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Evolution of the structure and results of Primary Health Care in Brazil between 2008 and 2019

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Abstract *This paper describes the structure and results of Primary Health Care (PHC) in Brazil between 2008 and 2019. The medians of the following variables were calculated: PHC spending per inhabitant covered, PHC coverage, and rates of mortality and hospitalizations due to primary care sensitive conditions (PCSC), in 5,565 Brazilian municipalities stratified according to population size and quintile of the Brazilian Deprivation Index (IBP), and the median trend in the period was analyzed. There was a 12% increase in median PHC spending. PHC coverage expanded, with 3,168 municipalities presenting 100% coverage in 2019, compared to 2,632 in 2008. The median rates of PCSC mortality and hospitalizations increased 0.2% and decreased 44.9%, respectively. PHC spending was lower in municipalities with greater socioeconomic deprivation. The bigger the population and the better the socioeconomic conditions were in the municipalities, the lower the PHC coverage. The greater the socioeconomic deprivation was in the municipalities, the higher the median PCSC mortality rates. This study showed that the evolution of PHC was heterogeneous and is associated both with the population size and with the socioeconomic conditions of the municipalities.*

Key words *Primary Health Care, Structure of services, Morbimortality, Health financing, Health services coverage*

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Introduction

Primary health care (PHC) is recognized as one of the most effective strategies in reducing deaths and hospitalizations due to various grievances and diseases, particularly chronic non-communicable diseases in the adult population[1-6]. Since the 1960s, PHC has been adopted by various countries with different conformations, depending on the political objectives and the balance of power between the actors with decision-making power, serving both to provide simplified and low-efficacy services, called "selective PHC," and to coordinate care networks, guaranteeing the provision of adequate services for health needs. The networks coordinated by PHC encompass a broad set of actions and individual, family, and collective health services that involve promotion, prevention, protection, diagnosis, treatment, rehabilitation, damage reduction, palliative care, and health monitoring[7], with the potential to provide greater access to the health system as well as to modify the curative, individual, and hospital focus traditionally instituted in national health systems, in an integrative, collective, territorialized, and democratic care model[8].

In Brazil, according to the National Basic Health Policy (NBHP)[7], PHC should be developed through integrated care practices and qualified management, carried out by a multi-professional team and directed at the population in a defined territory, for which the teams assume health care responsibility. It has been developed on a large scale in the country since the 1990s, with emphasis on the Family Health Program, established in 1994, and later modified, in 2006, to the Family Health Strategy (FHS), as a strategy for changing the care model[9].

Since then, PHC has expanded in Brazil and in 2019 it was already present in 99.7% of Brazilian municipalities[10]. Teixeira *et al.*[11] characterized the Brazilian Unified Health System (SUS) as a permanent arena of conflicts, confrontations, negotiations, and pacts, in which attempts are made at organizing health policies. This characterization helps us to understand two fundamental points: (a) the expansion of PHC has not occurred homogenously in the whole of the national territory, despite its massive presence in the municipalities, which may have generated different PHC models in the various Brazilian municipalities, in turn diversifying the structure used and the results achieved in each location; (b) the consolidation of PHC has been a result of the implementation of a wide range of policies, which for almost two decades have shaped a national context of advances, but since 2017, with the new NBHP, fiscal austerity measures of the federal government and other measures in the organization of PHC (changes in the financing modality, shape of the health teams, and proposals for privatizing the services) have configured a set of regressions that threaten the advances achieved, as they affect the constitutive aspects of PHC, especially the organization of a community and territorial base and the constitution of multi-professional health teams[12,13].

Therefore, examining the evolution of PHC as a public policy, observing its structure (in terms of financing and population coverage) and its results (in terms of impact on the population's state of health) in the Brazilian municipalities may enable a better understanding of its diverse reality, also identifying its strengths and weaknesses. Thus, the objectives of this study are to describe the evolution of these dimensions of PHC in the country from 2008 to 2019 and to identify the differences, in this evolution, between groups of municipalities, according to population size and socioeconomic deprivation conditions.

Methodology

To achieve these objectives, we conducted a descriptive study with a data set relating to the structure and results of PHC in Brazil in the period from 2008 to 2019. We used as a reference a logical model for evaluating PHC performance, proposed by a set of researchers from Australia, Canada, and Switzerland[14] and published in 2021, which synthesized the main explanatory logical models for evaluating PHC performance.

The aforementioned model mapped four different and complementary key domains present in all the other models: needs of the population, organization and structure of PHC practices, provision of PHC services, and health results of the users and population.

To evaluate the evolution of the key domain of organization and structure of PHC, we chose as variables the PHC spending per inhabitant covered and PHC coverage, representing the funds invested and the human resources allocated, respectively. The choice of spending per inhabitant covered is based on the finding of its direct relationship with the percentage of PHC coverage. Using the covered population and not the total population of the municipality is a way of specifying PHC spending, mitigating any pos-

sible selection bias regarding municipalities with different coverage profiles.

