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Spatial inequality in accessibility to ICU beds in Brazilian municipalities in the Covid-19 pandemic

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Abstract

Due to the emergence of Covid-19, healthcare systems around the world have come under severe pressure. This highly contagious new virus causes severe breathing problems that require quick admission to an intensive care unit (ICU). Thus, good accessibility to ICU beds is essential to minimize the number of deaths. This study analyzes the inequality of access to ICU beds among Brazilian municipalities. For this, the spatial Gini index is calculated, considering the age and gender of the population, the number and location of beds and the distance separating the population from these beds. The findings show that there are regional differences in accessibility, being more limited in the North and Northeast regions. These regions are relatively poorer, and the North region is also characterized by having municipalities with a large territorial area and low population density. This is the first study on this topic for the Brazilian case.

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1. Introduction

In the years 2020 and 2021, the world witnessed the peak of a pandemic caused by a new virus, COVID-19 (coronavirus), which caused the collapse of health systems around the world. The virus, highly contagious, has caused respiratory problems in infected people, especially in the elderly, leading to the need for hospitalization and intensive care to reverse the disease process.

According to WHO (2020b), COVID-19 has the capacity to infect people of all ages. However, two groups are being relatively more affected by the contamination of the virus: the elderly (over 60 years old) and people with comorbidities. The disease can be symptomatic, with the patient commonly experiencing a dry cough, fever and a sore throat. Often, patients progress to a more severe pneumonia, requiring hospitalization in Intensive Care Units, with the use of mechanical ventilation (Baptista & Fernandes, 2020). The crisis in the health system stems from the rapid spread of the virus and the long time required to recover those infected who need hospitalization.

According to the latest data from the World Health Organization (WHO), Italy has 34 beds per 10,000 inhabitants, while Spain has 30. Despite having relatively developed health infrastructures, these countries have suffered a crisis in the health system, being unable to attend to all the patients requiring intensive treatment, especially due to the lack of beds, ventilators, protective equipment and professionals to provide care. It is also worth noting that the health crisis was less pronounced due to the adoption of social isolation measures combined with the widespread testing among their respective populations.

There is considerable political pressure to reduce the hospital structure in different countries, due to the high economic cost of having and maintaining ICU beds (Mckee, 2004). In recent years, the average occupancy of ICU beds has been used to stipulate supply in the total number of beds in hospitals and other health units (Green, 2002). Health care managers usually underestimate the number of beds needed because they do not take into account patient flow and length of stay (McManus, Long, Cooper, & Litvak, 2004).

Brazil has a public health system, the Sistema Único de Saúde (SUS), which is shared between the union, states, and municipalities. Its strategic principles are universality, equity, and integrality. Its organizational guidelines are regionalization and decentralization of health actions and services to municipalities (municipalization). The articulation between regionalization and municipalization aims to guarantee coverage of the entire population with adequate health equipment and services. The distribution of these types of equipment and services follows a hierarchical system in which the most complex and less frequently used are more concentrated and the most basic are more spatially dispersed.

Some striking characteristics of Brazil are its large territorial extension, its highly concentrated urban structure, regional differences and profound socioeconomic inequalities. Thus, despite the principle of equity and its decentralized organizational structure, these characteristics make the Unified Health System (SUS) in Brazil find it difficult to universalize access to health services for the entire population, especially for more complex procedures and costly, such as admissions to intensive care units (Goldwasser *et al*. 2016).

In 2014, Brazil had 22 beds for every 10,000 inhabitants (WHO, 2020a). However, these treatment units were concentrated in certain regions of the country, mainly in the Southeast. A study carried out by the Brazilian Federation of Hospitals (Matarazzo, 2019), estimated the density of beds has been decreasing over the last few years, reaching a total of 19 beds per 10,000 inhabitants in 2019. It also reveals the distribution of hospitals by state does not follow the distribution of beds, pointing out that the North and Northeast regions have hospitals with few beds, that is, the health units are considered small (up to 50 beds).

Seeking to shed light on the problem of a possible shortage of ICU beds in Brazil as a result of health problems such as Covid-19, this study aims to analyze the inequality of people's accessibility to ICU beds in hospitals and other health facilities. For this purpose, measures of spatial accessibility (SAM) were used, taking into account the population of Brazilian municipalities, the number of ICU beds in each health institution, and the distance of these populations to the beds. Inequality was measured using the spatial Gini coefficient and graphical analysis between population groups and distance to beds. In addition, the implications of this inequality in relation to the number of confirmed cases and deaths from the coronavirus are analyzed.

One of the implications of the low accessibility to hospital beds, especially to ICU beds, is the increased number of deaths resulting from the disease due to lack of care which, therefore, could be avoided. Ensuring greater access makes expanding the health infrastructure that is essential for proper treatment even more important.

