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AN OBSERVATION OF THE TERRITORIAL DISPERSION OF COVID-19 IN THE VALES REGION AND IN THE MEDIUM-SIZED CITIES OF SANTA CRUZ DO SUL AND LAJEADO IN THE STATE OF RIO GRANDE DO SUL (RS), BRAZIL

OBSERVANDO A DISPERSÃO TERRITORIAL DA COVID-19 NA REGIÃO DOS VALES E NAS CIDADES MÉDIAS DE SANTA CRUZ DO SUL E LAJEADO-RS

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Abstract

This article analyzes the spatial pattern of the dynamics of territorial dispersion of COVID-19 in the territory of the Vales (RS) region, identifying possible relations of such dynamics with the structure and functioning of the regional urban network, with the economic structure and the territorial division of regional labor, and with intraregional spatial interactions led by the medium-sized cities of Lajeado and Santa Cruz do Sul, the main economic and service centers of the Vales region. This article also analyzes the particularities, similarities, and specificities of the dynamics of the socio-spatial dispersion of the virus in the urban space of the medium-sized cities of Santa Cruz do Sul and Lajeado, correlating such dynamics with the sociodemographic and infrastructural characteristics existing in these two urban spaces.

Keywords: Territorial dispersion of COVID-19, Regional urban network, Medium-sized cities, Vales region.

Resumo

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O presente artigo analisa o padrão espacial da dinâmica de dispersão territorial da Covid-19 no território da região dos Vales-RS, identificando possíveis relações dessa dinâmica com a estrutura e funcionamento da rede urbana regional, com a estrutura econômica e a divisão territorial do trabalho regional, e com as interações espaciais intrarregionais comandadas pelas cidades médias de Lajeado e de Santa Cruz do Sul, principais centros econômicos e de serviços da região dos Vales. O artigo também analisa as particularidades, semelhanças e especificidades dessa dinâmica de dispersão socioespacial do vírus no espaço urbano das cidades médias de Santa Cruz do Sul e Lajeado, correlacionando tal dinâmica com as características sociodemográficas e infraestruturais existentes nesses dois espaços urbanos.

Palavras-chave: Dispersão territorial da Covid-19, Rede urbana regional, Cidades médias, Região dos Vales.

Introduction

COVID-19 is an infectious disease caused by the new coronavirus SARS-CoV-2. The disease arrived in Brazil in February 2020 (BRASIL, 2020) and, in the following month, on March 10 (SES-RS, 2020a), it reached Rio Grande do Sul. It has been considered a pandemic since the World Health Organization (WHO) decree of March 11 (WHO, 2020), and it first struck the city of Wuhan, China. The first time Chinese authorities reported cases of pneumonia of unknown cause to WHO was on December 31, 2019. Since then, the disease has spread rapidly to other countries and continents, usually from large urban centers, and has gradually spread throughout medium- and small-sized cities, advancing inland.

This phenomenon is related to the conditions of the technical/scientific/informational environment, which accelerate process flows and shorten distances, providing greater circulation of the virus in the globalization of the economy. The ability of human mobility through global routes facilitated the circulation of the new coronavirus SARS-CoV-2. The first ones to be contaminated were those belonging to high-income classes, due to their financial conditions to travel throughout different hemispheres and continents. The virus subsequently spread to the lowest and most vulnerable classes. According to Santos (2006), the fluidity of the dispersion took place primarily in the (global) territories with the highest technical densities of the equipment available, the so-called luminous spaces, and, subsequently, people who move from spaces less provided or even lacking such equipment, when looking for jobs and services, spread the virus in opaque spaces.

The Vales region, made up of the contiguous subregions of Vale do Rio Pardo and Vale do Taquari, in Rio Grande do Sul, had their first cases confirmed on March 21, in the municipalities of Lajeado and Estrela (RIBEIRO, 2020): people who returned from trips to Europe and from a sea cruise that had traveled the Brazilian coast.

In this context, the team of the Regional Development Observatory, associated with the Graduate Program in Regional Development, from the University of Santa Cruz do Sul decided to create the ObservaDR/Covid-19⁵ extension project, with the purpose of providing the public with secondary data and thematic maps, with scientific notes and information, on social, demographic, infrastructural, and health-related variables of the population in the neighborhoods of the municipalities of Santa Cruz do Sul and Venâncio Aires, in addition to regional data and maps on the territorial dynamics of spread of the virus in Rio Grande do Sul and in the Vales region. The project aims at producing scientific information that can inform and raise awareness among the regional society, as well as serve as support for decision-making by municipal public authorities and regional leaders in actions to prevent, control, mitigate, and fight COVID-19 in the regional territory.

This article presents part of the results achieved with the project. It intends to identify and analyze the territorial dynamics of the new coronavirus in the regional territory, with particular attention to the regional and municipal scales. This text also analyzes the relations between the spatial pattern and the dynamics of dispersion in the territory with the operation of the urban

⁵ The ObservaDR/Covid-19 project has been carried out by a team of 18 people, including professors, postdoctorates, master's and doctoral students from the Graduation Program of the University of Santa Cruz do Sul (PPGDR-UNISC). The project also operates in partnership with the Society of Architects and Engineers of Santa Cruz do Sul, the Municipal Offices of Planning of Santa Cruz do Sul and Venâncio Aires, and the Regional Council of Vale do Rio Pardo.

network and with the centrality and functions of the medium-sized cities of Lajeado and Santa Cruz do Sul, which are the main economic and service centers in the Vales region.

Gathering data about the reality in which one lives is important to, based on that, provide useful information for action planning and decision-making to prevent and fight the pandemic caused by the expansion of the coronavirus, as well as to provide scientific information for the society.

According to Santos (2007), the idea of a geographic scale is associated with the totality of the world and leads to an analysis of geographic space in its local, regional, national, and global dimensions, as an inseparable set of a system of objects and a system of actions. A set of fixed features and flows that interact in geographic space. The objects included in the space concern shapes; the actions, which are carried out in relation to and through objects, concern functions and result from and express social practices. Thus, space territorialization is a process and a product of social relations. Territory is understood as a space produced, lived, and owned by use, and determined by the different spatial functions and different uses it provides. It is the use of territory that makes it an object of analysis.

