: https://www.tse.jus.br/eleicoes/estatisticas/repositorio- de-dados--eleitorais-1/repositorio-de-dados-eleitorais

6 See https://developers.google.com/maps/documentation/geocoding/overview

7 São Paulo City Government Open Data. Districts of the Municipality of São Paulo. Available at: http://dados.prefeitura.sp.gov.br/dataset/distritos

8 DATASUS / São Paulo City Government. SIM/PROAIM and SIVEP - Flu. Available at: https://www. prefeitura.sp.gov.br/cidade/secretarias/saude/tabnet/. Download on 01/11/2023.

recent death records (2019 onwards) do not contain deaths from external causes (i.e., accidents, intentional and unintentional injury, etc.), because the updating procedures of these official data systems are often slow. Our excess deaths estimates are therefore relatively conservative.

Since the dynamics of the pandemic changed throughout time, we divided our analysis into two main periods: the first year, from April 2020 to March 2021, and the second year, from April 2021 to March 2022. We also disaggregated the analysis by trimesters as a robustness test, to analyze the evolution of this relationship throughout the pandemic.

Average household income figures by district were taken from the 2020 Map of Inequality,[9] a publication by Rede Nossa São Paulo that collects official and public statistics from several sources. It is recognized as a reliable source for intra-municipal socioeconomic data and has been used in studies about socioeconomic inequalities in São Paulo during the COVID-19 pandemic (Rocco et al., 2021). The income values reported in the Map of Inequality are from a survey made in 2017 by the Metro Company funded by the World Bank and adjusted for inflation to 2020 values.

In addition to controlling for average income and for exogenous mortality determinants when using excess deaths, we also took into account other inequalities that can affect health outcomes. Thus, also from the Inequality Map,[10] we obtained the average travel time spent in public transport to go to work. With this proxy of mobility, we seek to capture the unequal effects of the possibilities of isolation, as it is naturally more difficult for those who live in remote areas to follow the guidelines to stay at home for reasons of necessity (Mengue, 2021). Furthermore, this variable is also directly associated with exposure to the coronavirus, as public transport is often closed, with little ventilation and very crowded, characterizing an environment of high risk for the spread of the virus. From the same source, we extracted the percentage of the population covered by Primary Care and Family Health teams, in order to capture factors related to the health infrastructure of the districts, since the need for greater coverage of primary care is associated with precarious access to a quality hospital network. Further, we included the proportion of households not

[9] Rede Nossa São Paulo. 2020 Inequality Map. Available at: https://www.nossasaopaulo.org.br/2020/10/29/mapa-da-desigualdade-2020-revela-diferencas-entre-os-distritos-da-capital-paulista/

[10] This variable is calculated by Rede Nossa São Paulo again based on the 2017 Metro Company survey and on databases prepared by the Centro de Estudos da Metrópole, University of São Paulo.

connected to the water supply network,[11] an aspect also related to structural inequality and the difficulty of preventing infection.

Finally, to consider other socioeconomic aspects not included in the aforementioned controls, we chose to use the São Paulo Social Vulnerability Index (IPVS), which has already been considered in studies on COVID-19 lethality in São Paulo (Instituto Pólis, 2020). The index, prepared by the SEADE Foundation from the 2010 Census, classifies the city's districts according to the degree of social vulnerability of the resident population, taking into account several socioeconomic and demographic dimensions.[12] The variable for social vulnerability considered in our analyses is the percentage of residents considered to be in medium or greater vulnerability. In addition to including the index in the regressions, we use the IPVS as a criterion to exclude some districts in certain specifications for robustness tests.

Moreover, we control for age structure to ensure that the distribution of the elderly population between districts does not influence our results. For that, we collected demographic data of population distribution by age group in each district. The numbers are from 2020.[13] We add the percentage of the population in each ten-year age group between 0 and 69 years, leaving the share of the population that is over 70 years old as the omitted fraction. Additionally, we conduct robustness tests by restricting our sample to deaths of patients under 60 years old.

Table 1 shows descriptive statistics for our main variables.

The dependent variable in our main specification is the excess of deaths, as defined above. As independent variables, we include the percentage of votes for Bolsonaro and a vector of controls for each district. Thus, we estimate the following equation by OLS:

$$Excess_i = \alpha + \beta VotesBolsonaro_i + \gamma X'_i + \varepsilon$$

[11] São Paulo City Government. Indicator Observatory of the city of São Paulo. Available at: http://observasampa.prefeitura.sp.gov.br/moradia-e-saneamento-básico. Download on 05/12/2021.

[12] Government of São Paulo. IPVS — São Paulo Social Vulnerability Index. Available at: http://catalogo. governoaberto.sp.gov.br/dataset/21-ipvs-indice-paulista-de-vulnerabilidade-social. Download on 04/22/2021.

[13] São Paulo City Government. Resident Population by Age and Sex Groups. Available at: https://www.prefeitura.sp.gov.br/cidade/secretarias/licenciamento/desenvolvimento_urbano/dados_estatisticos/info_cidade/demografia/index.php?p=260265. Download on 04/21/2021.

where X'_i is a vector of socioeconomic characteristics of the district such as age structure, income, social vulnerability, and the other indicators mentioned in the previous section. The regressions are adjusted for clusters at the subprefecture level to allow for heteroskedasticity (32 clusters). In the equation, the estimated value of β represents the partial correlation between support for the president within the city of São Paulo and deaths in the pandemic, conditional on a series of controls. Based on evidence reported by other authors, the expectation is that β will be positive, indicating that regions with the highest percentage of votes for Bolsonaro had a higher number of deaths.