Over the past three years, several studies have been prepared with the inequality of accessibility to health services as their central research problem. This problem became more evident with the COVID-19 pandemic, given the need for quick care for infected people. The problem of accessibility is more important in countries with larger territorial dimensions, more concentrated urban structures, and socioeconomic inequalities, mainly in terms of income. This is the case in Brazil.

In a study applied to Florida/USA, Kim *et al*. (2022) examined temporal variations in the spatial accessibility of patients with Covid-19 to health resources to identify areas of low access and verify their socioeconomic and demographic characteristics. Using postal code data, they first identified spatial clusters of low accessibility and then estimated the chances of belonging to these clusters as a function of socioeconomic and demographic characteristics. The results indicated that rural areas and with greater participation of Latino or Hispanic people have less accessibility to health resources.

Park and Goldberg (2022) investigated the relationship between spatial accessibility to ICU beds and COVID-19 mortality rates. To do so, they analyzed spatial accessibility under the underlying uncertainties of bed availability and mobility in the greater Houston/Texas area. Based on supply and mobility, they used Monte Carlo simulation to measure accessibility to ICU beds, classifying areas into different degrees of accessibility. Finally, they investigated the relationship between accessibility measures and the COVID-19 case fatality rate. The results showed that there is adequate accessibility in central municipalities and inadequate in peripheral ones. They conclude that inadequate access to health care can cause higher COVID-19 mortality rates.

In a study carried out for the Illinois/USA region, Kang *et al*. (2020) measured the spatial accessibility of COVID-19 health resources. To do so, they used a rapid measurement method, first calculating the bed-to-population ratio for each hospital location and, second, summing these proportions in overlapping areas of homes and hospitals. With this, they were able to identify the geographic areas with a shortage of health resources. These areas have become priorities in actions to improve access, reducing the vulnerability of their population. The authors concluded that measuring inequalities in access to health services quickly made it possible to correct problems in a timely manner and save lives.

Bauer *et al*. (2020) studied the accessibility of ICU beds in 14 European countries and its impact on the lethality rate of COVID-19. They used an accessibility indicator given by the regional ratio of beds per 100,000 inhabitants and the distance to the nearest ICU. Results found national differences in levels of access to ICU beds. Correlation analysis revealed a negative correlation between ICU accessibility and COVID-19 deaths.

In an application for Brazil at the beginning of the pandemic, Palamim and Marson (2020) analyzed correlations between epidemiological and geographic variables and the number of ICU beds. The results showed a positive correlation between ICU beds/10,000 inhabitants and GDP and population density. The authors conclude that there are significant differences between Brazilian states in terms of the number of ICU beds and ICU beds/10,000 inhabitants and that only in some states, the number of ICU beds was above 1 to 3 per 10,000 inhabitants, the recommended number by the World Health Organization (WHO). Efforts to make beds available via field hospitals eased the problem.

Also for Brazil, Pereira *et al*. (2021) analyzed territorial inequalities in access to health during the COVID-19 pandemic. For this, they used high spatial resolution data from the 20 largest cities in Brazil and calculated network distance metrics to estimate vulnerable populations or those with low access to health facilities. Using a balanced floating catchment area indicator, they estimated spatial inequalities in access to hospitals with ICU beds and mechanical ventilators, considering the effects of traffic congestion. The results showed that there were spatial inequalities in access to health services during the pandemic and that the availability of ICU equipment varied between cities, being lower among black and poor communities.

This paper is structured as follows: Section 2 presents the data; Section 3 describes the methodology used; Section 4 shows and analyses the findings; and Section 5 offers some final remarks.

2. Data

This study used data provided by DATASUS (Brazilian Ministry of Health) and the Brazilian Institute of Geography and Statistics (IBGE). Information regarding the total population of municipalities for the year 2019 is from IBGE (IBGE, 2019). Information on the municipal population by age group and sex is also from the IBGE and corresponds to the year 2015, the last year available (IBGE, 2015). The number of ICU beds in health units (adult plus pediatric) is from the DATASUS and corresponds to the period of March 2020 (DATASUS, 2020).

The geographic coordinates of the municipalities were calculated by the centroids of their polygons. The geographic coordinates of health facilities with ICU beds were taken from the DATASUS (2020). Of a total of 2,197 establishments with ICU beds, only 10% had problems with missing or incorrect values. For these cases, the coordinates were obtained through geolocation using the QGIS software, using the addresses of the establishments. For a small number of cases, it was necessary to carry out a manual search via Google Maps to find the information.

The study data were organized into two different databases. The first was with information on the resident population, disaggregated by age groups and gender (Table A1), and the geographic coordinates of all municipalities in Brazil. The second base has information about the health units: the number of ICU beds in each unit (Table I, Table II, and Figure A1) and their geographic coordinates. Combining these two bases, it was possible to calculate the indicators of accessibility and unequal access to beds (Figure A2, Figure A3, and Table A2).