In order to understand the dispersion of COVID-19 throughout the territory, the developments of different functions and uses of space become important elements of analysis. According to Faria and Bortolozzi (2009, p.39),

“The use of the concepts of space and territory by Milton Santos allowed to change the focus of attention, which was previously on the disease, to the social determinants of health conditions. The social appropriation of space produces territories and territorialities conducive to the spread of certain diseases. The uses and functions accepted by each spatial fragment can conform to territorial profiles that reveal the conditions of access to health services, exposure to risk factors, socio-spatial exclusion, among other factors determining health situations in social groups.”

According to Czeresnia and Ribeiro (2000), Milton Santos' contributions are a relevant reference for an analysis of the relationship between space and disease, as they provide us with the understanding of their production and dispersion as the result of the social organization of space.

This study, the approach of which is qualitative, uses official secondary data collected from government agencies, such as the Health Office of Rio Grande do Sul (SES-RS), the Municipal Health Offices of Santa Cruz do Sul and Lajeado, the Ministry of Agriculture, Livestock, and Supply (MAPA), the Brazilian Institute of Geography and Statistics (IBGE), and the Ministry of Labor and Employment, by means of the 2018 Annual List of Social Information (RAIS). The data were initially organized and systematized in spreadsheets, and, after some pre-analysis, they were georeferenced with QGIS software, with subsequent preparation of thematic maps, such as those presented in the next sections. Data on the dispersion of the COVID-19 pandemic in the region were collected from March 20 to July 17, 2020. Supplementarily, stories from *Gazeta do Sul* newspaper (from Santa Cruz do Sul) and *Informativo do Vale, A Hora*, and *Independente* (from Lajeado) were used in the analysis.

This article is organized into three sections. The first provides a brief socio-spatial characterization of the territory of Vale do Taquari and Vale do Rio Pardo. In the second, the spatial pattern of the territorial dispersion of COVID-19 in the Vales region is presented, as well as the role that the operation of the regional urban network, the urban dynamics of medium-sized cities, and the territorial division of regional work played in this expansion of the virus in the regional territory. The third section presents an analysis of the spread of the virus in the geographical space of the medium-sized cities of Santa Cruz do Sul and Lajeado, with the identification of similarities and particularities in this process. Ultimately, the final considerations are presented.

Vales (RS) region and urban network: brief characterization

The Vales region is located in the Eastern Center of the State of Rio Grande do Sul and its territory corresponds to the contiguous territories of the regions of the Regional Development Councils (Coredes) of Vale do Rio Pardo and Vale do Taquari, which in turn belong to the Functional Planning Region 02, established by the State Government⁶.

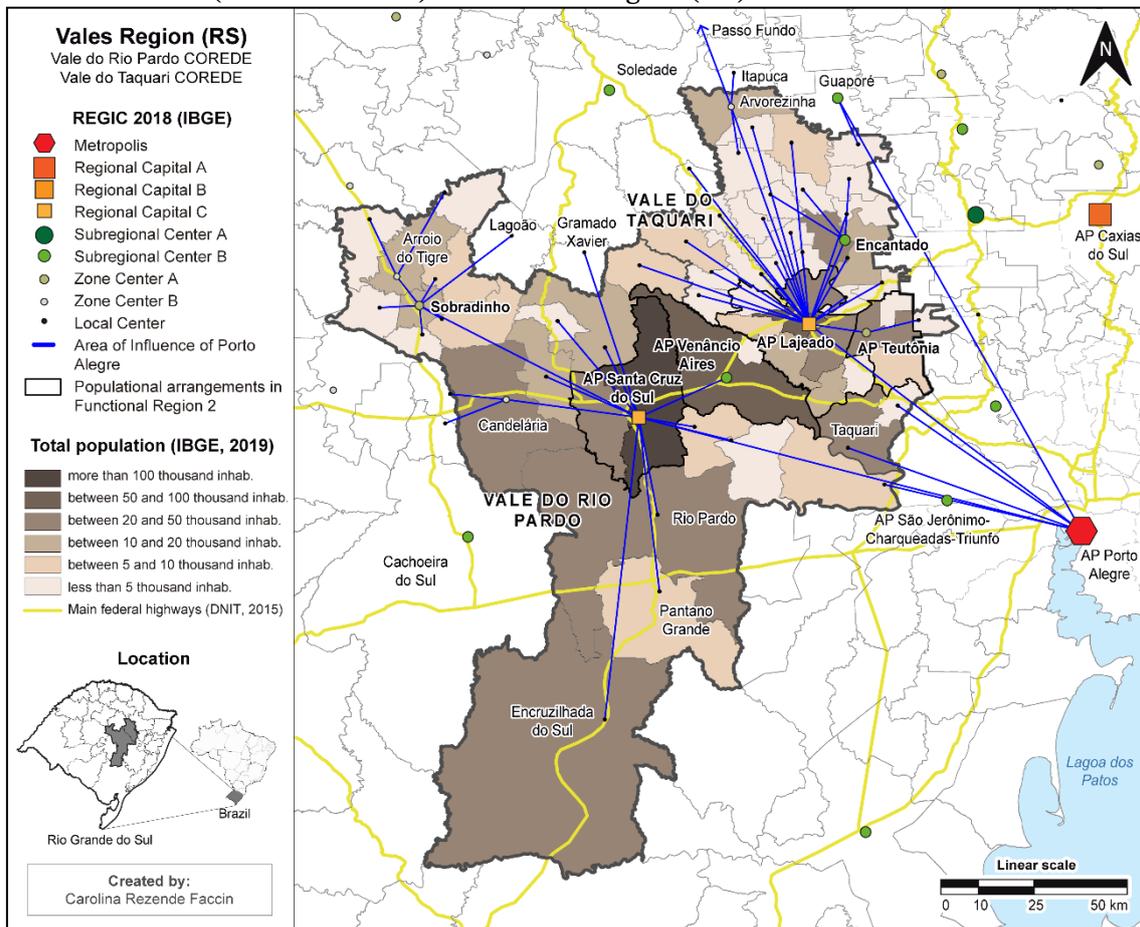
⁶ In the state of Rio Grande do Sul, a type of regionalization was created in 2006 for the purpose of territorial planning, in which the municipalities and regions of the Regional Development Councils (Coredes) were grouped into nine Functional Planning Regions. This regionalization, proposed by the State Planning Office (through the RUMOS 2015 Study), uses as basis for definition of regions economic, environmental and social homogeneity criteria and variables related to the identification of employment polarization, movement by type of transport, urban hierarchy, organization of the health and higher education network services, among others (SEPLAG, DEPLAN, 2015).