4. Results

In Table 2 we present the results of the main model, in columns (1) to (4) for 2020 and in columns (5) to (8) for 2021. In columns (1) and (5), without any controls, the results suffer from omitted variable bias. COVID-19 mortality is correlated with exogenous factors associated with socioeconomic inequalities that are heterogeneously distributed among the districts of São Paulo. These variables are also related to the percentage of votes for Bolsonaro — richer districts with lower IPVS have higher rates of votes for him (Figure 5 and Figure 6). In columns (2) and (6), when we add the average income of the districts to the model, the coefficients linked to votes become significant. In these columns, the income coefficient is negative, indicating that there is in fact an opposite relationship between average income and excess deaths, which caused a negative bias in the previous specification.

With the addition of the age structure and other socioeconomic controls, in columns (3)-(4) and (7)-(8) of Table 2, the coefficient of votes remains positive and significant in all specifications, increasing in magnitude as the omitted variable bias reduces. As these variables are correlated with votes and are associated with mortality, their inclusion as a control reinforces the effect of support for the president on deaths during the pandemic. Interestingly, the results hold for both years of analysis, which is in line with previous publications (Castilho et al., 2023; Barberia et al., 2022).

In terms of magnitude, the interpretation of the coefficients is that a percentage point of votes is associated with an increase of around 5 deaths per 100,000 inhabitants. For example, considering the difference between the district of Mandaqui (the one with the highest excess deaths in our analysis period: 458 excess deaths per 100k, or 401 deaths in total, between April 2020 and March 2021), which had 48% of votes, and the district of Butantã (the one with the smallest excess mortality), which had 40% of votes, this difference of 8 percentage points would represent about 40 deaths per 100k (or 35 actual deaths) attributed to political preferences in the district of Mandaqui during the first year of the pandemic.

Age is an extremely relevant factor in our analysis. Even though we control for age structure in our regressions, we also conducted analyses restricting our sample to deaths of individuals under 60 years of age. This approach guarantees greater significance to our conclusions, as the severity of COVID-19 tends to be greater for the elderly and the distribution of this population is heterogeneous among districts. In Table 3, we show results for two different age groups. The 20-60 age group is especially relevant for our study, as it only includes those to whom voting was mandatory in 2018 (aged over 18) and who are not yet elderly. Due to the compulsory vote, it is the population stratum most susceptible to consuming political content, thus being more exposed to discourses and guidelines by government officials. In both cases, the coefficients remain positive and significant.

As a secondary result, in Figure 4 we present the correlation using the second wave as the dependent variable. This variable is defined as the percentage change in the daily average of deaths from COVID-19 in the first trimester of 2021 compared to the daily average in 2020. Districts with the highest percentage of votes for Bolsonaro had a more severe worsening in the pandemic in early 2021. Because these are comparisons between the same districts over time, the correlation presented is relevant without a need to control for socioeconomic factors. Still, we also checked, with multivariate linear regression, that the results remain largely unchanged with such controls (Table 7).

In summary, the coefficients with respect to votes for Bolsonaro of the main model in Table 2 are positive and significant, even with controls and with different dependent variables. We also performed several robustness tests to ensure the validity of the results, which are presented below.

4.1. Robustness Checks

Our results could have been influenced by arbitrary decisions, such as the definition of excess deaths and other specification choices. Therefore, we performed several robustness tests, shown in Table 4.

To confirm that the results are not influenced by socioeconomic inequalities, we performed a sample selection in some specifications using the IPVS value as a threshold. The idea is the same as including the IPVS as a regressor: prevent results from being biased by a high average income in rich districts with a significant fraction of the population in a vulnerable situation (thus more susceptible to COVID-19). Therefore, we excluded those districts that, among those with an average income above the mean of the districts, had IPVS greater than or equal to the median of the sample (see Figure 6). We considered the median in the latter case because the distribution of IPVS values is very heterogeneous. With this restriction, the results remain positive and significant (column (1) of Table 4). We note that although the cut- off is arbitrary, it is robust to variations: shifting the threshold to lower values of IPVS does not change the relationship and the results remain significant. In a similar fashion, we tested for possible non--linear effects of income and results also remain unchanged (column (3)).

Although we innovate by using a smaller unit of analysis, another concern is that we fall into an ecological fallacy by generalizing individual behaviors while analyzing aggregated data. We tried to get around this problem by including the mobility proxy in the regression, but we also repeated the analysis by restricting the sample to districts in the first and fourth quartile of percentage votes, where Bolsonaro's margin of victory or defeat was wider. The same procedure was done with districts in the second and third quartile of votes, where the difference in support for the president was much more subtle. As expected, the results of the main specification remained with the sample restriction to districts with a wider margin (column (2) of Table 4), and the coefficients are negligible and not significant when we restrict the sample to districts with a tight margin of votes.

Column (4) of Table 4 shows the results of our main specification using Bolsonaro's vote share in the second round of elections instead of the first. As explained, we use the first-round number as our main variable to follow what has been done in other studies, but our findings remain largely unchanged when using second-round votes.