3. Methodology

The methodology adopted in this study is based on the work of Kalogirou (2017), where the Spatial Accessibility Measure (SAM), founded on gravitational theory, is used to assess the spatial accessibility to health services in Greece. We used the R software and the R-package SpatialAcc (Kalogirou, 2020b).

The SAM equation is provided in Kalogirou and Foley (2006), and can be described according to equation (1):

$$SAM_i = \sum_{j=1}^{k} \frac{n_j}{p_i d_{i,j}^{\beta}} \tag{1}$$

where: SAM_i is the measure of spatial accessibility in the municipality i, has higher values when accessibility to beds is greater; k is the total number of beds; n_j is the number of ICU beds in the facility; p_i is the population of the municipality i; $d_{i,j}$ is the distance between the facility j and the centroid of the municipality i; and β is the distance-decay parameter.

Spatial inequality is also calculated using the decomposition proposed in Rey and Smith (2013), by calculating and separating the Gini coefficient into two components: neighbors and non-neighbors. The neighborhood is defined by a matrix of spatial weights and the Gini is calculated using the R-package *lctools* (Kalogirou, 2020a), according to equation (2):

$$G = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{i,j}\left|SAM_i - SAM_j\right|}{2n^2 \frac{1}{n}\sum_{i=1}^{n} SAM_i} + \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}\left(1 - w_{i,j}\right)\left|SAM_i - SAM_j\right|}{2n^2 \frac{1}{n}\sum_{i=1}^{n} SAM_i} \tag{2}$$

where: $w_{i,j}$ are the spatial weights (1 for the neighbor observations and 0 for non-neighbor observations); and n is the number of observations. The closer the Gini is to 0, the greater the equality, the closer to 1, the greater the inequality.

The first component of the decomposition is related to the neighbors' Gini, close to 0 indicates a positive spatial correlation between the variables. In other words, there are spatial clusters between neighboring municipalities and the inequality is due to non-neighboring municipalities, the second component.

To assess whether inequality of access affects certain population strata differently, the distance between health facilities and population subgroups was computed, separated by age and gender. Graphical analysis of these results shows the cumulative proportion of these strata in relation to the distance to the nearest facility.

Finally, the result of the SAM was compared to the most recent data on contagion and deaths from Covid-19, in addition to hospitalizations and deaths from respiratory diseases, identifying where more ICU beds are needed to care for coronavirus patients.

4. Results analysis

The method used here takes into account four important aspects relevant to the theme of accessibility to ICU beds: the spatial location of the beds; of the people; population density; and the physical distance between the people and the beds. Considering Covid-19 issues, population density plays an important role in identifying where there is a high potential of contagion occurring at greater speed. On the other hand, the number of beds and the distance to the beds allows us to verify in which regions there is less capacity to deal with a large number of cases.

According to the IBGE population estimates for 2019, the population residing in Brazil, mostly occupies the Southeast and Northeast regions. Together, these two regions represent 69.21% of the Brazilian population. As we can see in Table I, they have the largest concentration of ICU beds.

Table I - Population and number of ICU beds, Brazil and Major Regions, 2019.

Variables	North	Northeast	Southeast	South	Midwest	Brazil
Population	18,430,980	57,071,654	88,371,433	29,975,984	16,297,074	210,147,125
Density (hab./km^2)	4.78	36.72	95.58	51.97	10.15	24.68
ICU beds	2,011	7,234	21,065	5,259	3,737	39,306
/ K km^2	0.52	4.65	22.78	9.12	2.33	4.62
/K hab.	0.11	0.13	0.24	0.18	0.23	0.19
ICU beds (public)	1,150	4,067	8,261	3,214	1,376	18,068
/K km^2	0.30	2.62	8.93	5.57	0.86	2.12
/K hab.	0.06	0.07	0.09	0.11	0.08	0.09

Source: Prepared by the authors. Raw data: IBGE (2019) and DATASUS (2020).

On the other hand, the demographic density is higher in the South than in the Northeast, being second only to the Southeast. This statistic is an important in relation to the need for beds in the short term, due to the rapid spread of some epidemic diseases, such as Covid-19.

However, the number of beds per thousand inhabitants is much lower in the Northern Region. In addition, this is the region that has fewer beds per thousand square kilometers. These data reveal a great inequality with the rest of Brazil, in the supply of beds, especially when compared to the Southeast Region.

In Brazil, are less than half the total of ICU beds are public. The Regions that contribute most to this are the Southeast and Midwest, where most of their beds are in the Private Network. The large difference in the number of public beds in relation to the total in these Regions makes the inequality in the supply of public beds per thousand inhabitants the lowest among all the Regions.

Looking at the maps in Figure A1, it can be seen that most of the health establishments that have ICU beds are concentrated in the Southeast, South and coastal areas of the Northeast Region. In the interior of the Northeast and in the Center-West the ICU beds are more distant. The North Region has large voids, showing that many locations are unattended.