According to FEE (2018), in 2018 the region had a total population of 806,942 inhabitants, which was equivalent to 7.09% of the state's population. Among the 59 municipalities and cities that make up the region, the medium-sized cities of Santa Cruz do Sul and Lajeado stand out as the largest and main regional urban centers, each with 130,002 and 88,026 inhabitants, respectively, according to IBGE's population estimate (2019) (Image 1).

In the Vales region, most municipalities have a total population below 20 thousand inhabitants, and in many of them, particularly in municipalities with less than 10 thousand inhabitants, rural population prevails. However, in the region as a whole the rate of urbanization has intensified since the beginning of the 21st century, with 99.6% of the population in Lajeado being urban; in Santa Cruz do Sul, this percentage reaches 88.9% (IBGE, 2010).

Image 1 presents a map with data spatialization for the total population estimated in 2019 (IBGE, 2019) by municipality in the Vales region, the road system with the primary highways (DNIT, 2015), and the structure of the regional urban network, according to the study of the Areas of Influence of Cities — REGIC 2018 (IBGE, 2020).

Image 1: Location, total estimated population of the municipalities (2019), and hierarchical structure of the urban network (REGIC — 2018) of the Vales region (RS)



Created by: Carolina Rezende Faccin, based on IBGE (2019, 2020) and DNIT (2015).

The structure of the regional urban network is dominated by the medium-sized cities of Lajeado and Santa Cruz do Sul, which acting as Regional Capitals C in the urban hierarchy, polarize, centralize, and influence, respectively, the territories of the Vale do Taquari and Vale do Rio Pardo regions (IBGE, 2020). These medium-sized cities employ centrality and territorial management capacity in the regional spaces where they are located by means of their administrative and economic functions. They also mediate different flows (of people, products, goods, inputs, capital, information, etc.) that circulate between rural areas and small cities — which make up their area of influence — and the metropolis of Porto Alegre, from which they also fall under influence in the context of the state urban network.

The increasing specialization and qualification of some services provided by these two medium-sized cities, such as higher education, health, technology, and logistics, have also attracted companies and users from the metropolitan region, therefore boosting the flows and interactions between these spaces.

The cities of Encantado and Venâncio Aires are classified in the regional urban network (one level down) as Subregional Centers B and have complementary urban economies, also employing moderate centrality in the respective regions of Vale do Taquari and Vale do Rio Pardo. The cities of Sobradinho, Arroio do Tigre, Candelária, Arvorezinha, and Teutônia are classified as Zone Centers, employing centrality in the municipalities which they are contiguous with and in the micro-regions where they are located (IBGE, 2020)⁷.

The regional economy is heavily dependent on agricultural production. In terms of its rural production and land structure, the Vales region can be divided into three distinct zones. The first refers to the central and northern part of Vale do Rio Pardo, characterized by a land structure made up of small rural properties (related to family farming) and tobacco and corn production. The second refers to the southern part of Vale do Rio Pardo, which has medium and large rural properties that have been focusing on rice and soybean production, cattle raising, and silviculture. The third refers to the region of Vale do Taquari, with small rural properties related to family farming, whose main product is chicken and pig breeding and milk production.

The urban economy relies heavily on the agro-industrial advantages of these primary products, with the strong presence of multinational subsidiaries, notably in the cities of Santa Cruz do Sul and Lajeado. These two cities, respectively, play an important role in the agro-industrial complexes of tobacco and chicken and pork meat established in the region, accounting for an important participation in national production and exports, being vertically integrated into the global market for these products.

In these two medium-sized cities, economic activities of companies and local cooperatives related to the sectors of food, metalworking, metallurgy, and rubber products also stand out, as well as companies and private institutions related to the development of wholesale and retail trade, and specialized services, with emphasis on health and higher education, in addition to activities related to the public sector. In these cities, there are numerous offices of various federal and state public bodies of the executive and judicial branches that consolidate them. The demand for these services strengthened these cities as important centralities within the Vales region, something evidenced not only by the commuting flows for work and study in higher education institutions, but also by the frequent movement of the regional population to search for products in wholesale and department stores and for specialized health care.

Because of these characteristics, these medium-sized cities have also become the locus for the emergence of the initial cases of COVID-19 in the area and were their centers of diffusion in the regional territory.

The spatial pattern of COVID-19's territorial diffusion in the Vales (RS) region

The data on the COVID-19 epidemic in Rio Grande do Sul, released by the State Department of Health, from March 20 to July 17, 2020, allow us to see that the COVID-19 pandemic has spread throughout the state, with a spatial pattern characterized by the diffusion of the virus from Porto Alegre and the metropolitan region inward the state. This spatial pattern of the COVID-19 diffusion basically follows two spatial elements: the main highways of the state and the cities, especially the medium-sized ones, which are connected by these roads.

The territorial dispersion of the virus follows the organizational structure and operational dynamics of the state urban network, starting from the metropolis Porto Alegre and its metropolitan region, going inland through the main highways toward the medium-sized cities (initially those located in the perimetropolitan regions), and then toward medium and small cities located in more distant areas.

