Inpatient flow for Covid-19 in the Brazilian health regions

Fluxo de internação por Covid-19 nas regiões de saúde do Brasil

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ABSTRACT The study aims to investigate the flows of Covid-19 hospitalizations in the 450 Brazilian health regions and 117 health macro-regions between March and October 2020. This descriptive study includes all Covid-19 hospitalizations registered in the Influenza Epidemiological Surveillance Information System between the eighth and forty-fourth epidemiological weeks of 2020. In Brazil, 397,830 admissions were identified for Covid-19. Emigration was 11.9% for residents in health regions and 6.8% in macro-regions; this pattern was also maintained during the peak period of Covid-19 hospitalizations. The average evasion for residents of health regions was 17.6% in the Northeast and 8.8% in the South. Evasion was more accentuated in health regions with up to 100 thousand inhabitants(36.9%), which was 7 times greater than that observed in health regions with more than 2 million inhabitants (5.2%). The negative migratory efficacy indicator (-0.39) revealed a predominance of evasion. Of the 450 Brazilian health regions, 117 (39.3%) had a coefficient of migratory efficacy between -1 and -0.75, and 113 (25.1%) between -0.75 and -0.25. Results indicate that the regionalization of the health system exhibited adequate organization of healthcare in the territory; however, the long distances traveled are still worrisome.

KEYWORDS Covid-19. Regional health planning. Hospitalization. Movement and displacement of patients.

RESUMO *Objetivou-se investigar os fluxos de internações por Covid-19 nas 450 regiões e 117 macrorregiões de saúde brasileiras, de março a outubro de 2020. Realizou-se estudo descritivo, compreendendo todas as internações por Covid-19 registradas no Sistema de Informação de Vigilância Epidemiológica da Gripe entre a 8ª e a 44ª semanas epidemiológicas de 2020. Identificaram-se 397.830 internações por Covid-19 no Brasil. A evasão foi de 11,9% dos residentes nas regiões de saúde e de 6,8% nas macrorregiões; padrão que se manteve no período de pico das internações por Covid-19. Houve, em média, 17,6% de evasão dos residentes das regiões de saúde do Nordeste e de 8,8% das do Sul. A evasão foi mais acentuada nas regiões de saúde com até 100 mil/hab. (36,9%), a qual foi 7 vezes maior que a verificada naquelas com mais de 2 milhões/habitantes (5,2%). O indicador de eficácia migratória negativo (-0,39) indicou predomínio da evasão. Das 450 regiões de saúde brasileiras, 117 (39,3%) apresentaram coeficiente de eficácia migratória entre -1 e -0,75; e 113 (25,1%), entre -0,75 e -0,25. Os resultados indicam que a regionalização do sistema de saúde mostrou-se adequada na organização do atendimento no território, porém, as longas distâncias percorridas ainda são preocupantes.*

PALAVRAS-CHAVE *Covid-19. Regionalização da saúde. Hospitalização. Movimentação e deslocamento de pacientes.*

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Introduction

Worldwide, Covid-19 has challenged health systems, which needed to reorganize health services to face the pandemic[1,2]. Given its high transmissibility, potentially aggravated by the emergence of new variants, and the absence of specific treatments, Covid-19 is rapidly spreading among high, middle and low income countries. United States, India and Brazil are the countries with the highest number of cases and deaths from Covid-19. However, although it has negative consequences around the world, in developing countries, Covid-19 is more likely to increase health inequities, including failures in access to health care and increased flow of patients for health treatment[3].

In Brazil, despite the transmission of the Sars-CoV-2 virus having rapidly reached all regions, this occurred in different proportions[4,5]. Regional inequalities that include, in addition to socioeconomic differences, an unequal distribution of resources and provision of health services – In addition to changing the flow of patients – have an impact on well-being, morbidity and mortality from the disease[4,5].

The spread of Covid-19, by reaching small municipalities, which are less structured in terms of providing medium and high complexity health services, challenges their management capacity[6]. A study showed that 90.4% of Brazilian municipalities did not have Intensive Care Unit (ICU) beds for adults, 59.3% did not have respirators/ventilators, 51.9% did not have electrocardiogram (ECG) monitors. 39.6% did not have defibrillators, 71.0% did not record infusion pumps and 84.6% did not have computed tomography scanners registered in the National Register of Health Establishments (CNES) in February 2020[6]. Although a small portion of patients with Covid-19 progresses to severe disease, these may require hospitalization and intensive care in the ICU[7]; thus, it is expected to find hospitalization flows between municipalities and within health regions.