The differences in the supply of ICU beds *per* inhabitant and in the spatial distribution of beds in the Regions are signs that there is unequal access of local populations to the beds. Although there is little imbalance in the spatial distribution between total and public beds in Brazil, the differences in bed supply in relation to municipal population can result in distinct values of inequality of access.

4.1 Spatial Accessibility Measure (SAM)

The mean accessibility to ICU beds is much higher in the Southeast and South when compared to the North and Northeast, as shown by the SAM averages in Table II. For Brazil and its Major Regions, the mean SAM score for access to the public beds is approximately half the score for access to total beds. In addition, the Southeast Region shows the greatest SAM variability between the municipalities, while the North is the most regular.

Table II - SAM descriptive statistics for ICU beds (total and public)

Beds		North	Northeast	Southeast	South	Center-West	Brazil
Total	Mean ($x10^{10}$)	0.05	0.14	0.84	0.43	0.27	0.42
	SD ($x10^{10}$)	0.11	0.22	7.42	0.73	0.55	4.09
Public	Mean ($x10^{10}$)	0.03	0.08	0.42	0.26	0.12	0.22
	SD ($x10^{10}$)	0.09	0.13	4.00	0.55	0.24	2.21

Source: Prepared by the authors.

The SAM results by municipality show that most municipalities have a very low level of access to ICU beds (total and public), compared to cities with greater accessibility. In the case of total beds, the cities that appear as outliers, with high SAM scores, are: Visconde do Rio Branco (MG), Jaú (SP), São Caetano do Sul (SP) and Tenente Portela (RS). Regarding public beds, the municipalities are the same, with the exception of São Caetano do Sul.

In order to better identify the differences in terms of access between the municipalities, we calculated the SAM logarithm. According to the map shown in Figure A2, the scores for accessibility to ICU beds are higher values in the Southeast Region, in the north of the South Region, around the Federal District and on the coast of the Northeast Region. These locations, in general, are closer to major urban conurbations.

As can be seen in the figure, the Northern Region has the lowest accessibility to establishments with ICUs. In addition, the south of the South Region and the interiors of the Northeast and Midwest Regions also showed a lower value in the measure of accessibility.

The Spatial Gini Coefficient of the SAM (G) was around 0.7 for the total and public beds, suggesting a severe inequality of spatial accessibility between municipalities. The Gini of neighbors showed a weak spatial correlation of SAM, since for different numbers of closest neighbors varied between 0.04% and 0.27% of the total Gini. Therefore, most of the inequality of accessibility is due to non-neighboring municipalities. All values were statistically significant. Table A2 shows the Gini coefficient and its spatial decomposition for the SAM of the total and public beds.

4.2 Spatial Accessibility by Population Groups

Most of the Brazilian population is young, approximately 50% were aged between 10 and 39 years in 2015, as shown in Table A1. Among the Major Regions, this distribution varies slightly: i) the populations in the North and Northeast were the youngest in Brazil. The range from 0 to 29 years old corresponded to 58.11% and 51.9% of the total population of each region, respectively; and ii) the South and Southeast have the largest number of elderly people, proportionally. In these regions, those over 60 years of age represent 13.71% and 13.28%, respectively. Regarding gender, for Brazil and the Regions, the number of women marginally exceeds the number of men, with the North Region being the only exception.

When observing the cumulative proportions of the populations in Figure A3, we can see that the youngest are, on average, further away from both the total and public ICU beds. This is possibly due to the greater agglomeration of intensive care units in those Regions that also concentrate the largest number of elderly people. Also, looking at the two graphs, it can be seen that the curves start at lower values of the cumulative percentage of the populations in the public beds, indicating that these are comparatively less accessible for all age groups.

More than 95% of the elderly (over 60 years old) are able to find an ICU bed within a 100km radius, but among the population up to 20 years old, less than 93% have such access. If we only consider public ICU beds for the same distance, the number of elderly people with access fails to reach 95%, while for the up to 20 year-olds it is around 91%. If a 50 km radius is considered, 83% of the elderly population would have access to an ICU bed, while for the population up to 20 years old, access would be less than 79%. If we only consider the public ICU beds, access of the elderly population is close to 83%, while for the population up to 20 years old it drops to 76%.

Apparently, the age groups at greatest risk from Covid-19 are those that have the easiest access to beds in Brazil. However, given the continental dimension of the country, the demographic differences in each Region may show a different relationship from the national average regarding the proximity of the beds and the population strata by age group. In addition, males were found to have slightly greater difficulty regarding access ICU beds. It is important to note that, in Brazil, men have had a higher mortality rate due to the virus than women.