Medium-sized cities are defined mainly by their particular position in the city network system and by carrying out various intermediation functions. In general, it is possible to conceptualize a medium or intermediate city as a center of social, economic, and cultural interaction,

⁷ IBGE, in its study Areas of Influence of Cities (REGIC), of 2018, defines this hierarchical classification between urban centers taking into account the interaction networks that connect cities, which are understood as territorial management centers, as nodes of the network and its respective areas of influence.

or as a center of goods and services more or less specialized for a group of the population that surpasses the limits of its own municipality, for being a territorial interaction node by means of transport and information infrastructures that articulate networks and regional, national or international scale (BELLET; LLOP, 2004 *apud* LLOP; ÚSON, 2012). They are cities that articulate different types of material and immaterial flows, that structure and organize the area's territory (CORRÊA, 1989). They are also related to their functions and, particularly, to the role they play in the regional, national and international urban network (BRANCO, 2006).

Medium-sized cities, in addition to being populous urban centers, are important regional economic hubs, and as such concentrate most of the companies, jobs, commercial activities, and specialized public and private services existing in the respective regions. Thus, they attract daily commuting flows of workers, students, rural producers, and consumers from the municipalities in the areas where these cities are located.

The spread of the virus can occur due to different situations, through contact between people from the same city, through the flow of people between nearby cities or, as it initially occurred, through flows of people who have returned from tourist or work trips from other countries also affected by the pandemic. In the Vales region, the first confirmed cases, in early March, were of people returning from trips to Europe and from a sea cruise along the Brazilian coast (in the case of Lajeado and Estrela) and from trips to the Santa Catarina coast (in the case of Santa Cruz do Sul). At the end of March, the state declared the situation of community transmission in the state (GOVERNO DO ESTADO DO RIO GRANDE DO SUL, 2020).

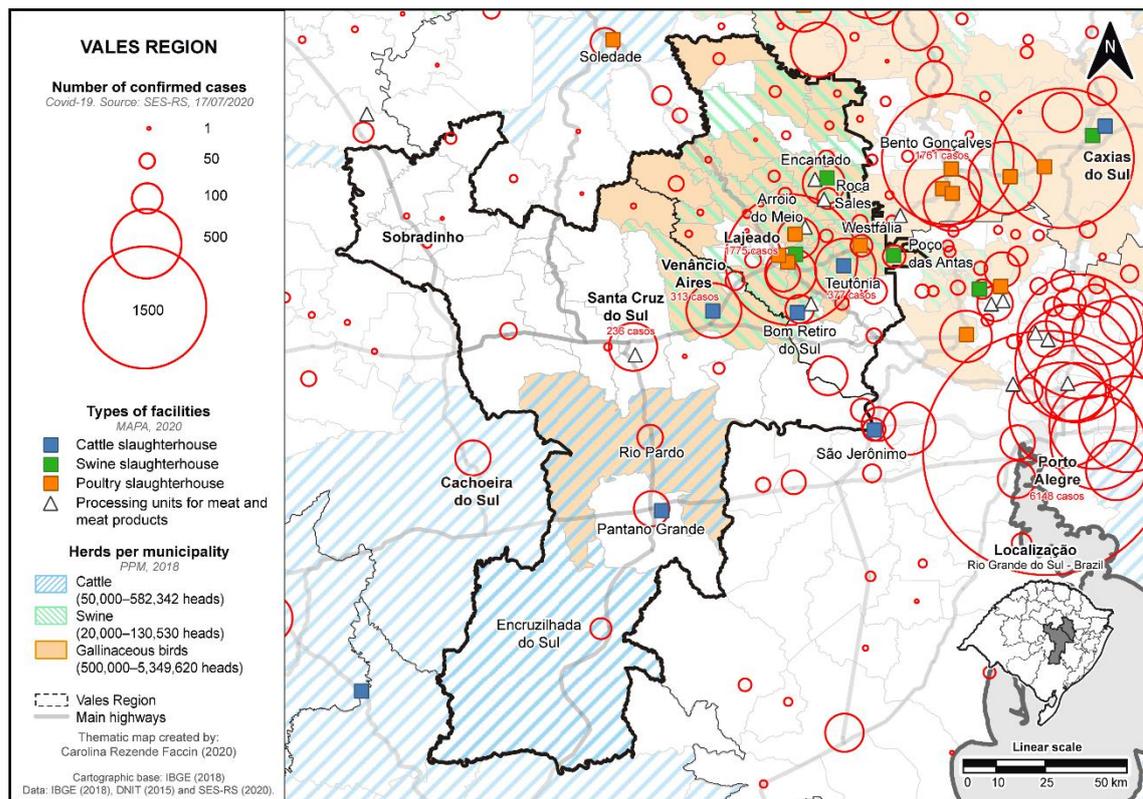
Observing the Vales region in the analyzed period, an unequal number of people infected with the new coronavirus SARS-CoV-2 and different dynamics of pandemic dispersion between the territories of the regions of Vale do Rio Pardo and Vale do Taquari were found. This uneven intensity in the cases and in the spatial dynamics of dispersion is related to the different economic structures, territorial divisions of work, and the specific spatial configurations, in terms of proximity, accessibility and interaction between the cities that make up the segments of the existing urban network in each one of these areas.

In the Vale do Taquari region, there was greater contamination among the population of its municipalities, mainly among workers employed in slaughterhouses (places that were identified as focus of infection by COVID-19). Because of this, Lajeado ranked among the cities with the highest numbers of confirmed cases in the state, and there was greater spread by the nearby municipalities. Some characteristics of the region may have contributed to this scenario.

Image 2 is a map that overlaps in the geographic space the municipal livestock production of cattle, pigs, and gallinaceous birds, according to data from the Municipal Livestock Production (IBGE, 2018); the location of slaughterhouses for poultry, pork, and beef, and processing units for meat and meat products, according to data from the Ministry of Agriculture, Livestock and Supply (MAPA, 2020); and the number of confirmed cases of COVID-19 by municipality until July 17, 2020, according to data from the Office of Health of Rio Grande do Sul (SES-RS, 2020b).

In the region, there are 15 slaughterhouses and processing units for meat products, 12 of which are in Vale do Taquari. Since the late 1940s, meat production in this region has taken place through the integration of family farmers into the meat processing agro-industry.