As variables of the key domain of health results of the users and population, we chose the rates of mortality and hospitalizations from the list of primary care sensitive conditions (PCSC), defined by Ordinance No. 221 of April 17th of 2008 of the Ministry of Health[15].

Also according to the adopted logical model[14], there are other variables from the domain of organization and structure, such as: governance models, vision, values, information systems, inputs, equipment, workforce training, and others. And there are others from the domain of health results of the users and population, such as: quality of life, wellbeing (perceived), functional status, resilience, empowerment, and others. However, given the lack of data that could serve at least as proxies for these variables for the Brazilian municipalities in the period from 2008 to 2019, in this study the analysis had to be directed to some aspects of the structure (financing and human resources) and the results (PCSC mortality and hospitalizations), which represents a limitation of the scope of the domains analyzed.

Given the major heterogeneity of the age composition of the populations of the Brazilian municipalities and due to the recognized effect of this composition over morbimortality[16], the rates were standardized, considering as a reference the age pattern of the country.

The PHC coverage data were collected on the *e-Gestor Atenção Básica* web portal of the Ministry of Health, through the publicly-accessible report of the coverage record for the Brazilian municipalities. The MH defined a new formula for calculating the PHC population coverage estimate, considering parametrized data from the PHC teams, Basic Health Care teams, and FHS teams. These data are only available for after July of 2007, therefore 2008 was considered as the starting date for the analysis of this study. The data relating to PHC spending per covered inhabitant were collected using the Public Health Budget Information System (SIOPS), considering the net values in the basic care subfunction, which were deflated for current 2019 values. Next, these values were divided by the estimated population covered by PHC in each municipality in each year.

The morbimortality data were collected in the Mortality Information System (SIM) and in the Hospitalizations Information System (SIH), both available for public access through the web portal of the Informatics Department of the SUS (DATASUS)[10].

Some studies[16-18] show that infant mortality can have different determinants from adult mortality. Therefore, in an attempt to avoid selection bias, we decided to limit the scope of the mortality and hospitalizations data of this study to adults.

Although the quality of the deaths and hospitalizations records has improved in the last 20 years, high proportions of deaths from unclear causes are frequent in Brazil and concerning, as they indicate problems of access to and quality of the health care received by the population[19], as well as compromising the reliability of the statistics on mortality by causes[20,21].

Some studies[22-24] show that in low-income locations access to diagnostic and therapeutic support services is lower, which can generate a higher number of recorded deaths from unclear causes, underestimating PCSC mortality. Therefore, the method developed by Cavalini and Ponce de Leon[25] was used to correct both under-reporting and unclear causes. In short, the deaths with unclear causes were redistributed, considering weighted criteria of information quality, adapted from Szwarcwald *et al.*[26].

To identify the differences in the evolution of the municipalities, in relation to their various social, economic, and demographic characteristics, they were stratified according to population size, defined by the Brazilian Institute of Geography and Statistics (IBGE), according to number of inhabitants: up to 5000; from 5000 to 10,000; from 10,001 to 20,000; from 20,001 to 50,000; from 50,001 to 100,000; from 100,001 to 500,000; and over 500,001. In relation to the social and economic characteristics, in turn, the Brazilian Deprivation Index (IBP) was used, developed by researchers from the Center for Integration of Data and Knowledge for Health (Cidacs/Fiocruz Bahia) and the University of Glasgow, in Scotland, within the Social Policy & Health Inequalities (SPHI)[27] project, which considers, based on the 2010 Demographic Census, the following indicators: the percentage of households with an income per capita under ½ a minimum wage; the percentage of illiterate people aged equal to or older than seven years old; and the percentage of households with inadequate access to basic sanitation and without piped water, refuse collection, a toilet, and a bathroom in the household. Based on these indicators, the IBP stratifies the municipalities into five quintiles, weighted by population: very low (Q1); low (Q2); medium (Q3); high (Q4); and very high (Q5). In short, each quintile of the IBP contains 20% of

the Brazilian population and the higher the IBP is, the worse the socioeconomic conditions of the municipality.

The medians of the structure and results indicators for each quintile of the IBP in each stratum of population size were calculated for each year between 2008 and 2019. The choice of the median and not the mean aims to reduce the effect of possible outliers derived from data-recording problems. Municipalities with missing or unreported values were removed from the analysis for that year and variable in particular. Municipalities without an IBP classification (as they were created after 2010) were removed from the analysis. Graphs were built with the description of the evolution of these indicators by IBP in each population size and a trend curve per population stratum, calculated using the "loess" method, which considers an ordinary least squares local polynomial regression adjustment. This choice enables the visualization of the trend curve of the median of each indicator in the period analyzed.

Results

In Brazil, between 2008 and 2019, there was an increase in the median of the two structure indicators, particularly municipal PHC spending per covered inhabitant, which increased 12.1% between 2008 and 2019. The median PHC coverage also rose from 98.8% in 2008 to 100% in 2019, therefore more than half of the Brazilian municipalities have 100% PHC coverage (there were 2,632 municipalities in 2008 and 3,168 in 2019) (Table 1).