Observing the spatial distribution of the number of confirmed cases of Covid-19 can help identify where more ICU beds will be needed in the short term. Using data from Dagnino and Freitas (2020), the map in Figure A4 (a) shows that many cases have been occurring in locations where accessibility to establishments with ICU beds is very low, such as the Northern Region and the southern part of the South Region.

Using the number of deaths as an indicator of where the demand for ICUs is highest, since there may be underreporting of coronavirus cases, it is clear that the North Region again appears as a potential candidate for a health system crisis. It is also evident that this may well also occur in the interior of some municipalities in the Northeast and Midwest.

In the maps in Figure A4 (b), we can see that hospitalizations and deaths from respiratory-system diseases in February 2020. Compared to data on the coronavirus, hospitalizations and deaths from respiratory diseases are occurring more in the interior of Brazilian states. These data can serve as a proxy for the actual stage of contagion and mortality, since many people may have been infected or died without being tested. In particular, the Center-West and South regions were more affected by respiratory diseases than by Covid-19.

The North and Northeast regions had lower accessibility to ICU beds than the other Brazilian regions. These two regions are the poorest in Brazil. In addition to poverty, the North Region is also characterized by its large territorial dimension and low population density. This region also has a large number of rivers, making it difficult to transport people to health units. Considering these regional characteristics, it is possible to say that the inequality of access to health services tends to be even greater than that estimated by the model since only physical and demographic factors were used.

The results of this study strengthen the importance of analyzing the spatial inequalities of accessibility to equipment and health services. Against the background of this research question, studies were carried out for the USA (Kim *et al*. 2022; Park and Goldberg, 2022; Kang *et al*. 2020), European countries (Bauer *et al*. 2020), and Brazil (Palamim *et al*. 2020; Pereira *et al*. 2021). All these studies found spatial inequalities of accessibility, mainly harming the poorest population and ethnic minorities, mainly the black population. In general terms, the results of this study are in line with these studies.

5. Final remarks

The extent of Brazil's territory makes the distribution of health establishments and of the Intensive Care Unit beds a complex challenge. The great inequality of access to beds aggravates the problems of care provision and fighting coronavirus in the country.

Policies to combat coronavirus have mainly focused on large cities. Although they have a bigger and better health infrastructure, the collapse in the health system occurred primarily in such cities.

The problem, however, is not restricted to large urban centers. In this sense, the results of the study also reveal a worrying situation for the interior of Brazil. In some of these places, deaths related to Covid-19 occurred due to a lack of access to hospital care.

In terms of public policy, the results found point to the need for efforts to ensure the availability of a minimum health infrastructure throughout the national territory. The results make it possible to identify which locations should be prioritized, that is, where there is greater inequality of access, especially for groups at higher risk. In addition to the search for universal access to health for the entire Brazilian population, these measures can stimulate technological development in the healthcare area in different regions, allowing us to be better prepared to face health crises or new pandemics in the future. With the COVID-19 pandemic as a backdrop, Lange *et al*. (2020) and Michard *et al*. (2020) engage in an interesting discussion about future needs for ICU beds.

