When professional background can betray our best intuition: the case of physician mayors in Brazil

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ABSTRACT

The present study analyses the effect of the election of physicians as local leaders on public goods delivery, especially in their areas of expertise. To do so, we compare the performance of public healthcare in locations where physician mayors got elected with the performance observed in municipalities where the mayor came from a different professional background. Our database contains information about more than 20 million births that occurred between 2006 and 2020, and we use a Regression Discontinuity (RD) design approach, analyzing the results of a quasi-experiment based on municipal elections with margins of victory close to zero. Our results show that marginally elected physicians (our highly skilled/specialized professionals) increase the percentage of newborns with low birthweight compared to their counterparts, an undesired outcome. Physician mayors lacking managerial skills promote this outcome in municipalities with lower physician rates (physicians per 1000 inhabitants) and lower coverage of Family Health and Basic Attention programs, especially in Municipal Hospitals, where mayors have higher responsibilities and autonomy. We identify the mechanism of these changes as reducing health expenditures related to medium and high-complexity care and prophylactic support. As a consequence of these lower expenditures, we observed a reduction in the total number of hours worked by physicians in municipalities where physicians got elected and an increase in the prevalence of c-section procedures. We also test different mediation variables and heterogeneities across our results. In sequence, we discuss theoretical implications for management literature and practical consequences for highly skilled and specialized professionals acting in the public sector.

Keywords: Mayoral Quality, Management Skills, Specialized Mayors, Public health, Low birthweight, Regression Discontinuity Design.

INTRODUCTION

Are physicians better than individuals from other professional backgrounds to deal with public healthcare? The literature on professional background and leadership shows that individual characteristics may influence the delivery of public goods. For instance, local leaders actions may be influenced by their partisanship (Samuels and Jr, 2014; Einstein and Glick, 2018; Benedictis-kessner, 2021; Benedictis-kessner *et al.*, 2022), and by their gender (Chattopadhyay and Duflo, 2004; Ferreira and Ferreira, 2011; Feeney, 2021; Park, 2021). Few studies also consider the influence of educational and professional backgrounds, especially where leaders play both political and executive functions (Avellaneda, 2009a, 2009b, 2015; Piña and Avellaneda, 2017). However, the comprehension of if and how these leaders' characteristics, especially their professional background, impact public service delivery is not well studied, and some counterintuitive results have shown that sometimes the actions taken by leaders may not follow what is expected according to their characteristics (Cordeiro et al., 2023).

Our study shows that the link between professional expertise and public goods delivery may not be the expected. Our results suggest that physicians in power, acting as municipal mayors, increased the prevalence of newborns with low birthweight, a significant outcome that is associated with the development of multiple health conditions across an individual life (Blencowe et al., 2019; United Nations Children's Fund & World Health Organization, 2004; Katz et al., 2013; Negrato & Gomes, 2013). We observed this undesired outcome regardless of each municipality's economic characteristics, specifically when associated with a lack of managerial capabilities of the elected physician. We show that physicians' mayors resulted in the bad outcome cited by making bad management decisions (i.e., reducing the expenditures on healthcare and consequently reducing the physicians' availability in their municipalities).

Our results suggest that doctors acting as Public Officials may not always increase the number of physicians hired, hospital capacity, and funding, as Pilny & Roesel (2020) suggested. Indeed, we suggest that significant technical knowledge might not be enough to promote adequate health outcomes, complementing the fact that doctors without management skills acting as CEOs may promote worse health outcomes than CEOs with management skills at the health unit level (Otero and Muñoz, 2022), our investigation shows that this is also true for doctors acting at a municipal level (i.e. in charge of a relevant part of an entire public healthcare system).

Using a causal analysis to better understand the impact of physicians' management competencies, we adopt a Regression Discontinuity Design approach as our empirical strategy, with the margins of votes obtained by physicians and non-physicians mayors our running variable. We work with close election results for all municipal elections that occurred in 5570 Brazilian municipalities between 2008 and 2020. Our database comprises individual information regarding over 20 million births, from where we obtain the birthweight and birth characteristics. We found the Brazilian reality an appropriate context for our investigation, as we know that in developing countries, especially those with recent democracies, political decentralization empowered municipalities, giving local administration control of a significant part of government spending (see the 1988 New Constitution). Therefore, elected officials (municipal mayors) play a substantial role in defining priorities, directing public expenditure towards different areas, and controlling the allocation of resources to promote better public services. We also focus on the election of Health Professionals (Physicians) in Brazil because this group of individuals, although representing only approximately 0.5% of voters, corresponds to around 5% of candidates elected in municipal elections in Brazil, being a significant group of politics. They also carry a specific Educational Background and present a Job Experience that could help them achieve different outcomes than mayors from different backgrounds in terms of Health Performance.

This study's academic implications include presenting empirical findings concerning the impact of professional background and mayoral quality (management skills) on public service performance, which expands the literature on elected officials' characteristics and local government. We also discuss managerial implications that include the fact that technical training may not be enough to produce better public outcomes in areas in which elected officials have expertise. The following section presents the theoretical background, the institutional background, and the public context analyzed in our study. Following, we have a section presenting our Data, the Methods used, our Results, and finally the Discussion / Conclusion of the paper.

THEORY DEVELOPMENT

Mayoral Quality, Management Skills, and Public Health Services

Local leaders directly interfere with public services through the allocation of resources and the capacity of coordinating local assets to provide better services (Cordeiro *et al.*, 2023). In this sense, one should expect that the personal qualifications of these individuals could potentially impact the delivery of public services, if these leaders have an adequate level of general managerial capabilities (Avellaneda, 2009b, 2009a; Loayza, Rigolini and Calvo-González, 2014; Piña and Avellaneda, 2017). Avellaneda (2009a, 2009b) also reported positive effects of job-related experience on public goods delivery.

Our study focuses on a specific group of local leaders composed of physicians who were elected as municipal mayors. This group corresponds to over 5% of the number of Brazilian mayors, although representing less than 0.5% of the voting population of Brazil. Physicians represent a highly skilled group, and their consequences in managerial positions are still controversial. Pilny and Roesel (2020) state that they can prioritize their own peers by contracting more physicians when in charge of hospitals' administration without changing hospitals' outputs.

On the other hand, Otero and Muñoz (2022) suggest that doctors in managerial positions (CEO) result in worse hospital performance when compared to non-physician managers. This led us to our first hypothesis:

Hypothesis 1a. Physicians elected produce different public health outcomes than their non-physician counterparts.

As we expect that worse managerial qualifications could lead to worse outcomes (Otero and Muñoz, 2022), we assess the impact of the election of physicians with different levels of qualification by comparing those who followed graduate courses with those who limited their studies to the medical degree. Despite the limitation of the information regarding which type of graduate course the elected mayor took, we assume that this type of formation could potentially influence the managerial capabilities of physicians by allowing them to get involved with the managerial and operational aspects of health centers. We test the impact of physicians' managerial capabilities on health outcomes in our Hypothesis 1b.

Hypothesis 1b. Elected Physicians' managerial capabilities influence health outcomes.

As physicians elected have access to the municipal budget and extensive expertise in healthcare, we expect different results from physicians elected in terms of healthcare management. Teodorovicz et al. (2022) showed that skilled professionals could reduce the performance gap between public and private organizations by adopting best management practices. We check if this logic applies to our context as our physicians' backgrounds could lead physicians' mayors to choose their priorities and allocate their resources differently than their counterparts with no specific know-how. We test this in our second Hypothesis.

Hypothesis 2. Physicians use their background to direct their efforts and to guide their managerial decisions differently than their counterparts.

INSTITUTIONAL BACKGROUND

Our quasi-experiment uses data from Brazil, a country with continental dimensions and peculiarities. This section presents an essential Brazilian background necessary to understand our empirical context better.