In this context, it is important to analyze the flows of admissions by Covid-19 within the health regions, since most municipalities do not have specialized services for the most severe cases of the disease. Health regions can be understood as a strategy to optimize the management of health services, the rationalization of resources and institutional support for the creation of health care networks[8]. The regionalized organization of health services in the Unified Health System (SUS) defines the flows of patients in the territory, both at the level of regions and at the level of health macro-regions, and depends, among others, on the supply of transport and the capacity of the reference municipalities[9,10].

The aim of this study was to investigate the flows of admissions by Covid-19 in the 450 regions and 117 macro-regions of health in Brazil, from March to October 2020. The following were evaluated: i) the proportion of admissions of residents within their region of health and its health macro-region, stratified by the period of greatest stress in the health system; ii) the flows of patients who sought admissions by Covid-19 between the health regions, mapping the regions and macro-regions that presented a migratory process of evasion/invasion of admissions by Covid-19.

Material and methods

A descriptive study of hospitalization flows by Covid-19 was carried out in the health regions, taking into account the different cutouts (health regions and macro-regions). The unit of analysis was the health region, covering all the 450 regions and 117 macro-regions of health in Brazil.

The macro-regions were defined based on CIT Resolution No. 37/2018, which defines a minimum of 500,000 inhabitants for the Northern states and 700,000 inhabitants for the other states.

The number of admissions for Covid-19 was obtained through the Information System for the Epidemiological Surveillance of Influenza

(Sivep-Gripe), of the Ministry of Health (MS) of Brazil. Sivep-Gripe was initially created to monitor the influenza virus in the country, based on a sentinel surveillance network of the flu syndrome, and adapted in 2020 to guide the National Health Surveillance System for the simultaneous circulation of the new coronavirus. Based on Technical Note No. 20/2020-SAPS/GAB/SAPS/MS and Sesab Ordinance No. 233, of June 19, 2021, every case of hospitalization by Severe Acute Respiratory Syndrome (Sars) or death from Sars, even if not hospitalized, but that fits the definition of the case, must be notified at Sivep-Influenza, within 24 hours, by the registered units (hospitals, Emergency Care Units – UPA, Emergency Medical Care Service – Samu, Verification Service of Death – SVO). In this database, it was not possible to distinguish which data refer to the public or private sector. For the sample of this study, only individuals in which the final classification of the case was SRAG-Covid-19, confirmed after the positive result of the molecular RT-PCR test for the virus Sars-CoV-2[11], were considered.

The study included all admissions for Covid-19 registered in the Sivep-Gripe from March 1st to October 29th, 2020, which are equivalent to notifications made between the 8th and 44th epidemiological weeks. This period was selected due to the availability of data until this study was carried out.

To estimate the service capacity of health regions to provide admissions by Covid-19 to their residents, the proportion obtained was calculated by dividing the sum of all admissions of the disease carried out by residents within their respective health region by the sum of all hospitalizations by Covid-19 performed by residents of that health region. This proportion was calculated in two distinct periods. The first period refers to the peak of admissions for Covid-19 in the health region, defined as the epidemiological week with the highest number of admissions for the disease, plus the previous and subsequent epidemiological weeks. This period represents the situation in which the hospital system would be most demanded by the population served. The second period refers to the other epidemiological weeks, excluding the peak period of admissions due to Covid-19.

To identify the flows of hospitalizations due to the disease, data from the origin of the patients (health region of residence) were crossed with data from the place where the hospitalizations were carried out (service health region). With the crossing of admissions by Covid-19, it was also possible to identify the indicator of migratory efficacy, which takes into account the evasion and invasion of patients. According to Rocha[12], the greater the evasion of patients, the lesser the capacity to assist the population locally or regionally; and the greater the invasion of patients, the greater the power of attraction exerted by the conditions of care provision[12]. The Migratory efficacy Indicator (MEI) was obtained by the formula below:

$$MEI = (I - E) / (E + I)$$

Where 'I' is invasion, defined as the entry of patients from other health regions; 'E' is evasion, defined as the departure of patients to other health regions; 'I – E' is the net migration (entry minus exits of patients in a health region); 'E+I' is the gross migration (inflows plus outflows of patients in a healthcare region). The indicator assumes values between 1 and -1 inclusive. Values close to 1 indicate high migratory attraction, while values close to -1 indicate high migratory repulsion.