Another arbitrary decision was to use excess mortality instead of confirmed COVID-19 deaths. To ensure that our results are not driven by this choice, we also repeated the analysis using the total number of deaths due to COVID-19 (Table 5). Again, the significance, sign, and magnitude of our results are very similar to the main specification. Furthermore, considering data on the number of deaths is non-normally distributed and over-dispersed count data, we follow other studies (Castilho et al., 2023; Brown and Ravallion, 2020) and use data on confirmed COVID-19 deaths to estimate negative binomial models. Table 6 shows that we obtain similar results. In this case, the interpretation is that an increase of one percentage point of votes for Bolsonaro is associated with an increase of 0.04 in the expected log count of COVID-19 deaths per 100k people, which can be approximated to around 4%. This is comparable in magnitude to our OLS results, as 4% of excess deaths in 2020 corresponds to around 6 additional deaths per 100k residents in the average district.

Moreover, we constructed another explanatory variable to try to reject the possibility that the results are driven by some omitted variable that is correlated with votes and behavior — that is, there could be some factor intrinsic to Bolsonaro voters and their ideologies that made them engage in risky behavior regardless of the president's actions. Mariani et al. (2020) analyze population participation in previous vaccination campaigns to rule out the possibility that behavior in the coronavirus pandemic is determined by pre-existing health-related behavioral trends. In the same light, we seek to differentiate the effect of support for President Bolsonaro itself from predefined individual traits. For this, we build the following variable:

$$SupportBolsonaro_i = \left(VotesBolsonaro_i - \overline{VotesBolsonaro}\right) - \left(Right_i - \overline{Right}\right)$$

where the bars represent the average of all districts and *Right* represents the percentage of votes for candidates also associated with the right of the spectrum in other elections. We performed the analysis with three different variables: votes for Aécio Neves in the 2014 presidential elections, votes for João Dória in the 2016 municipal elections and votes for João Dória in the 2018 state elections. Then, we repeat the main specification, but using $SupportBolsonaro_i$ instead of $VotesBolsonaro_i$ as the dependent variable. With this strategy, we found results that suggest that we can rule out the possibility that risk attitudes during the pandemic were only caused by predetermined behaviors. In all regressions with different proxies for right-wing ideology, the Bolsonaro effect is still positive and significant (Figure 2 and Table 8).

Finally, we disaggregated the analysis by sub-periods to see how this relationship evolved during time. Figure 3 shows coefficients from our main specification divided in trimesters. We again see that the positive and significant association holds throughout the pandemic, and is largest in magnitude during the first half of 2021 (the second wave).

5. Discussion and Conclusion

Our results corroborate the conclusions found by the various aforementioned articles and are robust to several tests. We used the excess of deaths which, in addition to working as an adjustment for underreporting, helps to control for exogenous mortality determinants. COVID-19 mortality is greatly affected by inequality between districts, since places with more income tend to have better sanitary conditions, but also a larger share of elderly people in the population. We hypothesize that these two factors work together, in the opposite direction, to explain why there is no clear relationship between income and deaths confirmed by COVID (Figure 6). Using excess deaths, the correlation is negative. This finding — poorer places have a greater excess of deaths — is in line with what would be expected in terms of the relationship between socioeconomic conditions and mortality in the pandemic, and has been also observed in other studies at the national level (Duque et al., 2020). That's why, ignoring income controls, the relationship between votes and deaths disappears when we use excess instead of confirmed deaths. Controlling for income and age structure is thus important given the high correlation between socioeconomic profile and votes, which has also been reported in the political science literature.

In a related manner, we analyzed the evolution of the relationship between votes and deaths and found that not only the results persisted throughout the two years of the pandemic but were in fact stronger during the first half of 2021 (i.e., the second wave of the pandemic — Figure 3). This result is in line with other studies: Castilho et al. (2023) found that the association between votes for Bolsonaro and COVID-19 mortality persisted throughout quarters between February 2020 and October 2021, while Barberia et al. (2022) show that this relationship was strongest between March and May 2021. Importantly, vaccines were made available in the beginning of 2021, which could lead to endogeneity issues. Not only one would expect vaccine take-up to be associated with political preferences with greater resistance from Bolsonaro supporters, but vaccination rates might lead to reverse causality as they can lead to increases in mortality which then spur vaccination take-up. However, in Brazil, there were no significant differences in vaccination rates between municipalities with greater support for Bolsonaro, which may be due to the historical success of vaccination campaigns (Castilho et al., 2023).

Nonetheless, although we performed several specifications and found results that are supported by numerous studies with similar conclusions, there are some noteworthy caveats. First, as far as we know, there are no data on social isolation at an intra-municipal scale. This variable would be important to detail the mechanisms behind the studied relationship. Yet, the literature has shown that distancing is endogenous (Ajzenman et al., 2023) and strongly related to votes for Bolsonaro. To mitigate possible problems and distinguish the reduction in isolation influenced by political behavior from the difficulty of isolation due to working conditions, we used the aforementioned pre-pandemic mobility index. However, we acknowledge that ancient mobility patterns might not be representative of mobility during the pandemic, which presents a significant caveat.