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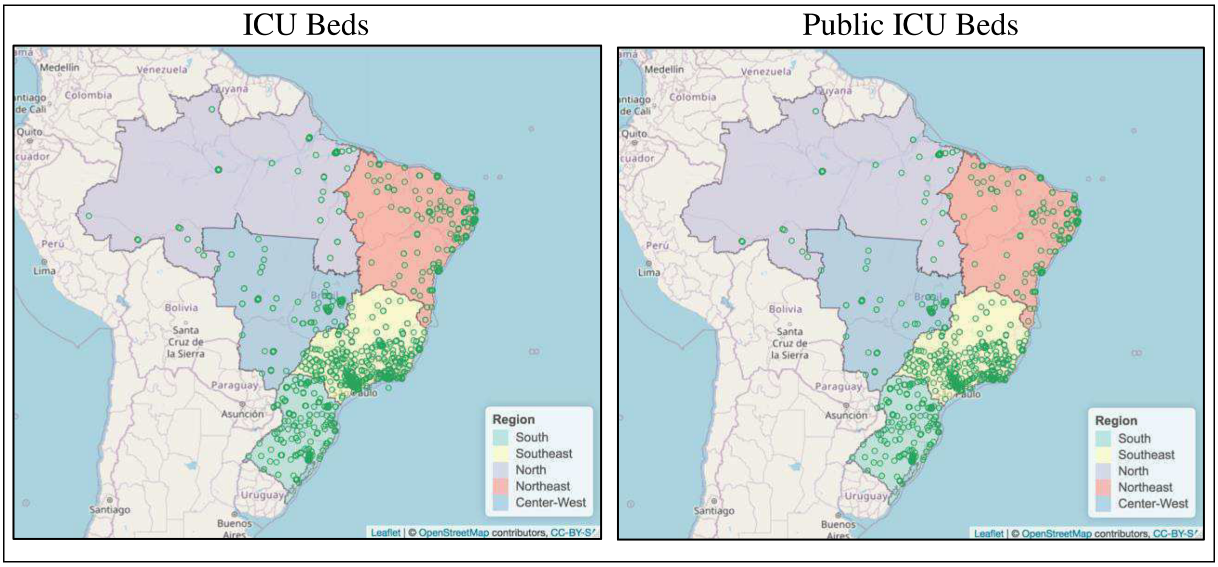
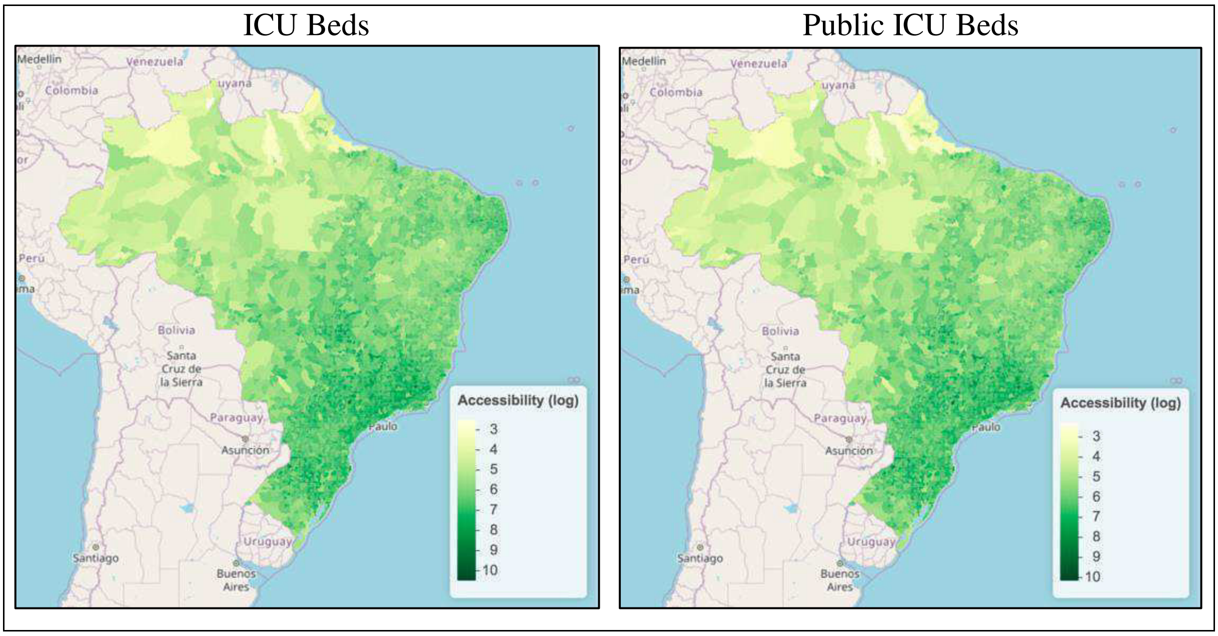
Appendix

Figure A1 - Maps of the Brazilian Regions and location of establishments with ICU beds (total and public)