Brazilian Electoral System

Brazil is divided into five regions: North, Northeast, Midwest, Southeast, and South. These regions comprise 26 federative units (states) and the Federal District, which has a particular classification since it is home to the Brazilian Federal Capital. The following level of Brazil's administrative division is composed of 5570 municipalities. The Brazilian population is approximately 208 million inhabitants, unevenly distributed amongst the country, and the voting population is close to 156 million. It is essential to highlight that Brazil presents a great social inequality between different regions, directly impacting the number of resources available to each location. South and Southeast regions, the most developed ones, concentrate over 70% of the national Gross Domestic Product (GDP) while accommodating close to 56% of Brazil's population. On the other hand, the Northeast contributes to almost 14% of the national GDP while accommodating over 27% of the country's population (Pochmann and da Silva, 2020).

Concerning the political structure, the Brazilian public administration is divided into three powers, the Executive, the Legislative, and the Judiciary. These powers exist at three administrative levels: federal, state, and municipal. Judiciary members are not elected directly by the population; however, Executive and Legislative members are. Elections in Brazil occur every

four years. Federal and State elections define candidates to the executive roles of President and State Governors and the legislative roles of Deputies and Senators. Municipal elections determine Mayors and Councilors. These two types of elections occur two years apart from each other. For instance, the last federal and state elections happened in 2022, while the previous municipal elections happened in 2020. All positions have a 4 (four) year mandate, except Senators, who have an 8 (eight) year mandate. However, the Brazilian Constitution allows the reelection of Deputies, Senators, and Councilors for an undetermined number of mandates. Presidents, Governors, and Mayors have a limit of two sequential personal mandates.

Municipal Elections, the focus of our study, occur in one round when the winner receives more than 50% of the valid votes or when the municipalities' voting population does not surpass 200 thousand voters. A second-round election occurs when the voting population is over 200 thousand people, and no candidate obtains the most valid votes (50% plus one). The municipalities with the possibility of second-round elections include only 96 cities (1.7% of the number of Brazilian municipalities). In our quasi-experiment, we discard these municipalities due to the possibility of strategic voting in the first round (Fujiwara, 2011).

Brazilian Unified Health System

Health System. As our empirical strategy uses birth data, it is essential to highlight some characteristics of the Brazilian Health System. The Brazilian population has access to private healthcare through health plans and insurance. However, the private system is still limited to wealthier regions and serves around 30% of the Brazilian population (Paim *et al.*, 2011). Therefore, most Brazilian population depends on Public Health assistance through the Unified Health System (SUS).

To understand SUS' characteristics and limitations, we must address the existing health assistance before its creation. Until the 1980s, Private and Philanthropic institutions were Brazil's most relevant health assistance providers. The public component of Brazil's healthcare included facilities supported by the Social Security National Institute of Health Assistance (INAMPS), an autarchy that invested resources coming from contributors from the formal employment sector, which was concentrated in urban areas and limited to a small portion of society (de Souza, 2002). At the end of the 80s, INAMPS established more agreements with state and municipal public institutions and expanded the served public towards a public and universal service model. Altogether with a movement led by scholars, health professionals, and society, this resulted in the definition of health assistance as a right of all Brazilians and as a government duty included in the 1988 Brazilian Constitution. The Constitution also included that the Unified Health System, yet to be created, should be supported by the Social Security, Union, States, and Municipal revenues, but the definition of the expected participation of each entity in funding SUS remains a complex dilemma until nowadays (Scatena, Viana and Tanaka, 2009).

Unified Health System financing. The Constitutional Amendment nº29 (EC-29) is a milestone in defining the roles of the Union, States, and Municipalities in financing the SUS. The Government approved this amendment in 2000, almost ten years after the Federal Law nº8080 enactment, which formally created the SUS.

The EC-29 established the percentage of municipal, state, and federal revenues earmarked for financing the SUS. The EC-29 defined a minimum investment for municipalities of 15% of their incomes on public health assistance and 12% for States. The federal government minimum investment was established using the 2000s expenditure as the baseline. The federal component for the following years should then increase based on the observed GDP growth. Consequently,

the expenditure on health assistance was decentralized, and States and Municipalities became responsible for a relevant part of public health policy implementation (Cordeiro, 2001; Fleury *et al.*, 2010).

The circulation of resources between different government levels is possible through Federal, State, and Municipal Funds or via direct expenditures. The transfers between funds are the most common method used nowadays. A Municipal Fund, for instance, may receive financial resources from a State Fund, a Federal Fund, or municipal tax collection.

Federal transfers have been divided between medium and high-complexity assistance, epidemiologic and disease control resources, and Basic Attention resources since 1998 (de Souza, 2002). The Basic Attention resources have a fixed component (Fixed PAB), which corresponds to a fixed value per capita, and a variable part (Variable PAB) that depends on how vulnerable the municipality is. The definition of the vulnerability level considers the percentage of people insured, demographic density, GDP per capita, and rate of inhabitants in an extreme poverty situation. To receive the Variable PAB, municipalities must fulfill a series of requirements. One of these requirements is the increase in the municipal coverage of the Family Strategy Program, a Program developed to reorganize primary healthcare in Brazil through the creation of multidisciplinary teams consisting of physicians, nurses, and community agents that support up to 4000 people per team (Ministério da Saúde, 2012).

In all its forms, Federal resources are still the predominant source of financial resources for public health assistance. However, state and municipal levels' contribution has increased since the creation of SUS. The municipal attributions also increased during the consolidation of the Unified Health System. Municipal Health Secretaries, under the authority of Municipal Mayors, became responsible for formulating local public health policies meeting the necessities

of the local community, analyzing the services demanded, and controlling the operational aspects of health facilities in their territory (de Souza, 2002; Villani and Bezerra, 2013; Pinafo *et al.*, 2016). Even though municipalities receive federal and state resources and guidelines, the decentralization of public health coordination allowed mayors to interfere directly with the allocation of resources. Physicians Mayors with their particular backgrounds are expected to bring a specific set of competencies to identify healthcare priorities as extensively reported in the literature (Dunham et al., 1994; Falcone & Satiani, 2008; Hoff & Mandell, 2001; Schneller et al., 1997).

Prioritary municipalities. Considering the uneven distribution of resources and the demand for healthcare in highly vulnerable locations, the government and society have made efforts to identify and prioritize resource allocation to these municipalities. We use four classifications of vulnerable areas in our study. The first is the Extreme Poverty classification the Health Ministry uses in their database. The second vulnerable group includes municipalities from Basic Attention Program's Group 1, which present the most precarious health performance indicators and, therefore, receive higher variable payments to stimulate investments (Ministério da Saúde, 2012; Mendes and Marques, 2014). The third group consists of the municipalities belonging to the "g100" list, which contains the 112 municipalities with high socioeconomic vulnerability defined by the National Front of Mayors (Frente Nacional de Prefeitos, 2020). Finally, the fourth group of vulnerable municipalities includes those with specific Indigenous Health Programs.

METHODS

We use data from multiple different sources following listed: (i) the Brazilian Supreme Electoral Court (*TSE*), (ii) the Brazilian Institute of Geography and Statistics (*IBGE*), (iii) the

Brazilian Municipal Basic Information Survey (*MUNIC*), (iv) Information System on Live Births – Brazilian Ministry of Health (*SINASC-DATASUS*), (v) Mortality Information System – Brazilian Ministry of Health (*SIM-DATASUS*), (vi) National Registry of Health Establishments – Brazilian Ministry of Health (*CNES-DATASUS*), (vii) Brazilian National Treasury. Our resulting database comprises data from 5452 different Brazilian municipalities, corresponding to almost 98% of the Brazilian municipalities, and includes information concerning more than 23 million births.