Moreover, mortality data for years after 2019 do not include external causes of death, which influences our excess deaths calculation. Also, due to the limited availability of data segregated by district, we did not include other controls that could be relevant, such as concrete measures of within-district inequality (such as the GINI index) and indicators of health-related behavior in periods prior to the pandemic (e.g., adherence to previous vaccine programs). The social vulnerability index tries to capture these effects, but it also has its limitations, even more so considering that it was calculated from 2010 census data.

Another issue may arise due to measurement error in some of our variables. As Barberia et al. (2022) argue, the use of proxies for political ideologies (i.e. using aggregate vote data) leads to measurement error and bias, because not only it is not possible to infer individualized preferences from aggregate data, but voting choices might not be representative of ideology. Furthermore, the district reported in the mortality data considers the patient's residential address, which is not necessarily in the same district as their polling station. It is possible that some voters have their voting addresses in different districts than their residential addresses, which could bias our results.

To think about what this means in terms of bias, suppose that in a given district there is a large share of residents who are Bolsonaro supporters and do not follow the guidelines from health authorities. Suppose further that they are also particularly less likely to vote in a different district than those that do not support Bolsonaro. Then, this district would have a larger number of deaths, and an even larger vote share for Bolsonaro. This would lead to ovestimation in our models. If people consistently vote differently than what we would expect based on their district's average political leanings, and if this difference varies significantly between Bolsonaro's supporters and the rest of the population, our models could be skewed.

However, the Electoral Court assigns polling stations to voters based on their residential address,[14] which partially alleviates such concerns (see Figure 1 for a comparison between the official zoning used by TSE and the district division used by the local São Paulo government). Finally, the main problem in this kind of study is ecological fallacy. As we discussed, this occurs when inferences about individual-level relationships are made from aggregate data. Our approach of considering a smaller unit of analysis as other publications alleviates this concern, but we still lack individualized data and therefore do not completely solve this issue and aforementioned problems such as omitted variable bias. Though we control for several socioeconomic characteristics at the aggregate level, we do not take into account individual traits that might be relevant to both political preferences and health outcomes such as race and education. Also, we look into a smaller unit of analysis at the cost of reducing sample size, which has several implications such as reduced precision of our estimates and reduced external validity. Future studies should include more cities in the sample in order to consider a greater number of observations.

All things considered, our findings are relevant both in terms of theme and due to the innovative methodology of using geolocation to associate databases with intra-municipal data. A growing body of research has studied relations between electoral results, ideological behavior and socioeconomic outcomes. We contribute to such literature by conducting intra-municipal analysis of the relationship between political preferences and mortality. Additionally, our method of geolocation is useful for several studies, as it allows the merging of databases from different sources that use distinct geographical boundaries.

[14] Supreme Electoral Court (TSE). O que todo eleitor precisa saber sobre domicílio eleitoral. Available at: https://www.tse.jus.br/institucional/escola-judiciaria-eleitoral/publicacoes/revistas-da-eje/artigos/revista-eletronica-eje-n.-3-ano-4/minirreforma-eleitoral-201cbaratear201d-as-campanhas-e-diminuir-o-espaco-para-o-debate-democratico. Access on 01/12/2023.

The Brazilian political scenario is challenging and the pandemic aggravated the country's intrinsic difficulties even more. Nevertheless, investigating the nuances of how the behavior of individuals may be affected by political leaders can be decisive in contributing to reflections on the local scenario and contributing to the adoption of public measures. Further studies with innovative research designs are needed to allow a better understanding of the relationship between political preferences and individual attitudes without suffering from the bias present in ecological studies. Such knowledge can be helpful to understand how politicians and voters respond to emergency situations, which can then help guide planning in the future. This investigation can be expanded in the future to analyze further impacts of denial and polarization in Brazil, which potentially extend to areas such as climate change, violence, prejudice, and other forms of social instability.

6. Declaration of interest

The authors declare no competing interests.

7. Tables and figures

Table 1 - Summary Statistics

Statistic	Mean	St. Dev.	Min	Median	Max
Bolsonaro vote share 1st Round	41.26	6.70	26.10	41.70	55.24
Bolsonaro vote share 2nd Round	53.85	8.71	34.31	54.56	71.24
Income	4,718.33	1,902.94	2,628.63	4,047.00	9,591.93
COVID-19 deaths in 2020 (per 100k)	168.71	65.63	11.87	177.14	278.01
COVID-19 deaths in 2021 (per 100k)	149.97	59.00	13.03	149.81	263.92
Excess deaths in 2020 (per 100k)	174.92	84.94	–14.86	169.85	458.00
Excess deaths in 2021 (per 100k)	147.26	66.02	–8.87	148.88	304.47
Population	126,551	63,090	53,938	109,276	351,711
Elderly share	20.64	9.80	8.23	19.01	57.45

Note: Deaths in 2020 refer to deaths between April 2020 and March 2021, and deaths in 2021 refer to deaths between April 2021 and March 2022. Excess deaths are calculated as the difference between the total number of deaths in each period and the average number of deaths in the same period of 2017, 2018, and 2019.