Image 2: Municipal livestock production, slaughterhouses, and cases of COVID-19 (07/17/2020) in the municipalities of the Vales region (RS)



Created by: Carolina Rezende Faccin, based on MAPA (2020), IBGE (2018), and SES-RS (2020b).

From the 1990s onwards, many slaughterhouses in the state of Rio Grande do Sul, including some in the region, began to conform to the standards of the competitive international market and started exporting their products. During this period, there is also capital concentration in this productive sector, with total or partial acquisition of companies and local cooperatives by large national and international groups, such as BRF and JBS. In the 21st century, ventures focused on agribusiness commodities for export were boosted and strengthened (DELGADO, 2012). Just to mention a few, Poço das Antas had a new slaughterhouse established in 2012, and Arroio do Meio had one in late 2019 (whose project started around 2014). In short, it is a productive sector in expansion, with a view to the foreign market.

This information becomes relevant in the context of the increase in confirmed cases of COVID-19 in the Vales region and, especially, in those cities with slaughterhouses. The municipality of Lajeado, until July 17, 2020, had 1,775 confirmed cases of the virus, and between May 22 and June 16, it was the municipality with the highest number of cases in the state. This increase in the number of cases is justified by the spread of the virus through the two slaughterhouses in the city, when they became the main contagion focus (CHAPARINI, 2020). According to Medina (2020), until May 22, 530 people, out of the 840 infected in Lajeado, were slaughterhouse employees. Together, these slaughterhouses employ more than 4,982 people who work in the poultry and pig slaughter sectors and in the manufacture of meat products (RAIS, 2018). This situation led the state courts to impose a ban on these two slaughterhouses for 15 days, due to the high number of employees who tested positive for COVID-19⁸ (HAUTRIVE, 2020).

It is possible to see that the spread of the virus among cities in the Vale do Taquari region is closely linked to the structure of the urban network and to the flows of workers within the meat production chain, given that the regional economy is made up of an intense network of division of

⁸ The increase in the number of COVID-19 cases, having slaughterhouses as foci of spread, also happened in the municipalities of Bento Gonçalves, Garibaldi, Passo Fundo, Marau, and even in other countries such as the United States, Germany, and Canada. What can still be seen is that the confirmed cases are concentrated in poultry slaughter units, as was the case of JBS in Passo Fundo, and Minuano and BRF in Lajeado (MAPA, 2020; RAIS, 2018; HECK *et al.*, 2020; LECLERC *et al.*, 2020).

activities, carried out by companies, among the cities. For example, in one municipality, feed is produced; in another, animals are raised; and in another, the slaughterhouse is located and meat processing takes place. This is the case of Companhia Minuano de Alimentos, whose poultry slaughterhouse is located in Lajeado, the feed factory and the meat processing unit are in Arroio do Meio, the poultry hatchery is in Estrela, and there are aviaries in Estrela and Bom Retiro do Sul (RAIS, 2018; MAPA, 2020).

The proximity between the cities of Vale do Taquari allows the daily commuting of people to work in these places. As connectivity between these cities is facilitated by accessibility and spatial proximity, many people live in one city and work in another, becoming important vectors for transmission of the virus both to their families and to other cities. Because of this spatial proximity, the municipalities that are contiguous with Lajeado also showed an increase in the number of cases during the same May 22–June 16 period, namely Arroio do Meio (which had 178 total cases on July 17), Cruzeiro do Sul (with 120 cases), and Estrela (with 267 cases) (SES-RS, 2020).

Understanding the workplace of employees on the production lines of slaughterhouses can help explain the quick and easy transmission of the virus in these locations. As explained by Barzotto (2013), in the evisceration stage, the environment is humid, with extreme temperature variations, and workers are close to each other, about 1 meter apart, in contact all day with water and waste. The production line is the largest sector of slaughterhouses — it is a humid place, whose temperature must not exceed 12 °C (BRASIL, 1998).

The research carried out by Günther *et al.* (2020), which focused on how the virus spread and on the start of the SARS-CoV-2 outbreak at the largest meat processing plant in Germany, revealed that transmission does not depend only on social proximity between workers, but also on several factors related to workplace conditions. Air circulating at 10 °C and being constantly recycled, without being refreshed, in addition to the strenuous physical work, facilitated the spread of the virus to a radius of eight meters or more inside the slaughterhouse. Thus, the proximity between the workers in slaughterhouses, the cold and humid environment, with the consequent presence of droplets in the air, and the large number of employees in the same space make the environment conducive to the spread of the virus.

In the Vale do Rio Pardo region, although there are also some beef slaughterhouses, the dynamics of dispersion of COVID-19 was different. In this area, the regional economy is based primarily on the leaf tobacco production chain, whose territorial division of labor is less complex, which results in a simpler urban network from the perspective of its operation and the dynamics of flows. The cities of Santa Cruz do Sul and Venâncio Aires concentrate most of the industries to which family farmers deliver the tobacco produced in small rural properties located in the municipalities of the region. These cities also concentrate service companies and jobs related to the sector. Currently, there are approximately 9 thousand workers — most of them, around 7 thousand, are hired temporarily during the harvest period (Gazeta do Sul, 12/02/2020).

However, the industrial processing of tobacco differs greatly from that of slaughterhouses. The environment in the production lines of the tobacco plants does not have great variations in temperature, and the workers are more distant from each other. In addition, important measures have been taken by some companies in this sector, such as temporary suspension of activities, temporary reduction in the number of employees, and mandatory use of personal protective equipment, in order to reduce this risk of contamination and spread of COVID-19.