We first gathered the results from municipal elections that occurred in Brazil in 2004, 2008, 2012, 2016, and 2020 from the Brazilian Supreme Electoral Court (TSE), including candidates' information such as prior profession, previous entrepreneurial experience, age, marital status, schooling level, political affiliation and percentage of valid votes obtained. We then collected information concerning population, mortality rates, GDP per capita, and other municipal characteristics from the Brazilian Institute of Geography and Statistics (IBGE) and the Brazilian Municipal Basic Information Survey (*MUNIC*). From MUNIC, we also collected data regarding the level of education of mayors and the educational background of their municipal secretaries of health.

In sequence, we collected data concerning births that occurred in public and private health facilities from 2006 to 2020 from the Brazilian Ministry of Health (*SINASC-DATASUS*), data about mortality due to different causes from the Mortality Information System – Brazilian Ministry of Health (*SIM-DATASUS*). Finally, we collected information concerning health facilities' characteristics such as type of facility, number of professionals, and hospital's link with the Unified Health System, the Brazilian Public Health System, from the National Registry of Health Establishments – Brazilian Ministry of Health (*CNES-DATASUS*), and municipal

expenditure data from the Brazilian National Treasury registries. We better describe all the variables used in our experiment in Table 1.

Independent variable: Physician mayor (dummy). Physicians are a reduced and privileged group of professionals (Machado, 1997) with a relevant presence in Brazil's government. Although the number of physicians in activity in Brazil represents around 0.3% of the voting population, physician mayors are more than 5% of the mayors elected in Brazil for the period we developed our study. We chose physicians elected as our group of interest due to their backgrounds and their power to influence Health Management. We identify whether the mayor elected is a physician by the occupational background informed by the candidates. Our investigation encompasses the electoral results from three mayoral elections (2008, 2012, and 2016). We discarded results from elections before 2008 due to missing data and because professions' classification changed and is incompatible with previous years. We also discarded results from the 2020 election due to the non-completion of the term until the conclusion of this study. Each mayor elected remains in power for four years, having the possibility of an additional four years in case of reelection, and the number of physicians elected corresponds to 5.52% (1,414) of our 25,617 observations. The independent variable physician equals 1 for candidates self-declared as physicians and 0 otherwise. We compare physicians elected to our treatment group with candidates elected from eight different professional backgrounds: Lawyers, administrators, merchants, business owners, public servers, councilors, mayors, and professors. These mayors elected to compose our control group in the experiment.

Dependent variable: Low birthweight. (Dependent variable of health outcome). We used the newborn birthweight as the proxy of health outcome. We evaluated the birthweight reported for each birth of our sample and divided births between low, regular, and high birthweight (United

Nations Children's Fund & World Health Organization, 2004). The low birthweight newborns were those born with under 2500 grams, while the regular infants were those born with weights between 2500 and 3500 grams, and high birthweight newborns were those born with over 3500g, as suggested by the existing literature (Blencowe et al., 2019; United Nations Children's Fund & World Health Organization, 2004). The birthweight is an adequate proxy of health outcomes as the occurrence of low birthweight (<2500g) is highly associated with poorer general health outcomes for newborns throughout their entire lives, such as higher infant mortality risks (Katz *et al.*, 2013; Negrato and Gomes, 2013), cognitive losses and neurodevelopmental impairment (Paneth, 1995; Blencowe *et al.*, 2013), development of chronic diseases as adults (Barker, 2004; Negrato and Gomes, 2013), besides directly impacting the health systems' costs (Lewit *et al.*, 1995; Almond, Chay and Lee, 2005).

While constructing our dataset, we started with data at the individual level, using the births as our unit of analysis. In this first step, we created a dummy variable for each birthweight category: low, regular, and high. We then assigned the values 0 or 1 for these variables, being 0 assigned when the newborn's weight did not fit into a category and one otherwise. In sequence, we compiled all the births by the mother's municipality of residence and by year. Finally, as required by our empirical strategy, we compiled the data for the entire mayor's term, which comprises four years following the election. The final variables concerning birthweight represented the mean percentage of births that occurred during the four years following the election and belonging to each category of birthweight (low, regular, or high) for a specific municipality.

Covariates. We use different types of variables as covariates. We have candidates' characteristics such as Gender, marital status, and race. We also use municipalities' characteristics as covariates, such as the percentage of rural areas, GDP per capita, and percentage of houses with

water and sewage treated. Regarding the educational level of candidates, we created two variables to confirm that the level of education did not change the vote preference towards physician candidates. We use these variables to perform a manipulation check using candidate-level covariates as proposed by Marshall (2022a).

Mediation Variables. Mayoral Management Skills. We assess the influence of mayoral managerial competencies on health outcomes by checking whether the candidates took a graduate course, which could help develop better management skills. Although not able to verify which type of graduate degree the candidates took, we assume that in the case of elected physicians, a graduate course in subjects such as business administration and management could potentially increase their management skills, and courses in specialized medical subjects could at least improve physicians' knowledge on the routines, operational and managerial aspects of health facilities.

Mediation Variables. Health Programs. We test the effects of physician mayors on low birthweight, our main result, considering the level of coverage and the number of teams dedicated to two Health Programs, the Family Health Program and the Basic Attention Program. The coverage of each program is measured in percentual points and refers to the percentage of people that have access to them. The number of teams refers to professional groups dedicated to the programs. We compile these data and calculate the average of the observed results for the four years following the election.

Mediation Variables. Quantity of Physicians. The number of physicians is an integer variable that refers to the number of physicians working in a municipality. We also calculate the physician rates as the number of physicians divided by the population (number of physicians/1000 inhabitants) and the physician rates considering the number of hours worked by each professional,

which in practical terms indicates the number of hours doctors worked in each municipality, divided by the municipalities' population.

Mediation Variables. Type of Hospital. We investigate the outcomes obtained for five different types of health facilities: Private Hospitals not linked with the Unified Health System, Private Hospitals linked with the Unified Health System (hospitals that designate at least part of their capacity to the public health system), Federal Hospitals, State Hospitals, and Municipal Hospitals. These facilities differ from each other according to the origins of their resources. For public entities, for instance, federal, state, or municipal governments may subsidize the facilities' operation. To conduct this analysis, we created dummy variables indicating in which type of hospital the birth occurred. In our final database, we presented these results as the mean percentage of newborns with low birthweight, for instance, born in each type of hospital during the term following the municipal election.

Mediation Variables. Birth Characteristics. We use five variables to investigate birth characteristics. The first variable relates to the number of prenatal appointments. We measure in percentual points the number of women who did not receive adequate prenatal care (at least seven appointments). We then create a second variable that indicates the percentage of women who performed preterm births (less than 39 gestational weeks). The third variable is the percentage of women who received treatment to induce labor. Finally, the last two variables identify the percentage of women who performed c-sections and vaginal deliveries, respectively.

Heterogeneities. Economic Environment. We describe the Economic Environment of each municipality through four variables. The first one is a dummy variable that equals 1 when the municipality is considered an Extreme Poverty location by the Ministry of Health and 0 otherwise. The second dummy variable equals 1 when the municipality belongs to the Group 1 classification

of the "Basic Attention Minimum Payment" normative and 0 when the municipality does not belong to Group 1. The third variable indicates whether a municipality belongs to the "g100" list of municipalities. This variable equals 1 when the municipality is part of the "g100" group and 0 otherwise. Finally, the last dummy variable analyzes municipalities with a specific economic environment due to the presence of Health Programs focused on the Indigenous population. Again, the variable equals 1 when the municipality contains particular health programs and 0 otherwise.