With regard to the indicators of health results of the users and population, there was a small increase of 0.2% in the median age-standardized mortality rate, with correction for PCSC under-reporting between 2008 and 2019. In relation to hospitalizations, in turn, there was a reduction of more than 44.9% in the median in the same period (Table 1).

Analyzing the distribution of Brazilian municipalities according to population size and IBP classification, it is perceived that 74.3% of the municipalities are classified as having very high (Q5) or high (Q4) socioeconomic deprivation. Among the municipalities with a very high IBP (Q5), 70.5% are municipalities with a population of up to 20,000 inhabitants. It warrants mentioning that no municipality with a population greater than 500,000 inhabitants is classified as having a very high IBP (Q5). For municipalities with fewer than 100,000 inhabitants, the higher the population size is, the lower the proportion of municipalities with a high IBP.

In relation to the median municipal PHC spending per covered inhabitant, in the period from 2008 to 2019, according to population size and IBP classification, it was observed that the lower the population size was of the municipalities, the higher the median PHC spending in the period, particularly for the municipalities with fewer than 5,000 inhabitants, which presented a median value of R$ 698.36 per covered inhabitant in 2008 and R$ 944.89 in 2019. However, depending on the IBP of these municipalities, PHC investment was different in the same period. There is a difference in the median PHC spending per covered inhabitant for municipalities with fewer than 5,000 inhabitants, of R$ 387.13 in 2008 and R$ 489.72 in 2019, when we compare municipalities with a very low (Q1) and very high (Q5) IBP, with it being noted that PHC spending per covered inhabitant is lower in locations with greater socioeconomic deprivation (Figure 1).

For municipalities with 20,000 or fewer inhabitants, there was an increase in the median PHC spending per covered inhabitant independently of the IBP classification between 2008 and 2019. Municipalities with 20,000 or more inhabitants, in turn, presented a different behavior, with a reduction in the median PHC spending. It is perceived that this reduction was greater among the municipalities with a very low (Q1) and low (Q2) IBP, with municipalities with a high (Q4) and very high (Q5) IBP presenting a certain level of stability in spending per covered inhabitant (Figure 1).

Also regarding PHC spending, the median trend curve was also different depending on the population size, indicating a change in trend after 2015. For municipalities with fewer than 5,000 inhabitants, there was a reduction in the slope of the curve, indicating a decrease in the intensity of the increase in annual PHC spending. In municipalities with more than 20,000 inhabitants, in turn, a change in the direction of the trend curve could be perceived, indicating a reduction in annual PHC spending per covered inhabitant (Figure 1).

In relation to PHC coverage by population size and IBP classification, there was an increase in the median coverage between 2008 and 2019 for the municipalities with more than 10,000 inhabitants, as the municipalities with fewer than 10,000 mostly presented 100% coverage in 2008. However, analyzing the evolution according to

Table 1. Description of the structure and results of Primary Health Care in Brazilian municipalities in 2008 and 2019.

Variables	Year	n	Average	Median	SD	Min	Max
Structure							
Expenses with APS per covered inhabitant* R$	2008	4,984	522.02	405.47	1,051.04	0.00	52,275.56
	2019	5,495	577.87	454.84	494.69	0.29	11,466.82
PHC coverage	2008	5,564	83.54	98.88	24.98	0.00	100.00
	2019	5,565	92.21	100.00	15.32	0.00	100.00
Results							
PCSC mortality rate**	2008	5,562	119.68	116.00	63.33	0.00	622.92
	2019	5,565	120.42	116.31	59.59	0.00	564.76
PCSC hospitalization rate**	2008	5,562	1,452.45	1,215.54	1,055.47	0.00	12,726.06
	2019	5,565	1,082.28	838.59	896.89	0.00	16,555.50

*Population covered = population x percentage of PHC coverage. **Rate per 100,000 inhabitants, standardized by age, with correction for underreporting.

Source: Authors.

IBP, the median coverage of the municipalities with a very high (Q5) and high (Q4) IBP was greater in the period compared with those with a low (Q2) and very low (Q1) IBP. This difference in the median PHC coverage according to IBP is more evident in municipalities with more than 20,000 inhabitants. Finally, it warrants mentioning that, despite the increase, the greater the population size and the better the socioeconomic conditions of the municipalities were, the lower the PHC coverage (Figure 2).

Figure 3 presents the median municipal PCSC mortality rate, according to population size and IBP classification. The greater the socioeconomic deprivation was of the municipalities, the higher the median PCSC mortality rates, independently of population size. While the median rate was 122.38 PCSC deaths per 100,000 inhabitants in 2019 for the municipalities with a very high (Q5) IBP, it was 90.39 in the municipalities with a very low (Q1) IBP, without considering population size.

Considering the deprivation conditions, there is a noticeable change in the median trend curve for the municipalities with a very high (Q5) and high (Q4) IBP also after 2015, similarly to the one identified in PHC spending. In municipalities with a very high IBP (Q5) and with fewer than 50,000 inhabitants, the mortality rate decreased between 2008 and 2014 (95.8 in 2008 and 88.9 in 2014), followed by an increase between 2014 and 2019, reaching 108.5 in 2019. A similar situation was verified in the municipalities with a high (Q4) and very high (Q5) IBP and with fewer than 50,000 inhabitants (Figure 3).