The average distance traveled by patients for admissions outside health regions and between municipalities within the region was also calculated. This was calculated in the QGIS software based on the Euclidean distance in meters between the coordinates of the seats of the municipalities of residence and internment of the flow, using a polyconic projection with the Sirgas 2000 geodetic reference system. The coordinates of the municipal seats were obtained in the study 'Register

of Selected Locations 2010' by the Brazilian Institute of Geography and Statistics (IBGE). This information provides a measure of the path taken by patients, which was stratified by population size of the health region (up to 100,000 inhabitants; between 100,000 and 200,000 inhabitants; between 200,000 and 500,000 inhabitants; between 500,000 and 1 million inhabitants of inhabitants; from 1 million to 2 million inhabitants; and above 2 million inhabitants) and geographic region (North, Northeast, Central-west, Southeast and South).

Statistical analysis

Data were tabulated for each of the 450 regions and 117 macro-regions of health. Initially, the absolute and relative frequencies of hospitalizations due Covid-19 were presented. Then, the average evasion percentages in the health regions were calculated for Brazil and its five geographic regions, stratifying according to periods of greater and lesser demand for admissions and according to the population size of the health regions. Displacement was represented by mean distances, and graphically through maps, including flows between health regions and macro-regions. Likewise, the migratory efficacy in these territorial cutouts was presented through maps. For data analysis, version 14 of the Stata software was used. For the elaboration of the maps, the version 3.12 of the QGIS software was used.

Ethical aspects

Only secondary, publicly accessible and unidentified data were used. Thus, it was not necessary to submit the study to the CEP/Conep system.

Results

In the period from March to October 2020, 397,830 hospitalizations were registered in Brazil due Covid-19, being: 33,399 in the North (8.4%, rate of 17.9 hospitalizations per 10,000 inhab.); 37,626 in the Central-west (9.4%, rate of 22.8 admissions per 10,000 inhab.); 45,187 in the South (11.4%, rate of 15 admissions per 10,000 inhab.); 81,121 in the Northeast (20.4%, rate of 14.1 admissions per 10 thousand inhabitants); and 200,497 in the Southeast (50.4%, rate of 22.5 hospitalizations per 10,000 inhab.).

Only 11.9% of residents left their health regions to get hospitalization for Covid-19. However, stratifying the analysis by geographic regions, the Northeast stands out as the region with the highest number of patients, where 17.6% was observed, twice the percentage observed in the South region. Variations in terms of population size of the health regions were also identified, with an average dropout percentage of 36.9% in those health regions with a population of up to 100,000 inhabitants and 5.2% in those with a population above 2 million inhabitants. This inverse relationship between population size and dropout percentage is generally maintained, even though the data are stratified by geographic regions in Brazil (*table 1*).

Table 1. Percentage of evasion of residents from health region for hospitalization due Covid-19, according to geographic region, intensity of demand for hospitalization and population size of the patient's health region, between March and October 2020

		Population Size of the hospitalized patient home Health Region						
Region	**Period of hospitalization demand**	**up to 100 thousand**	**100 to 200 thousand**	**200 a 500 thousand**	**500 thousand to 1 million**	**1 to 2 millions**	**Above 2 millions**	**Total**
North	Total	38.5%	24.8%	15.9%	9.6%	-	1.7%	9.8%
	Higher demand	45.1%	27.0%	15.9%	11.4%	-	1.8%	10.3%
	Lower demand	36.3%	23.9%	15.9%	8.9%	-	1.7%	9.6%
Northeast	Total	62.9%	55.7%	40.7%	23.6%	5.0%	0.8%	17.6%
	Higher demand	61.9%	55.9%	42.5%	24.7%	4.8%	0.9%	19.1%
	Lower demand	63.5%	55.6%	40.0%	23.3%	5.0%	0.8%	17.0%
Southeast	Total	34.8%	20.4%	11.2%	9.9%	23.3%	7.5%	10.6%
	Higher demand	37.2%	19.3%	12.0%	9.4%	22.3%	7.0%	10.5%
	Lower demand	33.8%	20.8%	11.0%	10.0%	23.5%	7.6%	10.7%
South	Total	-	23.9%	14.1%	8.9%	4.2%	1.3%	8.8%
	Higher demand	-	24.7%	15.1%	9.1%	4.1%	1.2%	10.3%
	Lower demand	-	23.6%	13.7%	8.8%	4.2%	1.3%	8.4%
Center-west	Total	36.8%	28.8%	19.1%	28.9%	7.5%	1.0%	12.4%
	Higher demand	39.5%	32.5%	17.7%	26.2%	8.5%	1.2%	14.2%
	Lower demand	35.6%	27.4%	19.6%	29.6%	7.3%	1.0%	11.9%
Brazil	Total	36.9%	30.9%	20.3%	14.0%	12.8%	5.2%	11.9%
	Higher demand	40.0%	32.1%	22.2%	14.7%	11.3%	4.7%	12.9%
	Lower demand	35.5%	30.4%	19.7%	13.8%	13.2%	5.3%	11.7%