Heterogeneities. Mayor Characteristics. We use two groups of variables referring to mayors' characteristics. The first is a dummy variable equal to 1 when the candidate elected is a woman and 0 when the candidate is a man. The second group of variables relates to the Political ideology of each candidate. We divide candidates according to their political parties, following two different classifications defined by Power and Zucco Jr (2009) and Coppedge (1997) that divide parties between left-wing, right-wing, and center-wing orientations. Given that Power and Zucco (2009) and Coopedge(1997) classify the PSDB, an essential party in Brazil, differently, we adopted this difference and discussed these results in the robustness section. We use dummy variables to classify each candidate into their respective groups.

Empirical Estimations. Our database allows us to explore how physician mayors impacted the health outcomes, especially low birthweight, during their terms. These analyses were conducted for different economic contexts and considering previously listed heterogeneities. Essentially, our empirical strategy aims to evaluate the causal effect of a physician's election on newborns' birthweight compared with mayors elected with different professional backgrounds.

In our study, the primary test identifies whether the prevalence of low birthweight in municipalities where the mayor elected is a physician differs from that observed in municipalities

where the mayors elected come from other professional backgrounds. We also test the same dependent variable (low birthweight) for sub-samples from our database, considering the management skills of candidates, the economic level of the municipalities, the coverage of health programs, the profile of the elected mayors, and so on.

To do so, we adopted a sharp regression discontinuity (RD) design (Arvate et al., 2018; Arvate & Story, 2021; Calonico et al., 2014; Cordeiro et al., 2023; Flammer, 2015; Flammer & Bansal, 2017; Imbens & Lemieux, 2008; Lee & Card, 2008; Lee & Lemieux, 2010) as our data allows us to identify the mayor elected clearly and we can use the election's results to define the margin of victory that is close to zero. This approach reduces the potential selection bias as we establish the mayor in a quasi-experimental manner. We also test (see Figure S1 in our online Appendix) for the possibility of electoral manipulation (McCrary, 2008). This methodology also ensures that jumps observed in any variables of interest are not due to municipal or non-observable characteristics.

The treatment variable $D_{i,t}$ is a dummy variable that equals one when a physician candidate defeats a nonphysician candidate in a municipality *i* in year *t* (treatment group). The control group ($D_{i,t}$ =0) is composed of municipalities where a nonphysician candidate defeated the physician candidate. The running variable of our model is the margin of victory ($Margin_{i,t}$), which is defined as the difference between the votes received by the elected and the runner-up candidates, considering the first and only round of the municipal elections analyzed. The relationship between $D_{i,t}$ and $Margin_{i,t}$ can be written as follows:

$$D_{i,t} = \begin{cases} 1 \; if \; Margin_{i,t} > 0 \\ 0 \; otherwise \end{cases} \quad (1)$$

The cut-off point, where the margin of victory equals zero, is the single criterion for separating the municipalities where physicians or candidates with different professional backgrounds were elected. The impact of a physician mayor on the dependent variable $Y_{it+\xi}$ is defined by the parameter β, which represents the Average Treatment Effect (ATE) near the cut-off. We use a non-parametric local estimator proposed by Calonico et al. (2014), which is based on a triangular kernel function and assumes different weights for bins according to their distances to the cut-off. The parameter β is defined as:

$$\beta = \lim_{Margin \downarrow 0} E(Y_{it+\xi} | Margin_{it}) - \lim_{Margin \uparrow 0} E\left(Y_{it+\xi} \middle| Margin_{it}\right) \quad (2)$$

We tested our main results for bandwidths different from the optimal bandwidths obtained using the methodology proposed by Calonico et al. (2014). We tested our results for a broader sample, including observations that presented a margin of victory further from the cut-off. We also tested our results with different polynomial orders as established by Gelman and Imbens (2019), and in all tests, our standard errors are robust and clustered at the municipality level.

RESULTS

Descriptive statistics

Table 2 shows that most of our dependent variables have no statistically significant difference between municipalities where physicians and nonphysicians are elected. Only one dependent variable, low birthweight in Federal Hospitals, was statistically different. Our results suggest that low birthweight in this facility was more prevalent when a nonphysician was in power.

Amongst our covariates, more variables were statistically significant. The nonphysician mayors also had more women in power, and a lower percentage of white candidates were elected. We also present in Table 2 the RD estimates for our covariates. None of the results for the RD coefficients was statistically significant. We also tested discontinuities for covariates (see Figure S2 in our online Appendix). Regarding the variable that indicates whether candidates have achieved higher education degrees (covariate with a gap), we perform additional tests (see Table S4 in our online Appendix) to verify whether this covariate influenced the winning candidate's victory margin, as proposed by Marshall (2022).

Insert Table 2 about here

Main effects of physician mayors on health outcomes (low birthweight)

Table 3 shows the low birthweight prevalence difference between municipalities where physicians and individuals from other occupations were elected.

Insert Table 3 and Figure 1

Table 3 contains three groups of non-parametric RD results: In Column 1, we present the previous electoral result, considering the period between 2005 and 2008, as evidence that the main result is not a consequence of changes that occurred before our quasi-experiment (p=0.528). In sequence, we present the posterior electoral result (three terms: 2009-2012, 2013-2016, 2017-2020) in Column 2. The result presented in Column 2 shows that municipalities with physician mayors elected to have a percentage of low birthweight newborns 0.8% higher when compared with municipalities with mayors from different backgrounds (p=0.011). Given the statistical significance of the result on the dependent variable presented in Column 2, we present this

evidence with robustness. Firstly, in Columns 3,4 and 5, we present the results for second, third, and fourth-order polynomials. (p=0.019, p=0.056, and p=0.073, respectively). Secondly, we test our main result by varying the (optimal) bandwidth used to estimate our coefficients. All the coefficients are presented in columns 6 to 9 (first-degree polynomial) and are statistically significant (p=0.059, p=0.024, p=0.010, and p=0.009, respectively). Finally, in column 10, we present our main result after calculating the coefficient including covariates in our model (p=0.002). Following Calonico et al. (2014), this procedure increases only the precision of results.

The general interpretation of the results is that municipalities where physicians were elected had worse health outcomes than municipalities where mayors elected came from other professions. This supports Hypothesis 1a in a bad way, as we have evidence that elected physicians are producing unfair outcomes. To understand the magnitude of this impact, one should observe that the average percentage of low birthweight prevalence is 7.7% for our entire sample, which means that the increase observed (around 0.8%) is equivalent to a rise of 10.4% in the prevalence of low birthweight. Figure 1 visually shows the discontinuity observed for the dependent variable close to the cut-off.

Unlike other empirical investigations, the non-parametric RD does not permit mediation investigation with the interaction of variables (independent variable*mediation variable). Thus, we build mediation evidence to investigate the sub-sample. For instance, we investigate the effect of the same independent variable with the same methodology used in the main results for situations of physician mayors with and without management skills.

Mediation: Management skills

We test the impact of physicians' election on low birthweight prevalence, initially considering whether candidates took graduate courses or not. We assume that individuals with

graduate studies would have more managerial competences than those without such expertise. We present the results in Table 4.

Insert Table 4 about here

The performance of physicians with graduate courses did not differ from that of non-physician candidates despite the qualifications of the non-physicians (columns 1 and 2). However, municipalities led by physicians without graduate courses presented an increment of 1.5% on the prevalence of low birthweight (p=0.009) when compared to municipalities where non-physician candidates got elected, despite non-physician mayors' qualification (columns 3 and 4).

We reinforce that the variable used as a proxy for management skills has its limitations (basically, the mayors can have done or not a graduate course in management), however, the results strongly suggest that lower management skills possessed by physicians in leadership positions (mayors) led to worse health outcomes when compared to municipalities with managerial teams with better management competences, supporting Hypothesis 1b.