Table 2 - Results — excess deaths

	Total excess deaths per 100k							
	April 2020 to March 2021				April 2021 to March 2022			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Votes	0.925	5.761***	6.896***	7.311***	1.237	4.412***	5.512***	4.790***
	(1.412)	(1.574)	(1.350)	(2.102)	(1.008)	(1.333)	(1.131)	(1.080)
Income (log)		–145.746***	–157.342***	–126.983***		–95.664***	–88.881***	–91.263***
		(26.366)	(20.055)	(28.624)		(26.617)	(21.901)	(26.942)
Age Structure	N	N	Y	Y	N	N	Y	Y
Other controls	N	N	N	Y	N	N	N	Y
N	96	96	96	96	96	96	96	96
R^2	0.005	0.257	0.474	0.596	0.017	0.204	0.393	0.566

Significance *p<0.1; **p<0.05, ***p<0.01

Note: Votes is the percentage of votes for Bolsonaro in the first round of the 2018 presidential elections. Income (log) is the natural logarithm of average household income. Age structure controls are the percentage of the population in each ten-year age group between 0 and 69 years. Other controls are as follows: mobility is the average time spent on public transport on trips to work; Coverage is the fraction of the population that is covered by Primary Care and Family Health teams; Water is the fraction of households not connected to the public water network; IPVS is the percentage of households living in medium or higher vulnerability according to this index. All numbers are by district. Standard errors are clustered at the subprefecture level (32 clusters).

Table 3 - Results — excess deaths (specific age groups)

	Excess deaths per 100k (April 2020 to March 2021)							
	20-60 years				0-60 years			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Votes	– 2.035**	1.004	1844***	3.039***	– 0.876	1.150***	1.472***	1.995***
	(0.868)	(0.631)	(0.566)	(0.742)	(0.568)	(0.411)	(0.403)	(0.521)
Income (log)		–91.554***	–107.306***	–68.978***		– 61.060***	– 68.462***	–49.532***
		(9.161)	(10.998)	(16.863)		(6.576)	(6.997)	(12.206)
Age Structure	N	N	Y	Y	N	N	Y	Y
Other controls	N	N	N	Y	N	N	N	Y
N	96	96	96	96	96	96	96	96
R^2	0.083	0.393	0.474	0.589	0.036	0.355	0.403	0.490

Significance *p<0.1; **p<0.05, ***p<0.01

Note: Votes is the percentage of votes for Bolsonaro in the first round of the 2018 presidential elections. Income (log) is the natural logarithm of average household income. Age structure controls are the percentage of the population in each ten-year age group between 0 and 69 years. Other controls are as follows: mobility is the average time spent on public transport on trips to work;Coverage is the fraction of the population that is covered by Primary Care and Family Health teams; Water is the fraction of households not connected to the public water network; IPVS is the percentage of households living in medium or higher vulnerability according to this index. All numbers are by district. Standard errors are clustered at the subprefecture level (32 clusters).

Table 4 - Results — robustness tests

	Total excess deaths per 100k (April 2020 to March 2021)			
	Selected districts (1)	1st and 4th quartiles (2)	Non-linear income (3)	2nd Round votes (4)
Votes	7.341***	10.382***	7.018***	6.042***
	(2.299)	(1.995)	(1.882)	(1.956)
Age Structure	Y	Y	Y	Y
Other controls	Y	Y	Y	Y
N	88	48	96	96
R^2	0.606	0.710	0.628	0.589

Significance *p<0.1; **p<0.05, ***p<0.01

Note: Table shows robustness tests with different specifications. Results follow our main model from Table 2. Column (1) excludes those districts that, among those with an average income above the mean of the districts, had a greater IPVS than the median of the districts. Column (2) restricts the sample to districts in the first and fourth quartile of percentage votes, where Bolsonaro's margin of victory or defeat was wider. Column (3) adds a cubic polynomial of the average household income instead of the natural logarithm. Column (4) uses the percentage of votes for Bolsonaro in the second round of the 2018 presidential elections instead of first-round votes. Age structure controls are the percentage of the population in each ten-year age group between 0 and 69 years. Other controls are as follows: mobility is the average time spent on public transport on trips to work; Coverage is the fraction of the population that is covered by Primary Care and Family Health teams; Water is the fraction of households not connected to the public water network; IPVS is the percentage of households living in medium or higher vulnerability according to this index. All numbers are by district. Standard errors are clustered at the subprefecture level (32 clusters).

Table 5 - Results — COVID-19 deaths

	Total COVID-19 deaths per 100k							
	April 2020 to March 2021				April 2021 to March 2022			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Votes	2.421**	6.300	6.946***	5.999***	2.841***	5.801***	6.406***	5.045***
	(1.042)	(1.122)	(0.904)	(1.024)	(0.853)	(1.074)	(0.848)	(0.880)
Income (log)		−116.877***	−120.605***	−126.430***		− 89.206***	− 88.201***	−105.004***
		(21.459)	(14.679)	(21.248)		(20.841)	(14.688)	(20.380)
Age Structure	N	N	Y	Y	N	N	Y	Y
Other controls	N	N	N	Y	N	N	N	Y
N	96	96	96	96	96	96	96	96
R^2	0.061	0.324	0.603	0.720	0.105	0.298	0.591	0.716

Significance *p<0.1; **p<0.05, ***p<0.01

Note: Votes is the percentage of votes for Bolsonaro in the first round of the 2018 presidential elections. Income (log) is the natural logarithm of average household income. Age structure controls are the percentage of the population in each ten-year age group between 0 and 69 years. Other controls are as follows: mobility is the average time spent on public transport on trips to work, Coverage is the fraction of the population that is covered by Primary Care and Family Health teams; Water is the fraction of households not connected to the public water network; IPVS is the percentage of households living in medium or higher vulnerability according to this index. All numbers are by district. Standard errors are clustered at the subprefecture level (32 clusters).