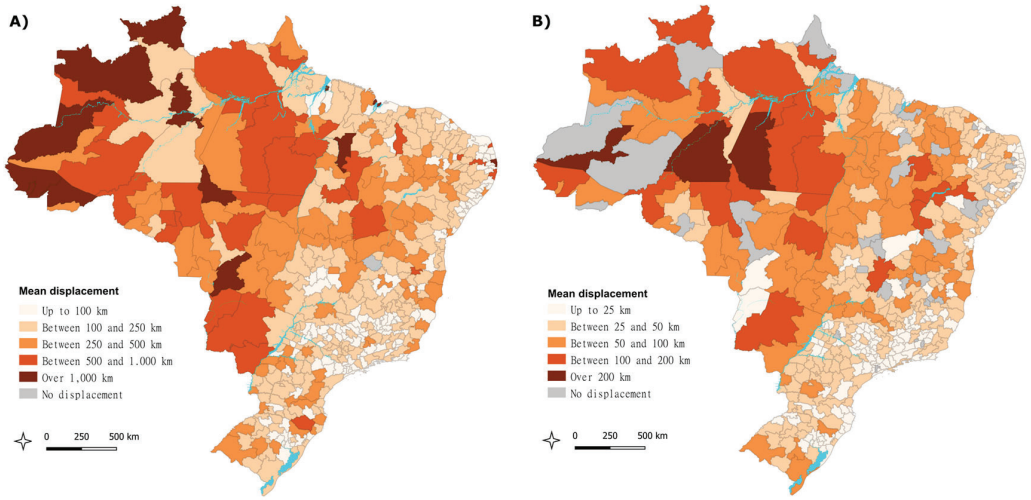
Source: Self elaborated.

Differences in evasion rates from health regions were not very sensitive in relation to periods with greater or lesser demand for hospitalizations, and it is not possible to identify an evident pattern in the variations between these periods when evaluated by geographic region and population size. However, the geographic regions, with the exception of the Southeast, presented a small increase in dropout rates when the period of greatest demand was analyzed (*table 1*).

The distances traveled by patients in the 47,476 admissions by Covid-19 recorded outside their own health region, added together, total 5.9 million kilometers, which represents an average of 229 kilometers per displacement. This indicator, however, is very heterogeneous, as it comprises average displacements ranging from 60 km in the Southeast to 409 km in the North. Although the largest number of hospitalizations for Covid-19 was found in the Southeast region (45%), and the largest average displacements, in the North region, followed by the Center-West region (182.8 km), it was the Northeast that presented the largest sum of displacements, more than 1.9 million km, since, in addition to presenting a relevant average displacement (135.4 km), it had the second highest volume of hospitalizations of residents due Covid-19 (30%).

The Northern and Central-western states are those with the highest averages of displacement to other health regions (over 300 km), being the main ones, in descending order: Acre (922.1 km), Mato Grosso (489 .2 km), Amazonas (484.2 km), Roraima (471.8 km), Mato Grosso do Sul (466.3 km), Rondônia (459.9 km), Pará (411 km) and Amapá (315 km) (*figure 1A*).