Figure 4 presents the median rate of municipal PCSC hospitalizations according to population size and IBP classification. In general, the median PCSC hospitalization rates decreased between 2008 and 2019 for all strata of municipalities with a population below 500,000 inhabitants. Municipalities with fewer than 5,000 inhabitants had a median rate of PCSC hospitalizations in 2019 of 793.90 per 100,000 inhabitants, while municipalities with between 5,000 and 10,000 and between 10,000 and 20,000 presented rates of 753.98 and 907.57, respectively. The stratum that in 2019 presented the highest median rate (994.24) was that of municipalities with a population between 20,000 and 50,000 inhabitants.

Analyzing the median rate of PCSC hospitalizations, according to IBP classification, it was noted that the quintiles of municipalities with the greatest deprivation presented a higher median rate, with the exception of those with a very high IBP (Q5). In general, this fact was also verified within all the strata by population size, in which the median rate of hospitalizations was higher in municipalities with greater socioeconomic deprivation. In the strata from 50,000 to 100,000 and from 100,000 to 500,000 inhabitants, the municipalities with a very high IBP (Q5) present the highest median rate of PCSC hospitalizations (Figure 4).

In relation to the trend curve for the median rate of hospitalizations, there was no inversion of

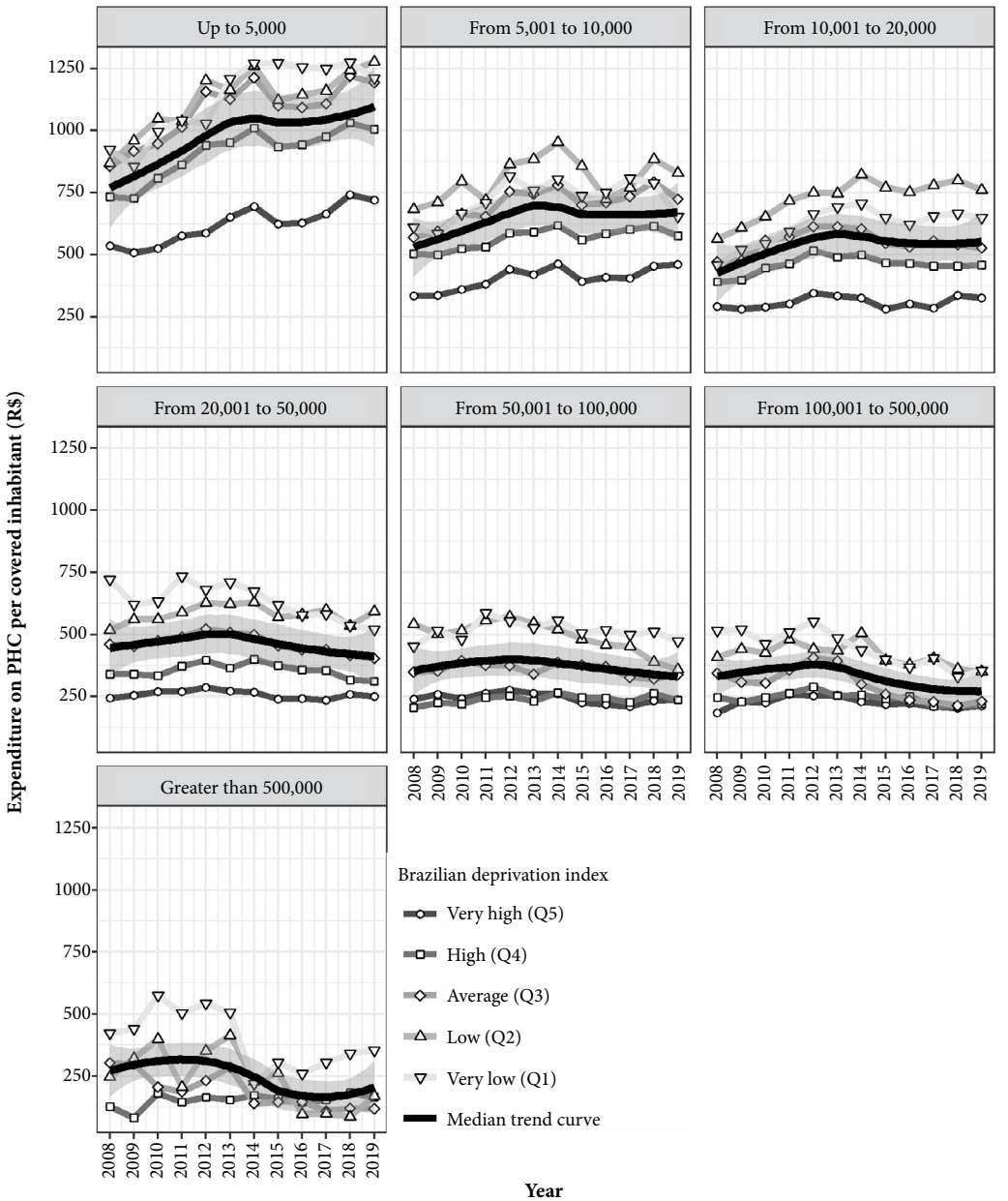

Figure 1. Median municipal expenditure on PHC[1] by population size and socio-economic deprivation of the municipality. Brazil, 2008-2019.