The territorial distribution of the virus in the Vale do Rio Pardo region has so far presented greater concentration of cases in the cities of Santa Cruz do Sul (236 cases) and Venâncio Aires (313 cases). In Santa Cruz do Sul, there has been a gradual increase in the number of cases, caused by the weekly flow of people moving between the city and the metropolitan region of Porto Alegre, but also due to recurring crowds in the central area of the city, where there is a large part of commercial establishments and services, and increasing relaxation of social distance practices. The city has strong regional centrality, attracting commuting flows from neighboring municipalities for work, study, and trade and specialized services, as in the cases of daily commuting from the municipalities of Rio Pardo, Pantano Grande, and Vera Cruz. Such dynamics of spatial interaction has contributed to the spread of the pandemic among these municipalities. In Rio Pardo, there are 70 cases; in Pantano Grande, 132 cases. In the municipality of Venâncio Aires, the pandemic has spread mainly through the commuting of people who move from the city to work in slaughterhouses in Lajeado, in Vale do Taquari.

In the next section, the analysis of the spread of the virus in the medium-sized cities of Santa Cruz do Sul and Lajeado is presented, with the identification of similarities and particularities of this process.

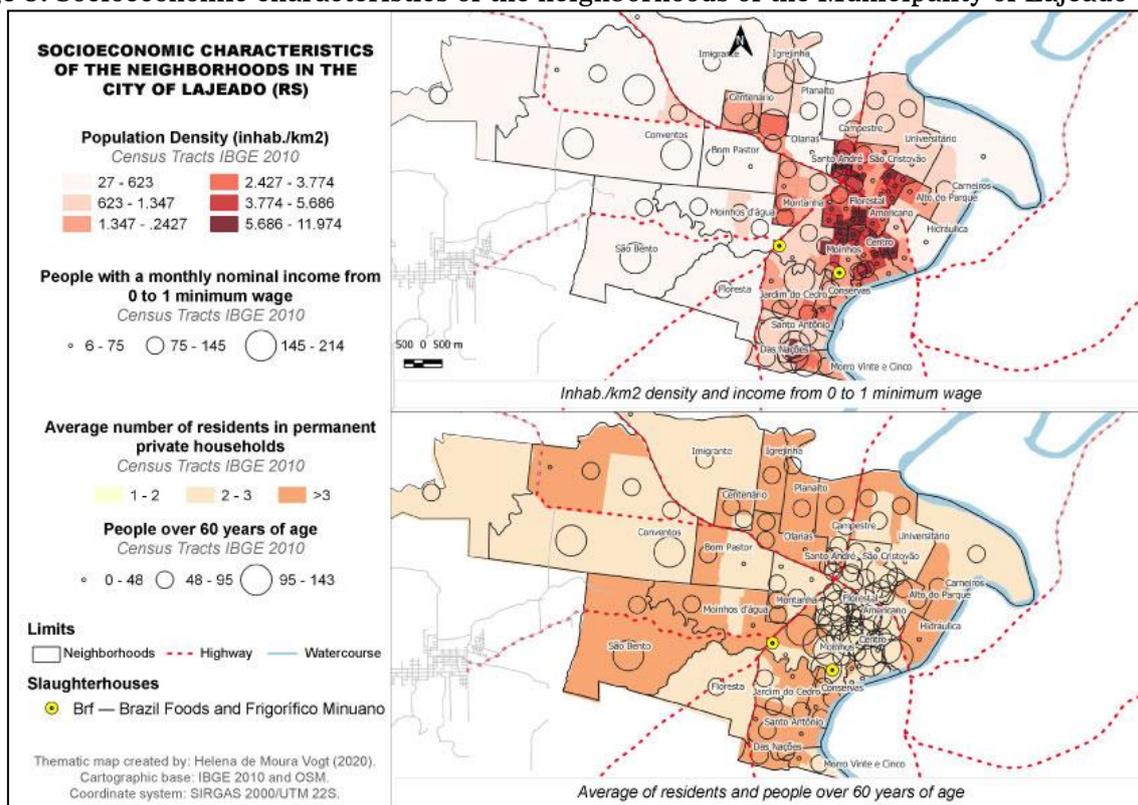
Diffusion of COVID-19 in the medium-sized cities of Lajeado and Santa Cruz do Sul: similarities and particularities

In general, it is possible to verify that the dispersion of COVID-19 in the urban spaces of the medium-sized cities of Lajeado and Santa Cruz do Sul has similar dynamics. The first cases occurred in central neighborhoods, later showing diffusion dynamics that on the one hand resulted in the intensification of the number of cases in the central areas, and on the other hand showed progressive dispersion of the pandemic toward the peripheral neighborhoods of these cities. The pandemic reached these cities through people who returned from tourist or business trips abroad or to the Brazilian metropolitan areas, expanded in the central areas, with greater concentration and crowding, due to the daily flows for commerce and services, and then went on to other neighborhoods and peripheral neighborhoods by means of the process of intra-urban interactions caused by the urban economy and the social dynamics of each city. Generally speaking — and taking into account the specificities —, this socio-spatial pattern of diffusion of COVID-19 was also seen in other medium-sized Brazilian cities, as was the case in the state of São Paulo, as indicated by the Radar Covid-19 research group, from UNESP (UNESP, 2020).

The diffusion of COVID-19 in the medium-sized cities of Lajeado and Santa Cruz do Sul also has particularities, due not only the social distancing rates reached in each city, but also due to the morphological, infrastructural, demographic, and socioeconomic characteristics of the urban space, and the distinct way in which these elements exist in the different zones and neighborhoods of these cities.

The health regions of Lajeado and Santa Cruz do Sul belong to the group of regions with the worst social distance rate in the state of Rio Grande do Sul, according to the monitoring based on cell phone applications that is performed by the State Government's Crisis Office. Between July 19 and July 25, 2020, the average weekly isolation rate in the health region of Lajeado was 36.9%. In the health region of Santa Cruz do Sul, it was 38.6%. The average isolation rate in the two regions is lower than the state average (41.4%) and the national average (40.3%). These low levels of social isolation in these areas are due to the increasing reduction in social distance observed in the cities of Lajeado and Santa Cruz do Sul in that same period, when the number of new cases of COVID-19 increased in their territories. Santa Cruz do Sul went from 237 to 295 cases — an increase of 24.47%. In Lajeado, the number of cases grew from 1,776 to 1,930 — an increase of 8.61% (SES-RS, 2020b, 2020c).