Mediation: Health Expenditures

Considering that physicians interfere directly with municipal resources' allocation, we analyze the impact of physician mayors' elections on health-related municipal expenditures. Our results suggest that physician mayors reduced the annual total health expenditure by 6.5 million Brazilian reais, equivalent to almost 1.3 million US dollars (p=0.091). The reduction occurred especially on expenses related to Medium and High Complexity (p=0.026) and Prophylactic Support (p=0.064). Results are presented in Table 5. We also report the effect of physicians' election on health expenditures, considering their management skills. Physicians elected who took graduate courses did not allocate their municipal budgets differently than their counterparts.

Physician mayors without graduate courses, on the other hand, reduced the total health expenditure (p=0.103) and reduced the spending on Medium and high-complexity health assistance (p=0.022) and Prophylactic Support (p=0.029). Results are presented in Table 6.

Insert Tables 5 and 6 about here

These results suggest that physicians elected, especially those without graduate courses, reduce the health expenditure in their municipalities. Although the reasons to do so may not be clear, the consequences may be. In Table S1 from our Online Appendix, we show that low birthweight prevalence increased by 1.1% when physician mayors got elected in municipalities with total health expenditure below the median (p=0.009) and 0.8% considering municipalities with total health expenditure from municipal resources below the median (p=0.011). We observed no similar result for municipalities with health expenditure above the median.

Mediation: Physicians' Availability

One of the consequences of reducing the municipal expenditure on public healthcare could be the reduction of the availability of doctors working at public facilities. In Table 7, we show that although the election of physicians does not interfere directly with the number of physicians or the physicians rate in the municipality (see Columns 1 and 2), the physicians' rate considering the number of hours worked by each professional, in Column 3, reduced, despite the limited statistical significance (p=0.125). Columns 4 and 5 show that low birthweight prevalence increases in municipalities where the physicians' rate (number of physicians / 1000 inhabitants) is below the median (p=0.006), reinforcing the importance of attracting and maintaining doctors working in each municipality.

Again, we examine the results dividing elected physicians amongst those who completed graduate courses and those who did not. Similarly to our prior results, the coefficients in Table 8 suggest that municipalities led by physicians without graduate courses had a reduction in the rate of physicians considering the number of hours worked by them, again with limited statistical significance (p=0.104).

Insert Tables 7 and 8 about here

Mediation: Types of Hospitals

We test the effect of physician mayors on low birthweight for different types of hospitals. The results are in Table 9. We show the results for Private Hospitals in Column 1 (p=0.327), Federal Hospitals in Column 2 (p=0.124), State Hospitals in Column 3 (p=0.168), and Municipal Hospitals in Column 4 (p=0.023).

Insert Table 9 about here

Our results suggest that low birthweight increases only in Municipal Hospitals, the type of facility the mayor elected could influence the most due to the characteristics of the public health system established.

Mediation: Birth Characteristics in Municipal Hospitals

As our main results occur in Municipal Hospitals, we test the effects of physician mayors on birth characteristics that could affect the birthweight in this type of facility. Firstly, we run our tests using the number of prenatal appointments as our dependent variable (p=0.244). We also test the occurrence of preterm birth (p=0.387) and the prevalence of induced labor (p=0.603) as dependent variables. The results for these tests are in Columns 1 to 3 in Table 10. Columns 4 and

5 of the same Table show the results for different delivery modes. We show that the percentage of c-section births performed in Municipal Hospitals increases by almost eight percentual points due to the election of a physician (p=0.009). In contrast, we do not observe an impact on vaginal birth prevalence (p=0.941). The increase in c-sections performed may suggest that the reduction in the physicians' availability may lead to professionals choosing to perform a faster and more predictable type of birth delivery.

Insert Table 10 about here

Following our analysis, we investigate the heterogeneities of the sample to help us understand better where the effect occurs.

Mediation: Health Programs

We test the impact of physicians' election on low birthweight prevalence considering the Health Programs' coverage in the municipalities. We present the results in Table S2.

Insert Table S2 about here

Although we have not observed any change in health programs' coverage due to physicians' elections, our results suggest that low birthweight prevalence increases in municipalities with Family Health Strategy coverage below the median (p=0.029) and with Family Health Strategy teams below the median (p=0.024). Locations where Family Health Strategy coverage and the number of teams are above the median do not present statistically significant results (p=0.235 and p=0.276, respectively). We present the Basic Attention Program results in Columns 5 to 8. We observe an increase in low birthweight prevalence due to the election of a physician in municipalities with Basic Attention Program coverage and the number of teams

below the median (p=0.064 and p=0.035). Still, we also observe an increase for municipalities with the Basic Attention Program number of teams above the median, with a limited statistical significance (p=0.082).

Heterogeneities: Economic Environment

We test the impact of physicians' election on low birthweight prevalence considering the Economic Environment of the municipalities. We present the results in Table S3 (online Appendix).

We analyzed the impact in municipalities belonging to four different groups. The first group considered municipalities with extreme poverty. The results presented in Columns 1 and 2 were similar and statistically significant for both municipalities with and without extreme poverty (p=0.070 and p=0.038, respectively). The second group comprises municipalities that belong or do not belong to the PAB1 group. PAB1 municipalities, as described by the Brazilian Health Ministry (Ministério da Saúde, 2017), are the most vulnerable ones and receive a higher amount of investments per capita in Health Programs. Results in Columns 3 and 4 suggest that the impact occurs amongst PAB-1 municipalities (p=0.015). Columns 5 and 6 show the results for municipalities belonging to the g100 group. This group is also the most vulnerable Brazilian municipalities (Frente Nacional de Prefeitos, 2020). The result in Column 6 suggests that the impact of physicians' election occurs in municipalities that do not belong to the g100 group (p=0.003). Finally, Columns 7 and 8 show the results considering municipalities with or without Indigenous Health Programs. Column 8 result shows that the impact occurs in municipalities without Indigenous Health Programs.

Investigating the Economic Environment of municipalities in our sample suggests that results do not depend on better or worse Economic Environments. There is no clear evidence that the impact is more prominent in vulnerable or less vulnerable locations.

Heterogeneities: Gender and Political Ideology

We also investigate heterogeneities amongst the physicians elected. We focus on the Gender and Political Orientation of candidates, and the results are in Table S4 (online Appendix).

Low birthweight increases in municipalities led by males (p=0.011) and center-wing politicians either considering Coppedge's (1997) classification of Brazilian Political Parties (p=0.000) or the classification proposed by Power and Zucco Jr (2009) (p=0.010). Female physicians elected do not influence the low birthweight prevalence (p=0.679), nor do Right and Left-wing candidates.

ROBUSTNESS CHECKS

Other occupations as leaders

We present the results for mayors from other professions in Table S5 (online Appendix). Lawyers, Administrators, Merchants, Business Owners, Public Servers, Councilors, and Mayors do not affect the outcome tested (low birthweight). Professors have a result with a low statistical significance, which is not sustained for different polynomial orders or different bandwidths.

Potential Bias due to covariates

To assess the possibility of covariates influencing the vote preferences, we also created dummy variables to analyze two specific situations. The first one is a dummy variable equal to

one when a physician is elected, and a non-physician with higher education is the runner-up. The second is a dummy variable that equals one when a candidate with higher education competes against a candidate without higher education. We show that having higher education degrees did not influence the election of physicians, as our RD estimates are non-significant (please see Table S6 in our online appendix).

We also tested our main results using physician mayors as our treated group and only candidates with higher education as our control group (our results remain statistically significant for this setting). In sequence, we show again that the results obtained are due to the physician's election and not due to a different level of education. We do so by calculating our estimates by comparing candidates with higher education with candidates with no higher education. The results in this setting are not statistically significant. All these results are presented in Table S6 in our online appendix.

Polynomials, Different Bandwidths and Covariates

We obtain our main results using local linear polynomials, as Gelman and Imbens (2019) recommended. As a robustness check, we test our main results using quadratic, third, and fourth-order local polynomials (Eggers *et al.*, 2015).