Table 6 - Results — COVID-19 deaths (Negative Binomial Model)

	Total COVID-19 deaths per 100k							
	April 2020 to March 2021				April 2021 to March 2022			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Votes	0.017**	0.040	0.047***	0.038***	0.038***	0.040***	0.047***	0.035***
	(0.007)	(0.009)	(0.008)	(0.009)	(0.007)	(0.009)	(0.008)	(0.009)
Income (log)		–0.718***	– 0.590***	–0.731***		– 0.597***	– 0.427***	– 0.636***
		(0.159)	(0.156)	(0.172)		(0.160)	(0.156)	(0.174)
Age Structure	N	N	Y	Y	N	N	Y	Y
Other controls	N	N	N	Y	N	N	N	Y
N	96	96	96	96	96	96	96	96
AIC	1,109.289	1,094.230	1,078.376	1,047.711	1,083.171	1,073.163	1,056.146	1,028.403

Significance *p<0.1; **p<0.05, ***p<0.01

Note: Table shows results from negative binomial models. Votes is the percentage of votes for Bolsonaro in the first round of the 2018 presidential elections. Income (log) is the natural logarithm of average household income. Age structure controls are the percentage of the population in each ten-year age group between 0 and 69 years. Other controls are as follows: mobility is the average time spent on public transport on trips to work; Coverage is the fraction of the population that is covered by Primary Care and Family Health teams; Water is the fraction of households not connected to the public water network; IPVS is the percentage of households living in medium or higher vulnerability according to this index. All numbers are by district.

Table 7 - Results — Acceleration of deaths

	Acceleration of deaths			
	(1)	(2)	(3)	(4)
Votes	2.123***	2.622***	3.006***	2.364**
	(0.473)	(0.479)	(0.727)	(0.972)
Income (log)		–15.038	–2.338	–5.362
		(9.717)	(12.974)	(14.988)
Age Structure	N	N	Y	Y
Other controls	N	N	N	Y
N	96	96	96	96
R^2	0.140	0.153	0.241	0.410

Significance: *p<0.1; **p<0.05, ***p<0.01

Note: Acceleration of Deaths is defined as the percentage change between the average number of deaths from COVID-19 per day throughout 2020 and the average number of deaths from COVID-19 per day in the first three months of 2021. Votes is the percentage of votes for Bolsonaro in the first round of the 2018 presidential elections. Income (log) is the natural logarithm of average household income. Age structure controls are the percentage of the population in each ten-year age group between 0 and 69 years. Other controls are as follows: mobility is the average time spent on public transport on trips to work; Coverage is the fraction of the population that is covered by Primary Care and Family Health teams; Water is the fraction of households not connected to the public water network; IPVS is the percentage of households living in medium or higher vulnerability according to this index. All numbers are by district. Standard errors are clustered at the subprefecture level (32 clusters).

Table 8 - Results — Ideology

	Total excess deaths per 100k (April 2020 to March 2021)		
SupportBolsonaro	(1)	(2)	(3)
Right = Aécio 2014 - 1st Round	3.895*** (0.675)	4.639*** (0.608)	8.125*** (1.883)
Right = Dória 2016 - 1st Round	5.645*** (1.510)	6.806*** (1.239)	12.627*** (3.148)
Right = Dória 2018 - 1st Round	11.282*** (1.348)	11.771*** (1.428)	10.957*** (2.002)
Right = Dória 2018 - 2nd Round	5.901*** (1.158)	7.229*** (0.995)	11.872*** (3.236)
Age Structure	N	Y	Y
Other controls	N	N	Y
N	96	96	96

Significance *p<0.1; **p<0.05, ***p<0.01

Note: $SupportBolsonaro_i = (VotesBolsonaro_i - \overline{VotesBolsonaro}) - (Right_i - \overline{Right})$

Each row corresponds to a different OLS model, which uses a different proxy for rightist ideology. The controls used are the same as in the main specification regressions.

Figure 1 - Comparison between electoral zones and municipal districts

Note: Light grey lines are the municipal district limits and darker lines represent electoral zones.