The city of Lajeado has a spatial configuration conditioned by the River Taquari, which borders it to the east and southeast, separating it from the neighboring municipality of Estrela. As for its socioeconomic characteristics, Image 3 shows the spatial distribution of four different indicators, extracted from the 2010 Demographic Census (IBGE, 2010), namely: 1) The population of the city is concentrated mainly in the neighborhoods located in the central areas of the city, such as Centro, Florestal, Moinhos, Americano, Santo André, and São Cristóvão, which have the highest demographic density, in the range from 3,774 to 11,974 inhab./km², and in the neighborhoods of the southern periphery, such as Santo Antônio, Das Nações, and Monte Vinte e Cinco, which present demographic density between 2,427 and 3,774 inhab./km²; 2) The neighborhoods with the highest average number of residents in permanent private households (more than three inhabitants per household), considering the data by census tracts, are the neighborhoods peripheral to the city center, which have higher population density, such as Hidráulica, Alto do Parque, Carneiros, Universitário, Campestre, Planalto, Igrejinha, Olarias, Centenário, São Bento, Moinhos d'Água, Conservas, Das Nações e Santo Antônio; 3) People with a monthly nominal income from 0 to 1 minimum wage are located in the south, southwest and northwest of the city, predominantly in the Santo Antônio, Monte Vinte e Cinco, Jardim do Cedro, Conservas, Moinhos, São Bento, Conventos, Centenário, Igrejinha, and Universitário neighborhoods. 4) The at-risk population, over 60 years old, is located predominantly in the central neighborhoods, such as Moinhos, Centro, Americano, Floresta, and São Cristóvão, and in the peripheral neighborhoods São Bento and Conventos.

Image 3: Socioeconomic characteristics of the neighborhoods of the Municipality of Lajeado (RS)

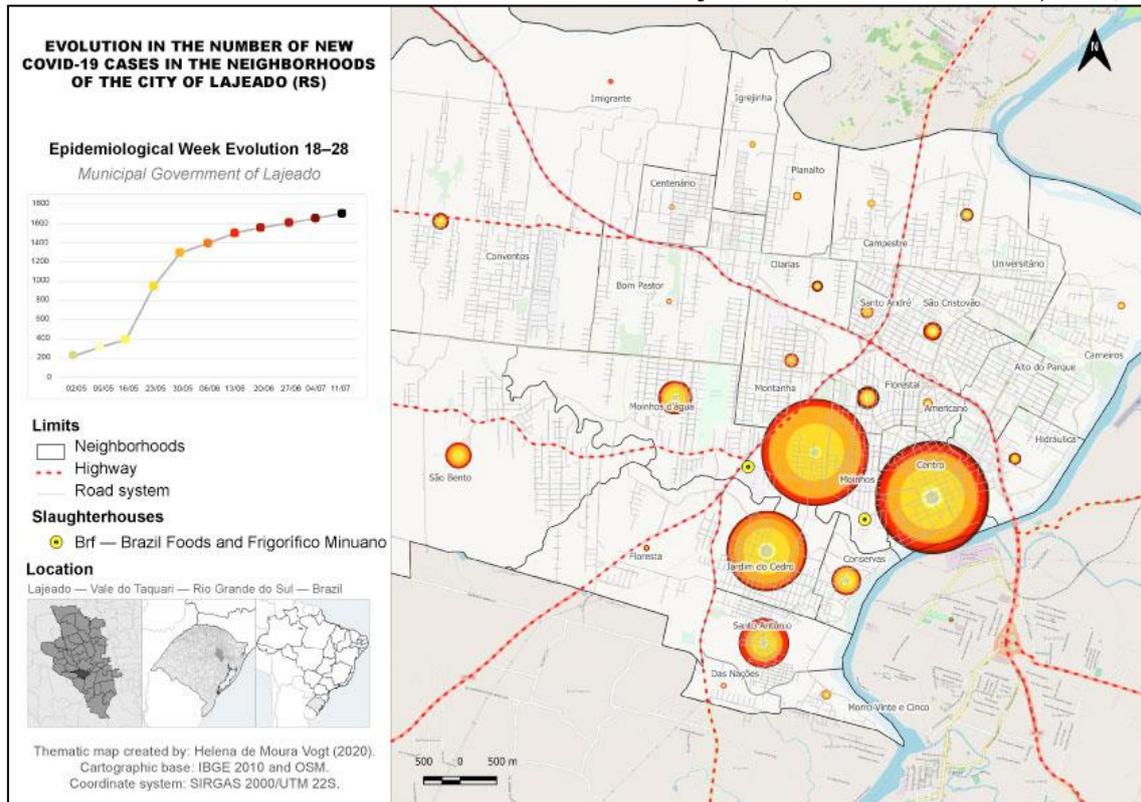
Created by: Helena de Moura Vogt (2020) based on census tracts (IBGE, 2010).

Image 3 also indicates the location of BRF's slaughterhouse, for poultry and pig, and Minuano's slaughterhouse, for poultry. They are located on Carlos Spohr Filho street, in the Moinhos neighborhood, 2 km apart from each other. Therefore, it is possible to see, based on the spatial distribution of the sociodemographic indicators and the location of the slaughterhouses in the city, the areas which have the greatest possibility of incidence and spread of the virus. Among them, the central neighborhoods close to the slaughterhouses that have higher population density and greater number of people over 60 years of age are highlighted, as well as the peripheral neighborhoods to the south and close to the slaughterhouses, which have lower monthly nominal income and higher average in the number of residents in households.

Taking into account this brief socioeconomic characterization of the neighborhoods in the city of Lajeado, it is possible to see possible correlations and to identify differences in the dynamics of the distribution of COVID-19 cases between the city neighborhoods, as shown in Image 4. It shows the territorial dispersion of confirmed cases of COVID-19 in the Lajeado neighborhoods between the 18th and 28th epidemiological weeks (i.e., between May 2 and July 11, 2020).