[1] Expenditure per inhabitant covered.

Source: SIOPS/MS.

trend in any of the strata with a population below 500,000 inhabitants and it generally continued to decrease. For the municipalities from the strata with a population between 50,000 and 100,000 and between 100,000 and 500,000 inhabitants, a slight change in the slope of the curve was noted also after 2015 and there was an inversion of the trend (it was increasing up to 2014 and decreasing between 2014 and 2019) for municipalities with more than 500,000 inhabitants (Figure 4).

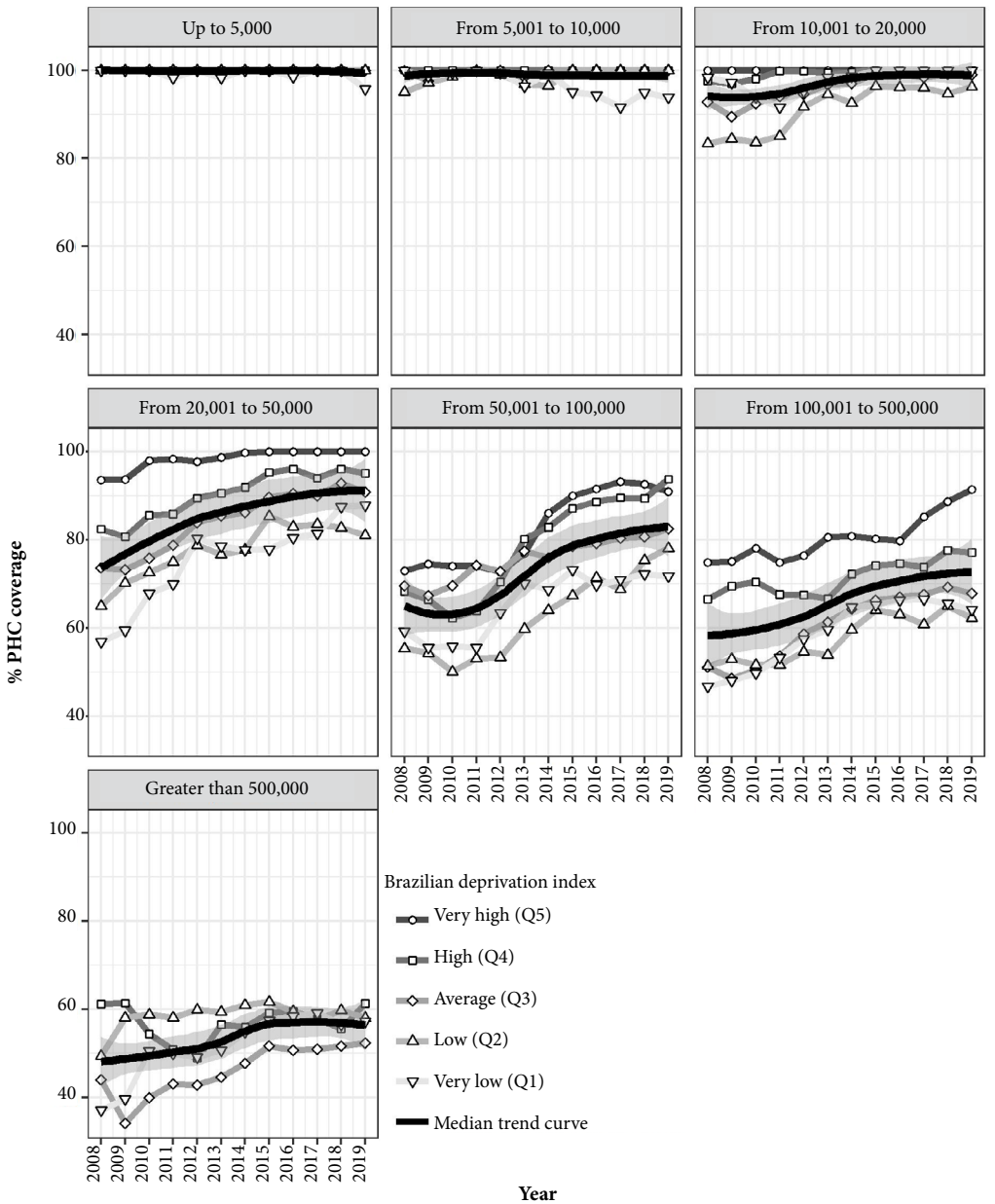

Figure 2. Median municipal coverage of PHC by population size and socioeconomic deprivation on the municipality. Brazil, 2008-2019.

Source: e-Gestor AB/MS.