Figure 1. Average displacement for hospitalization due Covid-19 performed outside the health region (A) and within each health region (B) in Brazil from March to October 2020

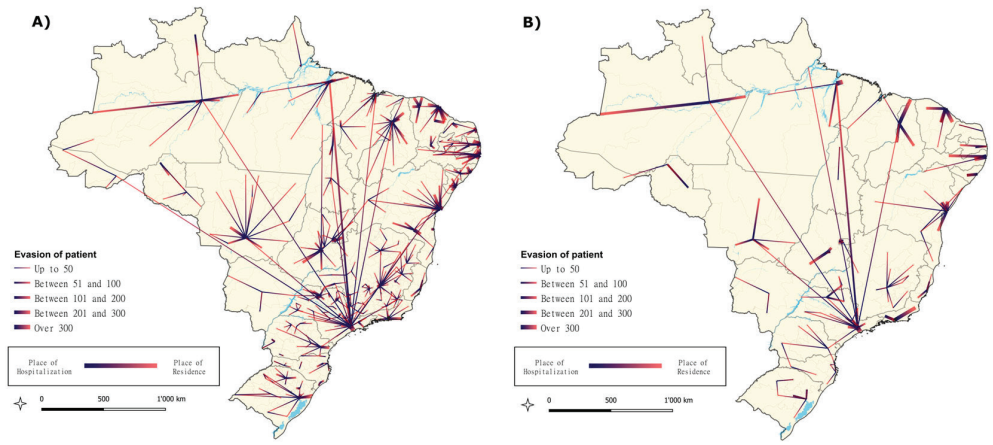


Source: Self elaborated.

In general, there was a lower average travel for hospitalization by Covid-19 within the health regions (28.2 km). Only a few states have average displacements above 100 km, they are: Amazonas (134.4 km), Rondônia (122.9 km), Roraima (117.1 km), Acre (108.2 km) and Mato Grosso do Sul (103.7 km). It is possible to see in *figure 1B* that the Southeast, both in relation to displacements outside the health regions and between municipalities within the health regions, had lower average displacements. In terms of internal travel to the health region, an average of slightly over 20 km was recorded in the Southeast.

Figures 2A and 2B show the most intense flows of patient evasion for admissions by Covid-19 in Brazil, starting from the health regions and macro-regions, between March and October 2020. The centrality exercised by the health regions of the municipalities of state capitals, appearing, in most cases, as the most frequent destination region of evasion flows for hospitalization in the scales of the federative units. Some health regions also go beyond state boundaries, such as the health region of the city of São Paulo, which influences all Brazilian capitals, being the most frequent destination for evasion in many of them (*figure 2A*). The capitals of the North and Central-west centralize flows from regions that are at great distances, as can be seen more clearly in the flows towards the health regions of Manaus, Belém and Cuiabá.

Figure 2. More intense flow of patient evasion for hospitalization due Covid-19 between health regions (A) and health macro-regions (B) in Brazil from March to October 2020



Source: Self elaborated.

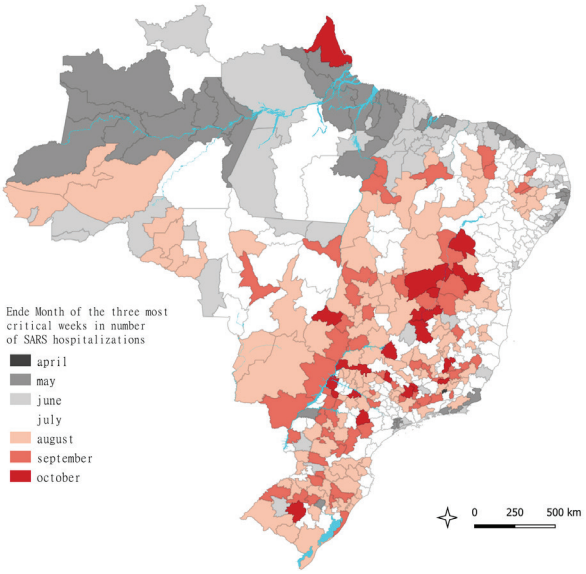
Note: The coordinates used as origin and destination to represent the flows between health macro-regions were defined from the coordinate of the seat of the most populous municipality in the macro-region.

Flows between health macro-regions, although based on a significantly smaller volume of displacements (representing only 6.8% of the hospitalizations of its residents), reinforce the centrality of state capitals, and the movement of various capitals towards São Paulo when the patients need to move to some other macroregion (*figure 2B*).