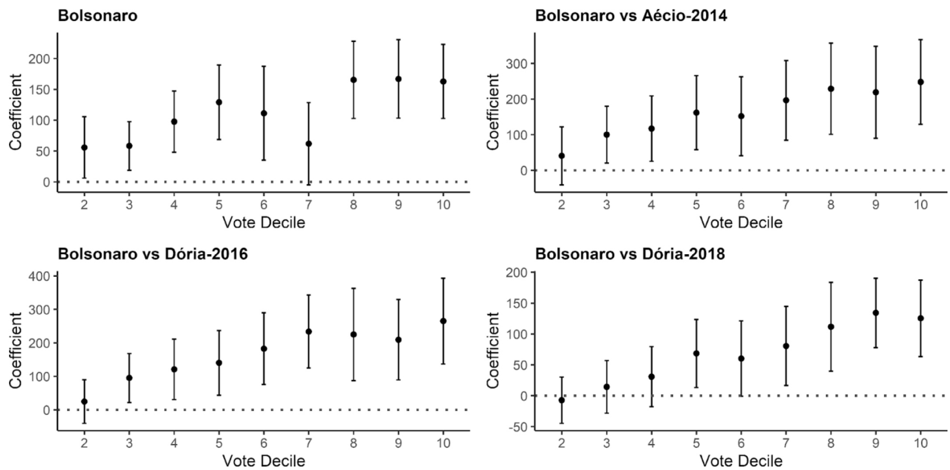

Figure 2 - Votes for Bolsonaro and Excess Deaths

Note: Coefficient estimates are from OLS regressions including indicators for vote decile, omitting the dummy for districts in the bin with the least percentage of votes for Bolsonaro (below the 10% quantile). The dependent variable is total excess deaths, calculated as the difference between the number of deaths in each district between April 2020 and March 2021, and the average of deaths in the previous three years. All regressions include controls for age structure, average income, and other socioeconomic variables. Standard errors are clustered at the subprefecture level and 95% confidence intervals are plotted. N = 96

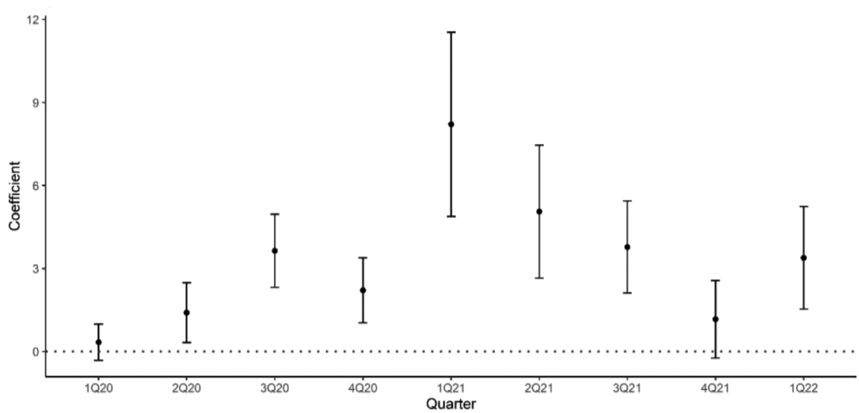

Figure 3 - Estimated effects of votes for Bolsonaro on excess deaths per 100,000 people by trimester

Note: Coefficient estimates are from OLS regressions. The dependent variable is total excess deaths, calculated as the difference between the number of deaths in each district during each three-month period, and the average of deaths in the same three months of 2017-2019. All regressions include controls for age structure, average income, and other socioeconomic vari- ables. Standard errors are clustered at the subprefecture level and 95% confidence intervals are plotted. N = 96

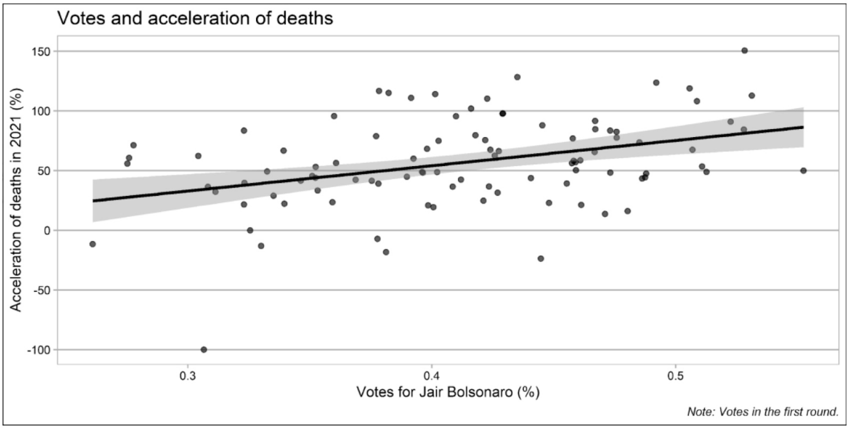

Figure 4 - Acceleration of deaths and Votes

Note: Acceleration of Deaths is defined as the percentage change between the average number of deaths from COVID-19 per day throughout 2020 and the average number of deaths from COVID-19 per day in the first three months of 2021. In the chart, $R = 0.37$ and $p < 0.0002$.