Discussion

The results of this study showed that the evolution of PHC, whether in the structure or results, was different depending on the population size and level of socioeconomic deprivation of the Brazilian municipalities.

These differences reinforced the hypothesis that socioeconomic deprivation has an effect over the level of PHC investment in Brazilian municipalities. Some studies[28,29] have indicated that certain mechanisms established at the end of the 1990s and beginning of 2000, such as the fixed and variable Basic Healthcare Package

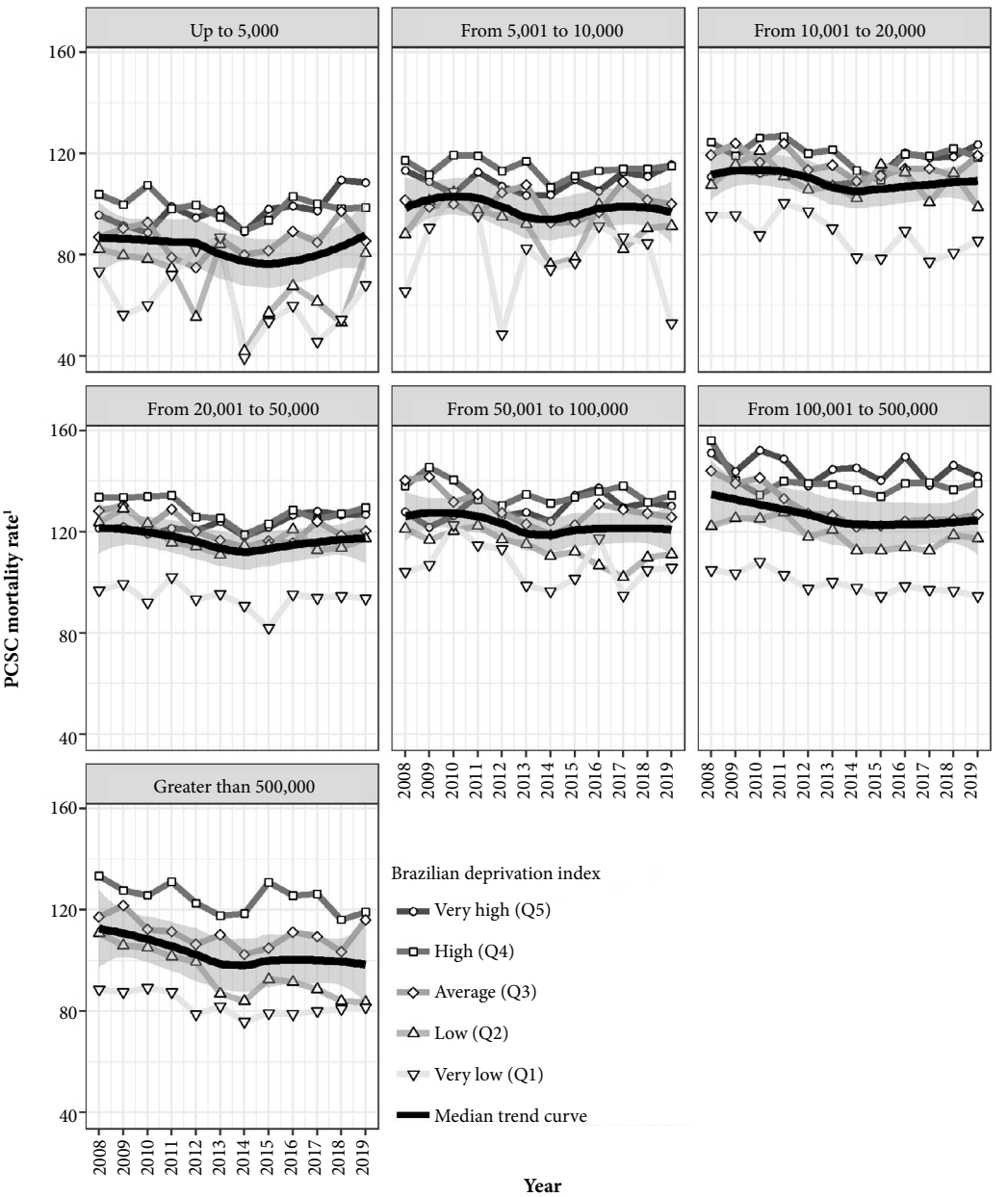

Figure 3. Median mortality rate from municipal PCSC according to population size and socioeconomic deprivation of the municipality. Brazil, 2008-2019.

[1]Age standardized rate, corrected for underreporting and ill-defined causes.

Source: SIM/MS.

(PAB), the financial limit on medium and high complexity, and the Strategic Actions and Compensations Fund (FAEC), were responsible for mitigating the differences in the distribution of resources per capital between the macroregions of the country. However, as shown in this study, which analyzed other variables relating to the municipalities, population size and deprivation level were municipal characteristics associated with inequality in PHC investment in Brazil.