We also test our main results for bandwidths different from the optimal bandwidth proposed by Calonico et al. (2014). We use four fixed bandwidths: 0.10, 0.20, 0.30, and 0.40.

Finally, we verify our main result, including covariates in our regression. Our main results remain statistically significant for all polynomials and bandwidths tested and for the model, including covariates. Results are presented in Table 3.

DISCUSSION

Our results suggest that physician mayors negatively impact a significant public health issue: low birthweight. This impact may lead to higher infant mortality rates and increased risks of multiple diseases (Barker, 2004; Negrato and Gomes, 2013). Physician mayors achieve this undesired outcome by allocating their municipal resources differently than their counterparts, especially in their areas of expertise (i.e. health). The increase in low birthweight prevalence, according to our results, occurred in locations underserved by the public health system, with lower presence of health programs and lower rates of physicians available, which reinforces the necessity of investments in health professionals and health in general.

Therefore, reducing physicians available and reducing health-related expenditures in locations where a physician is in power may be even more prejudicial to the municipalities' population.

Contributions to the literature

The present paper contributes to the public management literature by providing causal empirical evidence that management skills are essential to the effective administration not only at the unit level (Otero and Muñoz, 2022) but also at the municipal level. We also contribute to the Mayoral Quality literature by expanding the mayoral characteristics analyzed as potential sources of superior and inferior public goods delivery performance.

Implications for practice

Practitioners, especially those associated with the municipal administration, should reassess the focus of public health policies and direct their efforts to regulate the coverage of health programs and the number of health professionals to adequate levels, as we showed that worse outcomes occurred in municipalities with lower coverage of health programs and lower number of physicians. Practitioners should also analyze the reasons that lead to higher low

birthweight and c-section prevalence in Municipal Hospitals since there is no evidence that this condition is due to a worse economic environment.

Limitations and future research directions

Our study presents robust results for the specific Brazilian context. This leads to a high internal validity. However, similar studies in different contexts, for instance, in other countries with similar public health systems, such as the United Kingdom and its National Health System, could be beneficial for the external validity of our results. A better understanding of the mechanisms used by physician mayors that lead to the increase of low birthweight prevalence could also be helpful. Qualitative studies that include interviews with mayors and municipal health authorities may be an excellent path to follow.

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SUPPLEMENTARY MATERIALS

Figure 1: Physician mayor effect on birthweight outcomes

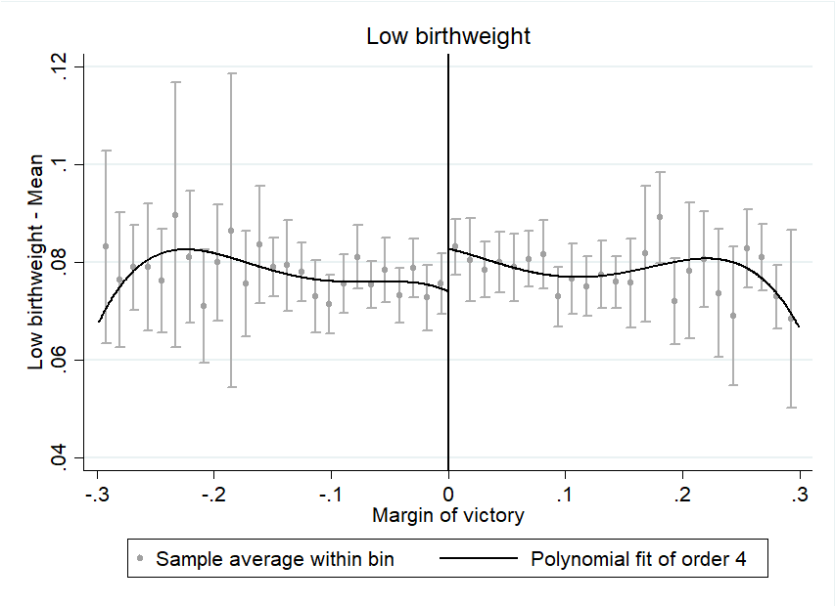

Figure 2: Physician mayor effect on low birthweight considering municipalities' Family Health Strategy coverage

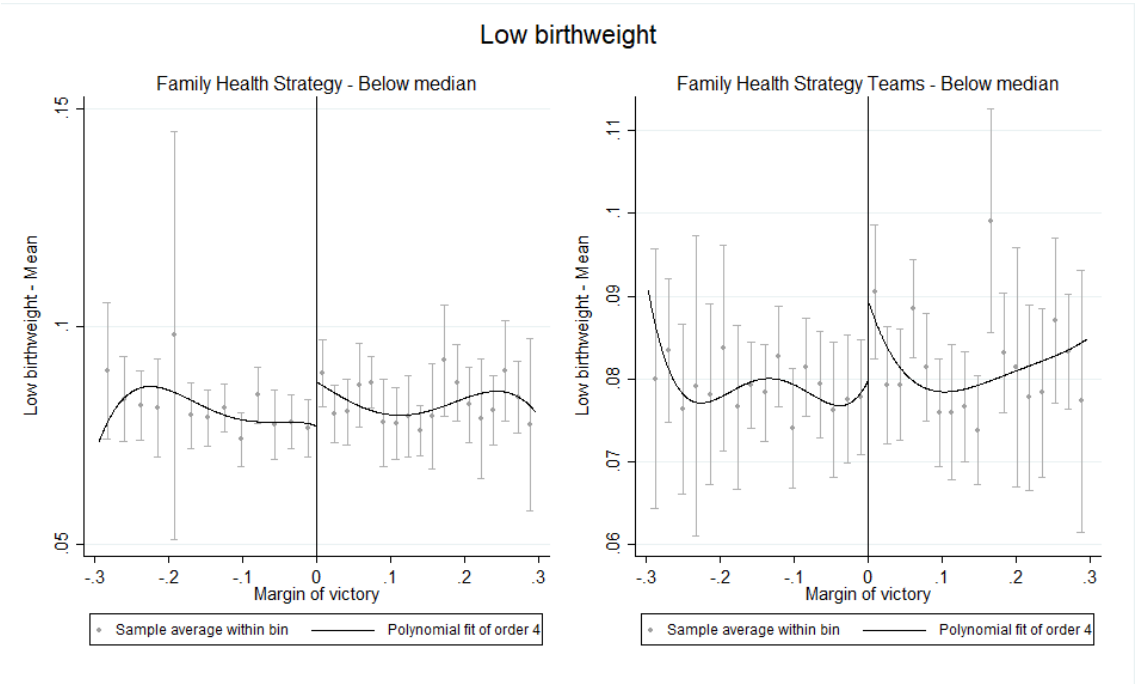

Table 1 – Panel A: Variables description

Panel A				
	Label	Variable	Construction of variable	Source
Mayor / Secretary Characteristics	Gender of mayors	Female mayor	Dummy variable equals to 1 when the mayor elected is a woman and 0 otherwise	Superior Electoral Court (TSE) – Mayoral Elections of 2008, 2012, 2016, and 2020
	Race of mayors	White mayor	Dummy variable equals to 1 when the mayor elected self declares as white and 0 otherwise	
	Marital status	Married mayor	Dummy variable equals to 1 when the mayor elected is married and 0 otherwise	
	Graduate courses	Graduate	Dummy variable equals to 1 when the mayor took graduate courses and 0 otherwise	IBGE - Brazilian Institute of Geography and Statistics – 2009 and 2012 Municipal Basic Information Survey
	Physician Secretary	Physician Secretary	Dummy variable equals to 1 when the Secretary of Health is a physician and 0 otherwise	
	Administrator Secretary	Administrator Secretary	Dummy variable equals to 1 when the Secretary of Health is an administrator and 0 otherwise	
Municipal Characteristics	% of rural population	Rural population as a percentage of the total population (by municipality)	We calculate the average of each variable for the four years following an election	IBGE - Brazilian Institute of Geography and Statistics – 2000 and 2010 Census and IBGE Cidades
	GDP per capita	Municipal Gross Domestic Product per municipal population		
	% of water treated	Percentage of population with access to water treatment		
	% of sewage treated	Percentage of population with access to sewage treatment		
Municipal Expenditure Characteristics	Health Expenditure	Health (General)	We calculate the average of the annual expenditure of each group for the four years following an election	Brazilian National Treasury
		Basic Attention		
		Medium and High Complexity		
		Prophylactic Support		
		Sanitary		
		Epidemiology		
		Others		