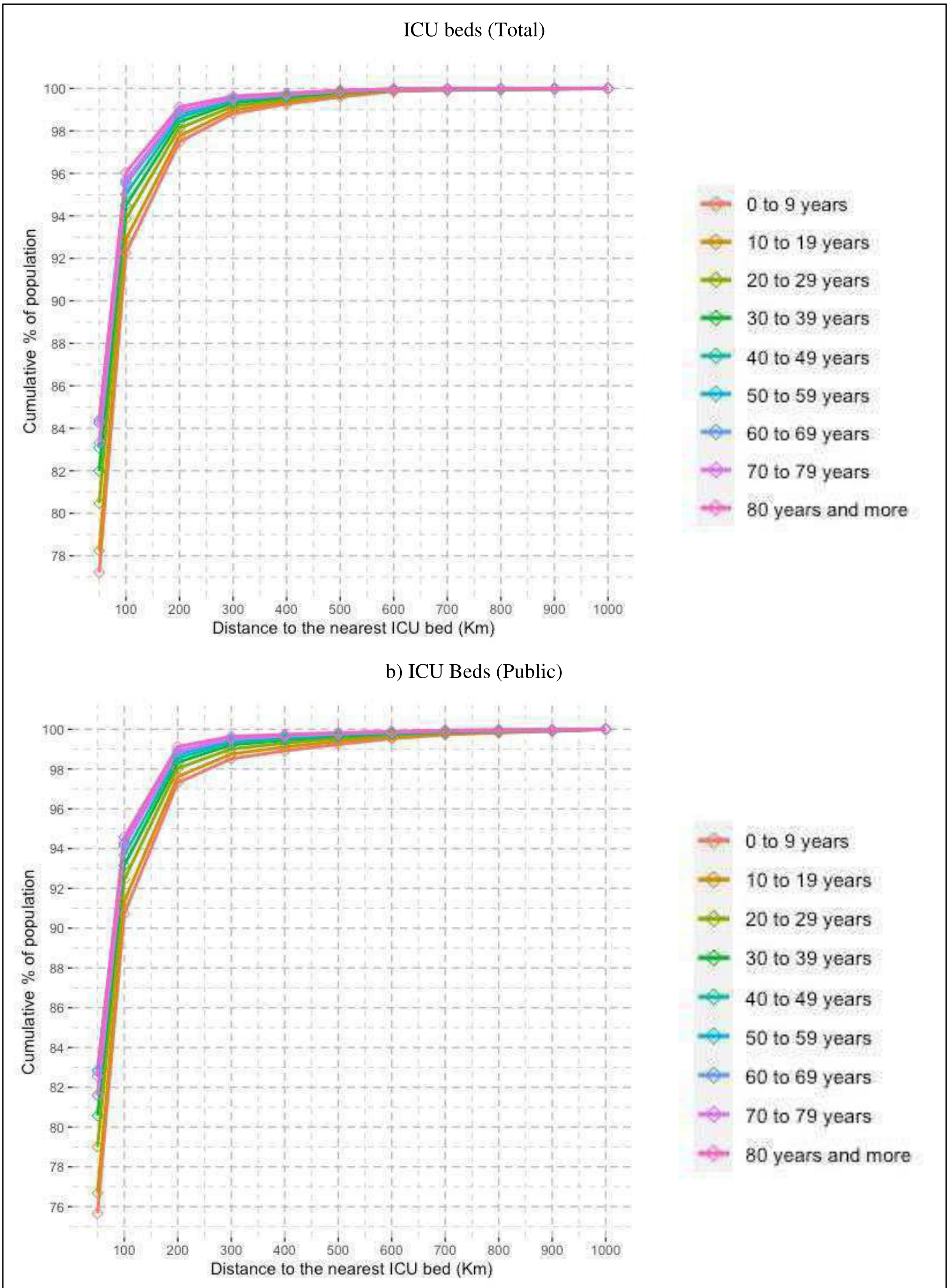
Source: Prepared by the authors. Raw data: DATASUS (2020).

Figure A2 - SAM logarithm maps for ICU beds by municipality (total and public)



Source: Prepared by the authors.

Figure A3 - Cumulative percentage of the population x distance to the establishment with ICU beds by age group (total and public)

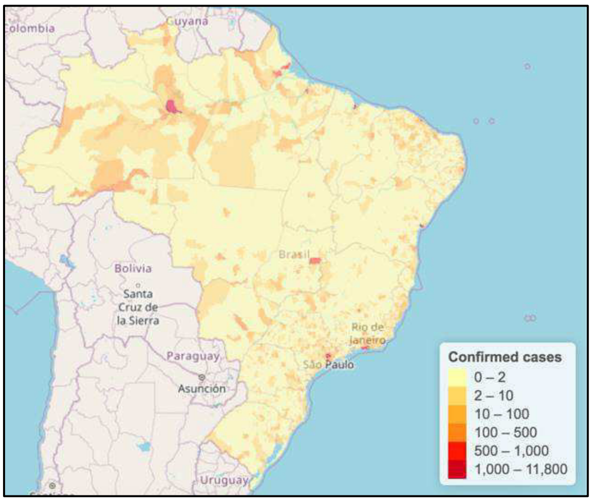


Source: Prepared by the authors.

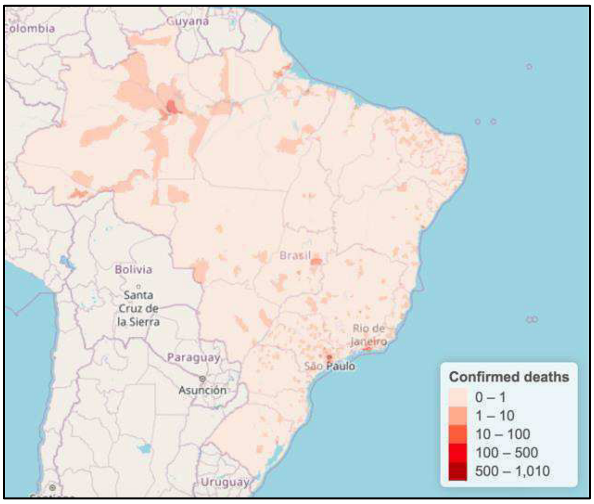
Figure A4 - Total number of cases and deaths from Covid-19 and from respiratory diseases by municipality