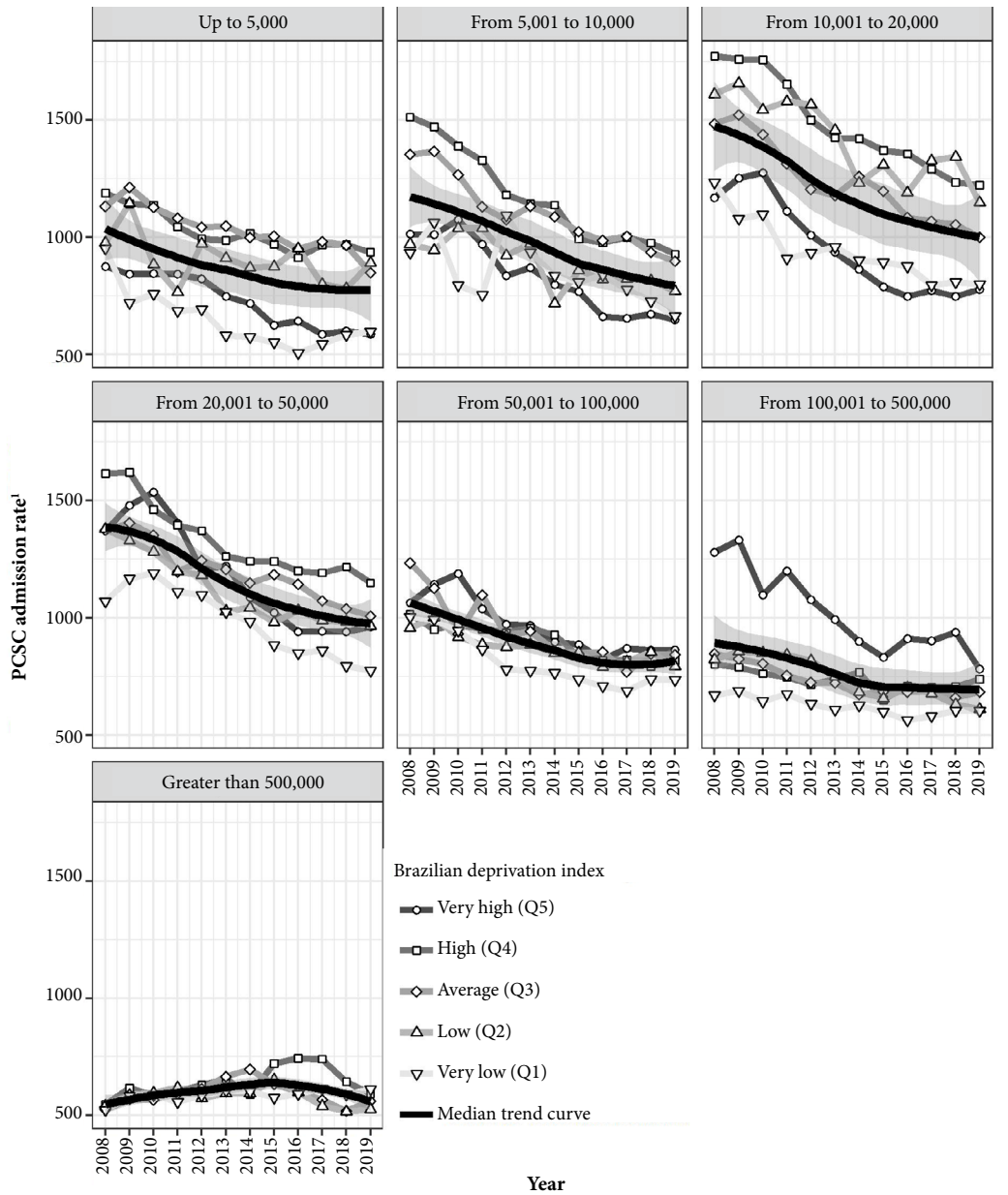

Figura 4. Median rate of hospitalizations for municipal PCSC according to population size and socioeconomic deprivation of the municipality. Brazil, 2008-2019.

[1] Age standardized rate, corrected for underreporting and ill-defined causes.

Source: SIH/MS.

One of the hypotheses regarding investment concerns the level of taxes raised and the constitutional transfers received by the municipalities. By carrying out an ordinary least squares regression of tax revenue and constitutional transfers per capita (obtained based on the time series of municipal indicators from the SIOPS) as an independent variable and PHC spending by covered

population as a dependent variable, the variation in the former explained 52% (R^2) of the variation in the latter. In other words, on average, a R$ 1 increase per capita in taxes and constitutional transfers in the municipalities between 2008 and 2019 may have implied a 17 *centavos* increase in PHC spending by covered population. The variation in the IBP, in turn, explained approximately 14% of the variation in tax revenue and constitutional transfers; therefore, a one unit increase in the IBP may have implied an average reduction of R$ 550.66 per capita in tax revenue and constitutional transfers.

When studying Brazilian tax federalism, Lima[30] highlighted the strength of the Union and of the political, economic, and local-regional interests represented by it and the weakness of the subnational spheres and their administrative machines. He concludes that there are no guarantees for the provision of a set of common services and benefits to the citizens in the different regions of the country and the decision-making autonomy of the subnational entities, which is restricted, inhibits regional adequacy in the destination of tax resources.