Table 1 – Panel B: Variables description

Panel B				
	Label	Variable	Construction of variable	Source
Birth Characteristics	Number of births	Total number of births in the municipality	We calculate the average of the number of births for the four years following an election	Information System on Live Births (SINASC - DATASUS) and National Registry of Health Establishments (CNES)
		Total number of births in the municipality that has information on the type of health facility where the birth occurred		
	Birthweight	Percentage of newborns with low birthweight (<2500g)	We calculate the average of the percentage of each type of birthweight prevalence for the four years following an election	
		Percentage of newborns with regular birthweight (between 2500 and 3500g)		
		Percentage of newborns with high birthweight (>3500g)		
	Prenatal Appointments	Percentage of mothers that attended to 0 appointments	We calculate the average of the percentage of each "category" of prenatal appointments for the four years following an election	
		Percentage of mothers that attended to 1 to 3 appointments		
		Percentage of mothers that attended to 4 to 6 appointments		
		Percentage of mothers that attended to 7 or more appointments		
		Percentage of mothers that attended to a number of appointments below recommended (less than 7)		
	Gestational weeks	Percentage of mothers with up to 22 gestational weeks	We calculate the average of the percentage of each group of gestational weeks for the four years following an election	
		Percentage of mothers with gestational weeks between 23 and 27		
		Percentage of mothers with gestational weeks between 28 and 31		
		Percentage of mothers with gestational weeks between 32 and 36		
		Percentage of mothers with gestational weeks between 37 and 41		
		Percentage of mothers with 42 or more gestational weeks		
		Percentage of mothers that performed preterm births (less than 37 gestational weeks)		
	Delivery induction	Percentage of mothers who had their labor induced	We calculate the average of the percentage of labor induced for the four years following an election	
	Delivery method	Percentage of women who performed vaginal births	We calculate the average of the percentage of each type of birth for the four years following an election	
		Percentage of women who performed c-section births		

Table 2: Descriptive statistics

The 2008, 2012 and 2016 elections							
	Physician Mayor			Nonphysician Mayor			RD Estimate
Dependent variables	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	
Low Birthweight (LB)	0.077	0.020	992	0.076	0.022	964	---
Number of Physicians	30.702	58.982	723	32.624	68.280	697	---
Physicians rate	0.764	0.651	723	0.754	0.668	697	---
LB – Private Hospital	0.042	0.035	992	0.041	0.035	964	---
LB – Federal Hospital	0.002	0.007	992	0.003**	0.009	964	---
LB – State Hospitals	0.017	0.023	992	0.017	0.022	964	---
LB – Municipal Hospitals	0.016	0.022	992	0.015	0.020	964	---
Prenatal Appointments (Below suggested)	0.127	0.196	992	0.130	0.195	964	---
Preterm (Municipal Hospitals)	0.020	0.030	992	0.019	0.029	964	---
Induced Labor (Municipal Hospitals)	0.016	0.039	964	0.016	0.039	936	---
C-section (Municipal Hospitals)	0.096	0.154	992	0.089	0.144	964	---
Vaginal births (Municipal Hospitals)	0.164	0.228	992	0.169	0.226	964	---
Covariates							
Mayor (Female)	0.057	0.232	1276	0.101***	0.302	1244	-0.052 (0.044)
Mayor (White)	0.242	0.428	1276	0.189**	0.392	1244	-0.033 (0.065)
Mayor (Married)	0.783	0.412	1276	0.752*	0.432	1244	0.053 (0.064)
Mayor (Higher Education)	0.995***	0.068	1276	0.490	0.500	1244	0.522*** (0.054)
% of rural population	0.350	0.213	822	0.341	0.210	849	0.004 (0.037)
GDP per capita	9,851.945	12,607.59	825	9,219.641	13221.07	854	554.4 (3656)
% of treated water	0.760	0.237	823	0.762	0.233	855	0.005 (0.028)
% of treated sewage	0.114	0.136	823	0.125*	0.143	855	-0.037 (0.025)
Physician vs Higher Education	0.491	0.500	1276	0.490	0.500	1244	-0.014 (0.076)
Higher vs Higher Education	0.507	0.500	1276	0.511	0.500	1244	0.015 (0.075)
The 2008 election	0.206	0.405	1276	0.240**	0.427	1244	-0.036 (0.076)
The 2012 election	0.179	0.384	1276	0.182	0.386	1244	0.057 (0.083)
The 2016 election	0.181	0.385	1276	0.140***	0.347	1244	-0.027 (0.069)

Table 3: Main effects of physician mayors on low birthweight

	Non-parametric RD									
	Dependent Variable:	**Low birthweight**								
	Previous to 2008	Posterior to 2008								
	First-degree	First-degree polynomial	Second-degree Polynomial	Third-degree polynomial	Fourth-degree Polynomial	First-degree polynomial - Different fixed bandwidths				First-degree polynomial (with covariates)
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Physician Mayor	**0.002**	**0.008****	**0.008****	**0.008***	**0.009***	**0.009***	**0.008****	**0.008*****	**0.007*****	**0.010*****
	(0.003)	**(0.003)**	**(0.003)**	**(0.004)**	**(0.005)**	**(0.005)**	**(0.004)**	**(0.003)**	**(0.003)**	**(0.003)**
P-value	***0.528***	***0.011***	***0.019***	***0.056***	***0.073***	***0.059***	***0.024***	***0.010***	***0.009***	***0.002***
Observations	1297	1400	1400	1400	1400	1400	1400	1400	1400	1400
Effective obs.	966	903	1177	1151	1226	613	1010	1180	1263	886
Bandwidth	0.219	0.166	0.298	0.279	0.349	0.100	0.200	0.300	0.400	0.161

Notes: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014); 2) Robust standard errors clustered at the municipal level; 3) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round (Fujiwara, 2011); 4) Previous 2008 considers the 2005-2008 term; 5) Posterior 2008 considers the terms 2009-2012, 2013-2016 and 2017-2020.

Table 4: Effects of physician mayors on low birthweight – Management Skills

	Non-parametric RD			
	Dependent Variable:	**Low birthweight**		
	Physician candidates with graduate studies Versus		Physician candidates without graduate studies versus	
	non-physician candidates			
	With graduate studies	With or without graduate studies	With graduate studies	With or without graduate studies
	[1]	[2]	[3]	[4]
Physician Mayor	**0.001**	**0.006**	**0.015*****	**0.015*****
	(0.008)	**(0.005)**	**(0.006)**	**(0.006)**
P-value	***0.855***	***0.173***	***0.009***	***0.009***
Observations	250	705	745	805
Effective obs.	167	486	392	423
Bandwidth	0.186	0.185	0.118	0.117

Notes: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014); 2) Robust standard errors clustered at the municipal level; 3) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round (Fujiwara, 2011); 4) Columns 1-6 consider the terms 2009-2012 and 2013-2016.