In contrast to these large displacements, it was found, in several states, the presence of poles of attraction of patient flow, in addition to the capitals. Among the 52 identified 'pole' municipalities, 23 were located in the Southeast (13 in Minas Gerais and 10 in São Paulo), followed by 15 in the Northeast (present in eight of the nine states), 9 in the South (in all three states), 3 in the North and 2 in the Central-west. Most of these municipalities were classified as Very High (12%) and High (67%) by the Municipal Human Development Index (IDHM), indicating that they are probably more developed municipalities than their neighbors. Analyzing the population size, compared with the other municipalities in their respective health macro-regions, 75% of the municipalities were the most populous in their health macro-region, acting as hubs for patient migration.

The health regions located in the North, especially in Manaus, Macapá and Belém, and in the coastal capitals of São Luiz, Fortaleza, Recife, Maceió, Rio de Janeiro, in addition to the state of São Paulo, have reached the critical period for hospitalizations for Covid-19 still in May 2020. Meanwhile, health regions in the states of Mato Grosso do Sul, Goiás and part of the interior of Bahia and Minas Gerais showed later peaks of hospitalizations for Covid-19. In general, the health regions distributed in the capitals of the South had their most critical moments of hospitalization in July (*figure 3*).

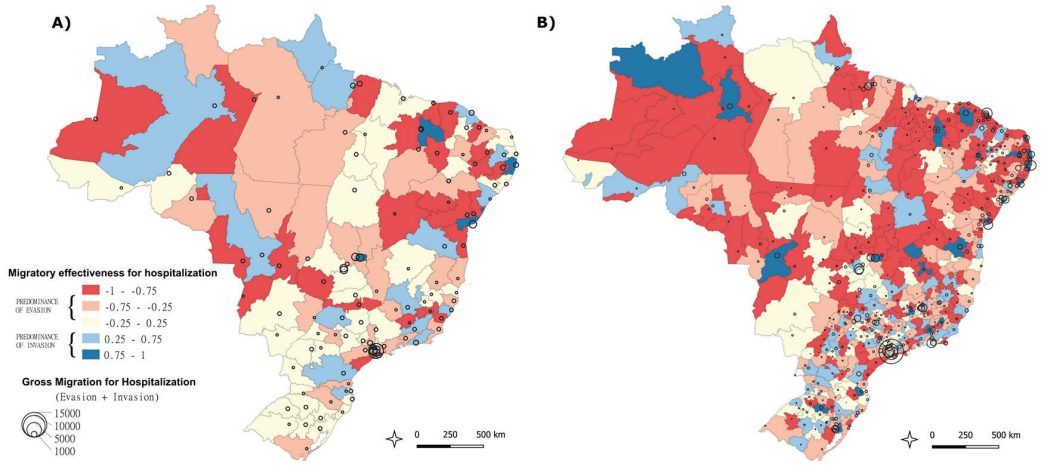
Figure 3. Temporality of the critical period of hospitalization due Covid-19 in Brazil, according to the health region, between March and October 2020



Source: Self elaborated.

The gross migration data for hospitalization by Covid-19, considering the displacement between the macro-regions, highlight in magnitude those of the Metropolitan Regions of São Paulo, Goiânia, Federal District and surroundings, Salvador, Recife and Fortaleza, all with total gross migration above 800 displacements. The South region, despite indicating greater average migration efficacy between health macro-regions, has low gross migration between them. A large part of the health macro-regions that had a greater amount of gross patient migration coincide with areas in which invasion movements predominate in relation to evasion, and occur more clearly in state capitals or in important cities in the interior. Migratory movements with a predominance of evasion stand out, more relevant in quantitative terms, in the macro-regions contiguous to those of the capitals (*figure 4 A*).

Figure 4. Migratory efficacy for hospitalization due Covid-19 in Brazil by health macro-region (A) and by health region (B) between March and October 2020



Source: Self elaborated.

The calculation of the migratory efficacy to health regions results in a national average value of -0.39. Negative values indicate a predominance of evasion processes, that is, there are more health regions where residents had to seek hospitalization due Covid-19 outside their region of residence. It is also noteworthy that displacements between health regions are still based on a higher gross migration base than that verified between health macro-regions. However, there was a heterogeneity of results within the Federative Units. The South region, even though it appears as the geographic region with the highest average of migratory efficacy of health regions for hospitalization due Covid-19, still presents a value lower than zero for the indicator (-0.17). In other words, despite the predominance of invasion or regions with efficacy close to zero in the South, there are several health regions with people fleeing. The other geographic regions show a greater number of health regions with a predominance of evasion. In the North, Northeast and Central-west, most health regions have a negative migratory efficacy (evasion). The Northeast region has the lowest average value of migratory efficacy among the health regions (-0.52), followed by the Central-west (-0.46), North (-0.45) and Southeast (-0.33) (figure 4B). The Southeast is the region with the greatest heterogeneity, with several regions with evasion and many others with invasion. It is important to highlight that most of the regions with high migratory efficiency (0.75 – 1) are surrounded by regions of low migratory efficiency (-1 – -0.75), indicating that it is possible the destiny of patients from neighboring regions.