This study suggests that one of the potential ways of correcting part of this inequality in PHC spending by covered population lies in changing the Brazilian taxation process, reducing the regional inequality by primarily considering socioeconomic deprivation criteria and thus mitigating the impact of the productive and commercial capacity of the municipalities in tax revenue and in the receipt of constitutional transfers, which in turn could produce an effect over investment in public policies, such as in the health actions and services provided by PHC.

Analyzing the median trend, it was possible to identify a change in the curve after 2015, whether in PHC spending per inhabitant covered or in the PCSC mortality rate. The methodology of this study does not enable us to identify the statistical significance of a change of trend or level in the periods before and after 2015 between the municipalities. Despite this limitation, it warrants mentioning that, in 2015, the country entered into an economic recession with the recording of a negative gross domestic product, which also continued in 2016. Also in 2016, there was the impeachment of President Dilma Rousseff, who was substituted by Vice President Michel Temer, which implied significant changes in Brazilian economic and social policy, which assumed fiscal austerity as a government management guideline. The greatest example of this austerity policy was the approval of Constitutional Amendment 95 in 2016, which established a ceiling for the current expenditure of the Brazilian federal government for 20 years, correctly solely by inflation.

Various studies[31-35] indicate that worse income and educational conditions are related to higher general and PCSC mortality rates. In Brazil, there was an inversion of the falling trend in the number of people in extreme poverty and poverty after 2015. In fact, there was a 37% increase between 2015 and 2019, after a reduction of almost 60% between 2002 and 2014[36]. Other studies[37-43], focused on European countries, have already identified the relationship between a financial crisis, fiscal austerity, and the impact on the health situation of the population.

It is not possible with the methodology of this study to establish whether the fiscal austerity promoted after 2016 by the Temer government, and the current federal government, may have contributed to or even prolonged the economic crisis. However, given the indications identified in this study, it is suggested that other studies with specific methodologies could investigate the association between an economic crisis, increased poverty, and PCSC mortality. Given the comprehensive nature of the concept of PCSC, it is even possible that the results would be different between the 19 groups of causes that compose the PCSC list (e.g.: diseases preventable through immunization, pulmonary diseases, hypertension, prenatal or postpartum diseases, and others), which implies a new recommendation for an investigation by group.

Regarding coverage, an expansion was found in the municipal strata with a population above 20,000 inhabitants, through there was a reduction in the median PHC spending by covered population. Dialectically, two phenomena may provide clues as to the explanation of this reduction in spending. On the one hand, it is possible to conjecture an increase in technical efficiency in the use of the financial resources of PHC, with, for example, a reduction in resource waste based on technological advances that enable stock monitoring and more competitive procurement processes, among other actions, enabling the maintenance or even expansion of the provision of PHC actions and services, using fewer financial resources per covered population. On the other hand, and seemingly more feasible, the financial crisis starting in 2015 impacted the taxes raised and constitutional transfers of the municipalities, implying a contraction of the budget available for the functioning of PHC without meaning a re-

duction in coverage. Thus, an expansion is identified in the number of teams between 2008 and 2019, with a possible increase in access to PHC, combined with a lower allocation of financial resources to guarantee the structure needed for the adequate functioning of the PHC units.

This financial contraction may have influenced the functioning of the health units since fewer financial resources can imply fewer material and human resources and equipment, deficient maintenance of the physical structure of the units, and other elements that are determined by the budgetary availability for PHC in the municipalities. This budgetary limitation may create job insecurity in these units, with a possible effect over the work process exerted by the PHC professionals. Despite this possibility, it warrants mentioning that the fall in the median spending per covered population was small in most of the strata by population size, with a stronger effect in the quintiles of municipalities with a low (Q2) and very low (Q1) IBP.

One limitation of this study concerns the PHC spending per capital data being self-reported by the municipalities themselves, and so there may be a certain level of bias in the records derived from reporting errors (intentional or not).

Despite the results found regarding the PHC structure and results, between 2008 and 2019, the study design was descriptive, using the median of the values, according to population size and IBP classification. Therefore, various municipalities presented a different evolution of the PHC structure and results from the median, which implies that the median result found may not have occurred for a set of municipalities due to other specific factors not analyzed in this study.

Concluding remarks

Nonetheless, despite this limitation, central tendency measures are useful for composing the panorama of PHC for a set of Brazilian municipalities. This study highlighted that there was an expansion in the structure and part of the results (especially a reduction in PCSC hospitalizations). However, this evolution did not correct the strong inequality between the municipalities according to population size and socioeconomic deprivation conditions. Thus, PHC planning in Brazil needs to consider these different aspects of these municipalities as a weighting element, on the path to reducing the inequality of the structure and results of PHC among the Brazilian municipalities.

Collaborations

RD Barros: conception, planning, analysis, interpretation and writing of the work. LEPF Souza: planning, interpretation and writing of the work. R Aquino: interpretation and writing of the work. The authors approved the final version submitted.

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