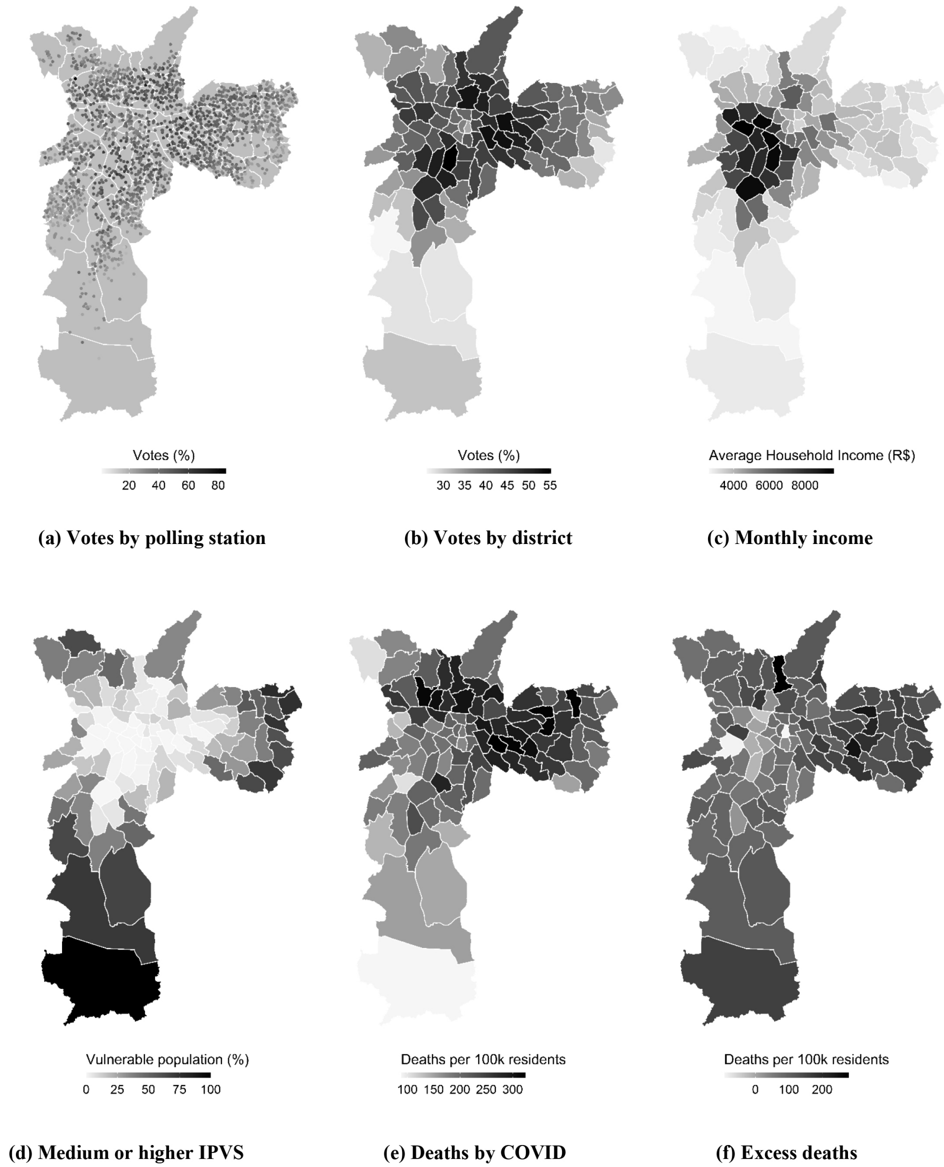

Figure 5 - Data by district

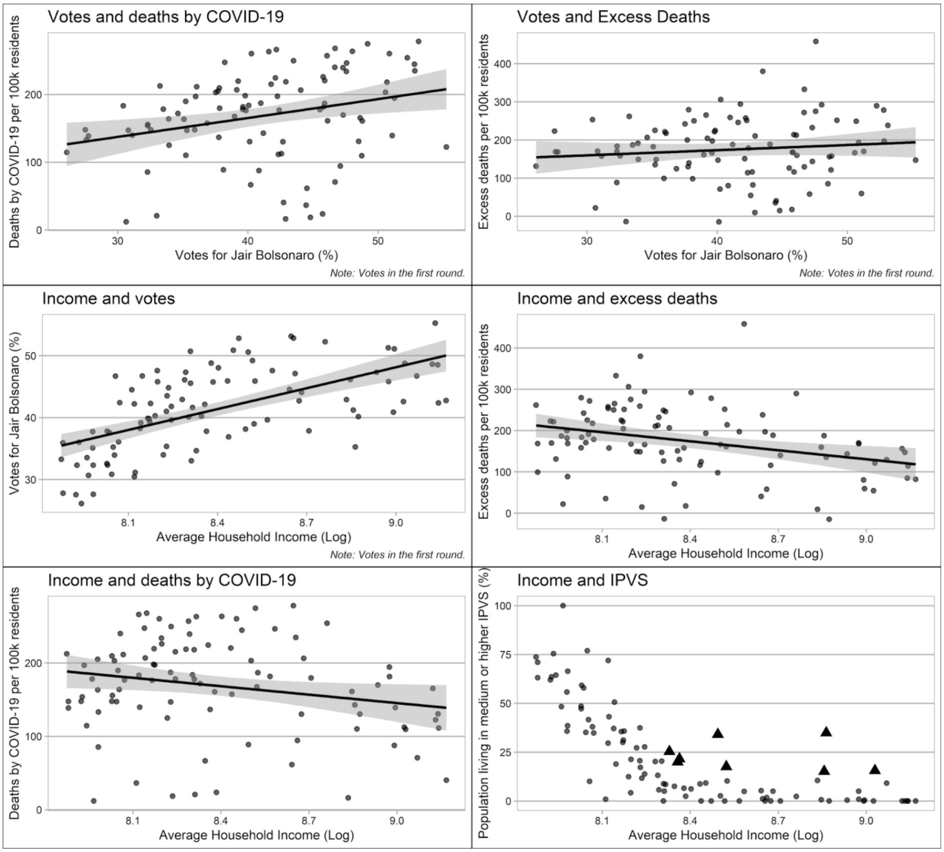

Figure 6 - Correlations between relevant variables

Note: Districts excluded in the robustness checks are shown with triangles in the last graph. Namely: Jabaquara, Jaguaré, Morumbi, Raposo Tavares, Rio Pequeno, São Domingos, Vila Andrade and Vila Sônia.

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