Discussion

The study results revealed a low percentage of evasion for hospitalization by Covid-19 in the Brazilian health regions (11.9%) and in the Brazilian health macro-regions (6.8%), and demonstrated the centrality exercised by state capitals. In addition, variations in flows were observed across geographic regions and in terms of population size in health regions

and health macro-regions. However, the peak period of admissions by Covid-19 did not seem to influence the hospitalization flow patterns of patients, although it diverged between Brazilian regions.

The selection of the health region allowed us to analyze the capacity for cooperation between municipalities in the same health region, given the challenges faced at the municipal level in terms of the supply of equipment and beds[13]. Historically, the decentralization of the SUS to subnational entities prioritized the municipalization of health movement until the year 2000, in which municipalities gained prominence in the provision and organization of health services[14]. However, the low inter-federative cooperation and the scarce experiences of health care networks reinforced the fragmentation of health care, compromising the implementation of the principles of universality and integrality of the SUS[15]. Part of this context is a consequence of the form which public health is financed, using payment per procedure and financial incentives for the development of specific policies, without necessarily being part of a health care network[16]. For example, the logic of federal transfers for medium and high complexity is still associated with the history of production and adherence to federal programs and incentives, causing competition among subnational entities for financial resources in detriment of cooperativism[15]. Starting at the Operational Norms of Health Care (Noas), published in 2001 and 2002[17], the regionalization of health gained space, as well as the organization of health care networks, which were regulated by Ordinance GM/MS nº 4.279/2010[18]. The following year, Decree No. 7.508/2011[19] established minimum criteria for the provision of health activities and services to establish the health regions, which must contain at least: i) primary care; ii) urgency and emergency; iii) psychosocial care; iv) specialized outpatient and hospital care; and v) health surveillance. All these precautions have a direct interface with coping with Covid-19 in the Brazilian context.

Regarding the low percentage of evasion for hospitalization due to Covid-19 in the Brazilian health regions, in this study, on average, 88.1% of residents were treated in their health regions from March to October 2020. Data from 2016 showed an evasion percentage of 33% of admissions performed in the SUS in a universe of more than 11 million admissions[8]. Thus, there is a possible advance in the resolution of service networks in health regions over time and for admissions by Covid-19.

However, the results of this study showed that while in the Northeast, on average, 17.6% evasion of residents from health regions was observed, this percentage was 8.8% in the health regions of the South. When residents had to look for hospitalization due Covid-19 in other health regions, the average distance was 229 km, with this average distance being smaller in the Southeast (60 km) and greater in the North (409 km).

Geographical access to the treatment of any disease is extremely important, as the agility and adequate time of care minimize the possible unwanted clinical manifestations of the disease. In an ecological study that addresses the origin-destination flows of hospitalizations of cancer patients conducted by Oliveira[20], it was evidenced that one of the causes of hospitalization flows is the geographic access to the provision of treatment and the barriers in the organization of health networks in the light of referral and counter-referral services for the treatment of diseases. Added to this, according to Xavier[8] in his study on regionalization according to hospitalizations, the issues related to the displacement of patients in search of treatments are intrinsically linked to the composition of the geographic space, its transport networks and the interpersonal relationships between communities in these municipalities.

In this study, the negative migratory efficacy indicator (-0.39), indicating a predominance of evasion, was probably influenced by the less populated health regions (79.1% of the health regions have less than 500 thousand

inhabitants), which are more frequent in the Brazilian territory. Of the 450 Brazilian health regions, 117 (39.3%) had a coefficient of migration efficacy between -1 and -0.75, and 113 (25.1%), between -0.75 and -0.25. Evasion was more accentuated in health regions with up to 100,000 inhabitants (36.9%), which was 7 times higher than that verified in health regions with more than 2 million inhabitants (5.2%). In the case of municipalities with small populations and low economic development, it is likely that the challenges of providing quality and timely health care to the resident population were accentuated, given budget constraints and the lack of scale for medium and high complexity.