Table 5: Effects of physician mayors on health expenses – Considering physician level of education

	Non-parametric RD						
	Posterior to 2012						
	Dependent Variable: ***Expenditure on***						
	Health (General)	Basic Attention	Medium and High Complexity	Prophylactic Support	Sanitary	Epidemiology	Others
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Physician Mayor	**$-6.5x10^6$ ***	**$-6.6x10^5$**	**$-5.2x10^6$****	**$-2.2x10^5$***	**$4.2x10^4$**	**$-1.8x10^5$**	**$8.7x10^4$**
	($3.8x10^6$)	**($1.7x10^6$)**	**($2.3x10^6$)**	**($1.2x10^5$)**	**($8.9x10^4$)**	**($1.3x10^5$)**	**($9.6x10^5$)**
P-value	***0.091***	***0.694***	***0.026***	***0.064***	***0.639***	***0.165***	***0.928***
Observations	860	858	858	858	858	858	858
Effective obs.	401	543	339	364	552	342	586
Bandwidth	0.106	0.159	0.087	0.095	0.163	0.087	0.181

Notes: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014); 2) Robust standard errors clustered at the municipal level; 3) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round (Fujiwara, 2011); 4) Posterior 2012 considers the terms 2013-2016 and 2017-2020 (due to lack of expenditure data prior to 2012).

Table 6: Effects of physician mayors on health expenses – Considering physician level of education

	Non-parametric RD													
	Posterior to 2012													
	Dependent Variable: ***Expenditure on***													
	Health (General)		Basic Attention		Medium and High Complexity		Prophylactic Support		Sanitary		Epidemiology		Others	
	Physician Level of Education													
	With graduate course	Without graduate course	With graduate course	Without graduate course	With graduate course	Without graduate course	With graduate course	Without graduate course	With graduate course	Without graduate course	With graduate course	Without graduate course	With graduate course	Without graduate course
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
Physician Mayor	**$-6.1x10^6$**	**$-6.6x10^6$***	**$-1.1x10^5$**	**$-9.1x10^5$**	**$-4.5x10^6$**	**$-5.4x10^6$****	**$-1.2x10^5$**	**$-2.5x10^5$****	**$-6.6x10^4$**	**$7.6x10^4$**	**$-4.0x10^4$**	**$-2.4x10^5$***	**$-4.7x10^5$**	**$1.7x10^5$**
	($5.2x10^6$)	**($4.1x10^6$)**	**($2.2x10^6$)**	**($1.8x10^6$)**	**($3.0x10^6$)**	**($2.4x10^6$)**	**($1.6x10^5$)**	**($1.2x10^5$)**	**($7.3x10^4$)**	**($1.1x10^5$)**	**($1.9x10^5$)**	**($1.5x10^5$)**	**($1.4x10^6$)**	**($8.0x10^5$)**
P-value	***0.243***	***0.103***	***0.961***	***0.613***	***0.131***	***0.022***	***0.465***	***0.029***	***0.368***	***0.482***	***0.837***	***0.109***	***0.734***	***0.827***
Observations	507	753	507	751	507	751	507	751	507	751	507	751	507	751
Effective obs.	239	358	330	487	208	318	190	332	248	531	262	298	246	589
Bandwidth	0.100	0.110	0.159	0.162	0.085	0.097	0.075	0.101	0.104	0.189	0.111	0.090	0.103	0.827

Notes: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014); 2) Robust standard errors clustered at the municipal level; 3) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round (Fujiwara, 2011); 4) Posterior 2012 considers the terms 2013-2016 and 2017-2020 (due to lack of expenditure data prior to 2012).

Table 7: Effects of physician mayors on low birthweight – Physicians in activity in the municipality

	Non-parametric RD				
	Posterior to 2008/2012				
	Dependent Variable:				
	Number of Physicians	**Physicians rate (Number of physicians / 1000 inhabitants)**	**Physicians rate (Considering Worked Hours)**	**Low birthweight**	
				Physicians rate – Above median	**Physicians rate – Below median**
	[1]	[2]	[3]	[4]	[5]
Physician Mayor	**-5.328**	**-0.012**	**-0.199**	**0.002**	**0.015*** **
	(9.503)	**(0.088)**	**(0.130)**	**(0.004)**	**(0.005)**
P-value	***0.575***	***0.888***	***0.125***	***0.582***	***0.006***
Number of observations	1420	1420	860	746	652
Effective number of observations	945	994	476	532	356
Considered bandwidth	0.176	0.187	0.131	0.212	0.119

Notes: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014); 2) Robust standard errors clustered at the municipal level; 3) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round (Fujiwara, 2011); 4) Posterior 2008 considers the terms 2009-2012, 2012-2016 and 2017-2020. Column 3 presents results Posterior to 2012 due to data limitation.

Table 8: Effects of physician mayors on low birthweight – Physicians in activity in the municipality

	Non-parametric RD					
	Posterior to 2008/2012					
	Dependent Variable:					
	Number of Physicians		**Physicians rate (Number of physicians / 1000 inhabitants)**		**Physicians rate (Considering Worked Hours)**	
	Elected Physician Level of Education					
	With Undergraduate Course	Without Undergraduate Course	With Undergraduate Course	Without Undergraduate Course	With Undergraduate Course	Without Undergraduate Course
	[1]	[2]		[3]	[4]	[5]
Physician Mayor	**5.615**	**-10.811**	**-0.005**	**-0.020**	**-0.254**	**-0.204***
	(12.727)	**(10.111)**	**(0.117)**	**(0.100)**	**(0.222)**	**(0.125)**
P-value	***0.659***	***0.285***	***0.285***	***0.842***	***0.253***	***0.104***
Number of observations	894	1223	894	1223	507	753
Effective number of observations	632	800	636	817	262	436
Considered bandwidth	0.190	0.168	0.193	0.174	0.253	0.142

Notes: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014); 2) Robust standard errors clustered at the municipal level; 3) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round (Fujiwara, 2011); 4) Posterior 2008 considers the terms 2009-2012, 2012-2016 and 2017-2020. Column 3 presents results Posterior to 2012 due to data limitation.

Table 9: Effects of physician mayors on low birthweight considering different types of hospitals

	Non-parametric RD			
	Posterior to 2008 *Dependent Variable:* **Low birthweight**			
	Private Hospital	Federal Hospital	State Hospital	Municipal Hospital
	[1]	[2]	[3]	[4]
Physician Mayor	**-0.006** **(0.006)**	**-0.002** **(0.001)**	**0.005** **(0.004)**	**0.008**** **(0.004)**
P-value	***0.327***	***0.124***	***0.168***	***0.023***
Number of observations	1400	1400	1400	1400
Effective number of observations	763	772	990	772
Considered bandwidth	0.130	0.131	0.192	0.131

Notes: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014); 2) Robust standard errors clustered at the municipal level; 3) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round (Fujiwara, 2011); 4) Posterior 2008 considers the terms 2009-2012, 2012-2016 and 2017-2020.

Table 10: Effects of physician mayors on birth characteristics / modes of delivery

	Non-parametric RD				
	Posterior to 2008 *Dependent Variable:*				
	Prenatal appointments (below recommended)	**Preterm birth**	**Induced Labor**	**C-section birth**	**Vaginal birth**
	[1]	[2]	[3]	[4]	[**5**]
Physician Mayor	**0.031** **(0.027)**	**0.004** **(0.005)**	**0.004** **(0.008)**	**0.079***** **(0.030)**	**0.002** **(0.031)**
P-value	***0.244***	***0.387***	***0.603***	***0.009***	***0.941***
Number of observations	1400	1400	1344	1400	1400
Effective number of observations	895	984	949	825	1094
Considered bandwidth	0.163	0.190	0.189	0.145	0.250

Notes: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014); 2) Robust standard errors clustered at the municipal level; 3) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round (Fujiwara, 2011); 4) Posterior 2008 considers the terms 2009-2012, 2013-2016 and 2017-2020.