a) Total number of confirmed cases and deaths by Covid-19

Cases on 24/04/2020

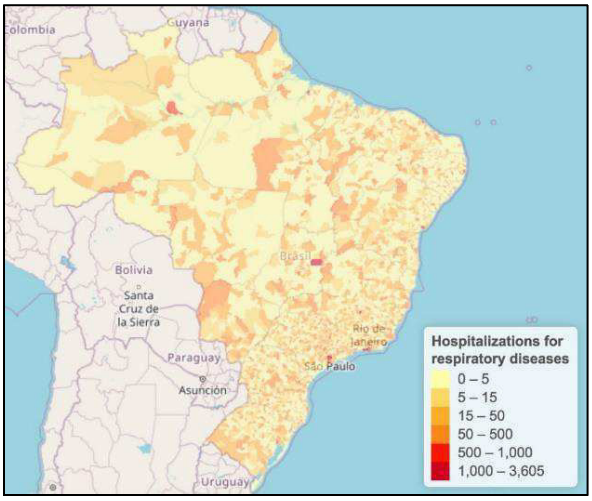


Deaths on 24/04/2020

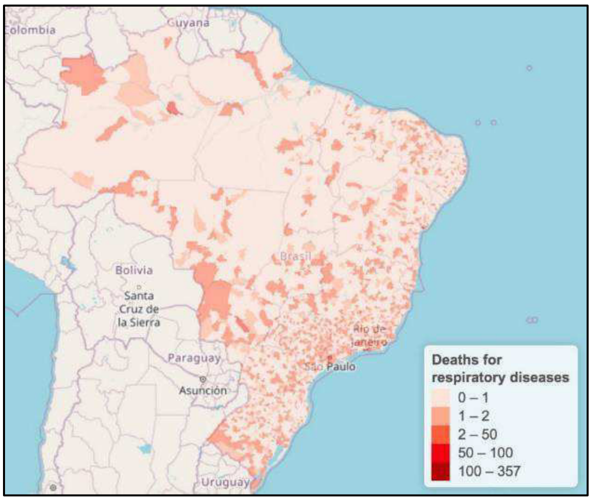


b) Number of hospitalizations and deaths from respiratory diseases

Hospitalizations in 02/2020



Deaths in 02/2020



Source: Prepared by the authors, from Dagnino and Freitas (2020).
Note: for the maps in part (b) the DATASUS (2020) was used.

Table A1 - Percentage of the population by age and gender, Brazil and Major Regions, 2015.

Age groups and gender	North	Northeast	Southeast	South	Center-West	Brazil
0 to 9	19.54	16.73	13.36	13.21	15.04	14.93
10 to 19	20.19	18.08	15.38	15.39	16.75	16.65
20 to 29	18.38	17.18	16.09	16.31	17.75	16.74
30 to 39	15.94	16.61	16.42	15.75	17.04	16.38
40 to 49	11.27	12.13	13.81	13.60	13.62	13.08
50 to 59	7.63	9.02	11.65	12.03	10.00	10.51
60 to 69	4.27	5.69	7.56	7.84	5.83	6.67
70 to 79	2.00	3.13	3.81	4.00	2.83	3.42
80 and +	0.78	1.43	1.91	1.87	1.14	1.62
Male	50.72	49.04	49.23	49.46	49.80	49.38
Female	49.28	50.96	50.77	50.54	50.20	50.62

Source: Prepared by the authors. Raw data: IBGE (2015).

Table A2 - Sensitivity analysis of the SAM Gini coefficient

ICU Beds (Total)						
k	Gini	Gini of neighbors	Gini of non-neighbors	% Gini of neighbors	% Gini of non-neighbors	p-value
4	0.695	0.000	0.695	0.042	99.958	0.01
5	0.695	0.000	0.695	0.057	99.943	0.01
6	0.695	0.000	0.695	0.071	99.929	0.01
9	0.695	0.001	0.695	0.114	99.886	0.01
12	0.695	0.001	0.694	0.158	99.842	0.01
20	0.695	0.002	0.694	0.275	99.725	0.01
ICU Beds (Public)						
k	Gini	Gini of neighbors	Gini of non-neighbors	% Gini of neighbors	% Gini of non-neighbors	p-value
4	0.698	0.000	0.697	0.042	99.958	0.01
5	0.698	0.000	0.697	0.058	99.942	0.01
6	0.698	0.001	0.697	0.072	99.928	0.01
9	0.698	0.001	0.697	0.116	99.884	0.01
12	0.698	0.001	0.697	0.160	99.840	0.01
20	0.698	0.002	0.696	0.279	99.721	0.01

Source: Prepared by the authors.

Note: The numbers in the first column represent the number of closest neighbors used in the spatial weight matrix of the Gini calculation and those in the second column show the general Gini. The third and fourth columns show the spatial decomposition of the coefficient for neighbors and non-neighbors, while the fifth and sixth columns show the proportion of these decompositions in relation to the global Gini. The last column is the *p*-value of the coefficient for a Monte Carlo simulation with 99 iterations.