Furthermore, the National Council of Health Secretaries (Conass) and the National Council of Municipal Health Secretaries (Conasems) have reinforced the role of regionalization in its guide for fighting the Covid-19 pandemic in the healthcare network[21]. Among the recommended actions focused on the regionalization of health, we can mention: i) the constitution of a solidarity network for the acquisition of Personal Protective Equipment (PPE), respirators and other necessary supplies; ii) the identification of back-up beds already in operation within the health region; iii) the survey of the expansion of beds according to the needs of each health region.

The regionalization of health is an advance arising from the SUS formulation process, which strengthens the principle of universality through the decentralization of access to local health services, but there is a bottleneck on the SUS regarding its responsiveness in relation to the strengthening of comprehensiveness and equity in care[22], what strengthens regionalization as a mechanism for organizing care flows as a strategy for improving the capacity utilization of services with a consequent reduction in dependence on other places for hospitalization[23]. Thus, it is necessary to understand that the process of health regionalization in Brazil is still unfinished, and that the absence of a legal entity established at the regional level in the SUS, with a constituted legal framework, with power for the planning and operation of health care networks in a regionally integrated manner, compromises this process[24,25].

The health system must perform its functions beyond the pandemic context, with the expansion of ICUs and hospital beds, being able to reorganize the flows in the service network in order to promote the expansion of access and capacity to respond to the usual demands and urgency and emergency[26]. Although there are other relevant factors, the results on patient evasion presented in this study, especially in health regions with a small population, point to the need to expand the offer of hospital services, beds and professionals in different health regions. The regionalization of health, associated with the continental dimensions of Brazil, makes many patients travel long distances in search of hospitalization, an unfavorable situation due to the pandemic and the rapid evolution of the disease[27].

Limitations

The use of secondary data may be subject to problems in the reporting of cases. The data represent the period from March to October 2020 (before the second epidemiological wave of Covid-19 in Brazil), and it is possible that hospitalization flows occur differently in other periods of the pandemic. It was also not possible to estimate, based on the data, the repressed demand for unaccomplished hospitalization, that is, a low percentage of evasion does not necessarily translate into a high capacity to meet the demands of the health region. Furthermore, it was not possible to distinguish the hospitalization flows of the public and private sectors, as this distinction is not available in the database of the health information system used in this study. Finally, it is important to emphasize that the Euclidean distance from the municipal centroids was used to quantify the flows between health

regions. This measure may have underestimated the actual distance covered by the patients.

Implications of the results for health policy

The analysis of hospitalization flows by Covid-19 in the health regions may indicate the need to reorganize the health regions so that they are able to meet their goals, with a view to guaranteeing resolute access to the care network, in a timely manner and with quality, effecting the process of decentralization of health actions and services, with the rational use of resources, in order to reduce local and regional inequalities.

Collaborators

Silva EN (0000-0001-8747-4185)* contributed to the conception and planning of the manuscript; interpretation of results; preparation of the first draft of the manuscript; and review and approval of the final version of the manuscript. Soares FRGS (0000-0001-8244-1800)* contributed to the conception and planning of the manuscript; data collection and analysis; interpretation of results; preparation of the first draft of the manuscript; and review and approval of the final version of the manuscript. Frio GS (0000-0001-6453-312X)* contributed to the conception and planning of the manuscript; data collection and analysis; interpretation of results; and review and approval of the final version of the manuscript. Oliveira A (0000-0002-3084-6491)* contributed to the interpretation of the results; and review and approval of the final version of the manuscript. Cavalcante FV (0000-0002-8706-0457)* contributed to the interpretation of the results; preparation of the first draft of the manuscript; and review and approval of the final version of the manuscript. Martins NRAV (0000-0003-1162-8795)* contributed to the interpretation of the results; and review and approval of the final version of the manuscript. Oliveira KHD (0000-0002-3600-4009)* contributed to the interpretation of the results; preparation of the first draft of the manuscript; and review and approval of the final version of the manuscript. Santos LMP (0000-0002-6739-6260)* contributed to the design and planning of the manuscript; interpretation of results; preparation of the first draft of the manuscript; and review and approval of the final version of the manuscript ■

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