As an example, it is worth mentioning that while the first confirmed case of COVID-19 infection identified in the Alto do Parque neighborhood occurred on 24.03.2020, in the Moinhos neighborhood, this infection occurred later, on 09.04.2020. However, the intensity of the spread of the virus was very different between them. On 29.07.2020, there were 25 confirmed cases of COVID-19 in the Alto do Parque neighborhood, whereas in the Moinhos neighborhood, 321 cases were already confirmed. Alto do Parque is a neighborhood with lower population density and a smaller contingent of people with a nominal monthly income of up to one minimum wage. The Moinhos neighborhood, on the other hand, has a population contingent with lower income and technical objects in the territory, such as two slaughterhouses, where the number of cases of contamination was significant, resulting from crowding and an inadequate model of sanitary control in the process of production. Thus, at the end of July, the numbers of confirmed cases of the disease were very discrepant between these neighborhoods.

As shown in Image 4, from May 2 to July 11, the highest numbers of cases occurred in the Centro (298 cases) and Moinhos (281 cases) neighborhoods. Also noteworthy are the neighborhoods of Jardim do Cedro (211 cases) and Santo Antônio (132 cases).

Image 4: Evolution of the number of COVID-19 cases in Lajeado (from 02/05 to 11/07, 2020)

Created by: Helena de Moura Vogt (2020) based on data from SES-RS (2020b).

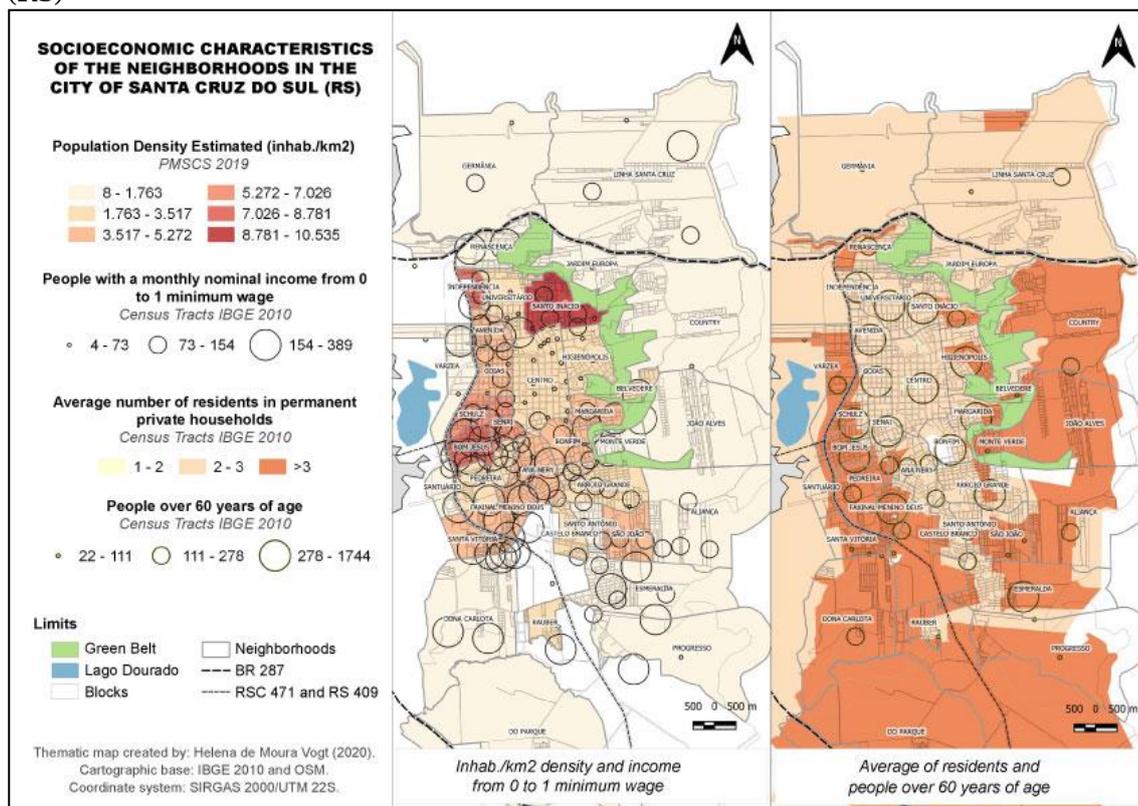
It is possible to see that the cases are concentrated in neighborhoods close to the slaughterhouses. This information is related to the growing number of confirmed cases after mass testing of workers in these slaughterhouses, following COVID-19 outbreaks. It should also be noted that the increase in cases occurred mainly between the weeks of 23/05 and 13/06, precisely when these outbreaks were identified in the slaughterhouses. Since then, the number of cases has stabilized, increasing again in the last week of July in virtually all neighborhoods.

A significant portion of the 4,982 workers formally employed in these slaughterhouses, according to RAIS (2018), live in neighboring cities and commute every day to work, notably by means of mass transportation, be it public or hired by their companies. Other workers live in the municipality of Lajeado, near their jobs, in the Moinhos, Centro, Jardim do Cedro, Santo Antônio, and Conservas neighborhoods.

In the Centro neighborhood, many people who work in slaughterhouses, including foreign immigrants, live in the old part of the city, next to the river, where housing and rents are more affordable due to real estate devaluation, since this is an area of frequent flooding in times of inundation of River Taquari, as happened on June 8, 2020.

In turn, when analyzing the socioeconomic characteristics of the neighborhoods in the city of Santa Cruz do Sul, based on census tracts from IBGE, it is possible to see, according to Image 5, a different socio-spatial configuration in relation to Lajeado. In Santa Cruz do Sul, the population is concentrated not only in the central area, but in the surroundings, as in the Santo Inácio and Independência neighborhoods, in the northern periphery, and in the Bom Jesus, Senai, and Schutz neighborhoods, in the urban periphery west of the city. Therefore, in Santa Cruz do Sul, it is possible to see that the neighborhoods with higher population density also have the largest number of people with a nominal monthly income of 0 to 1 minimum wage, differently from Lajeado.

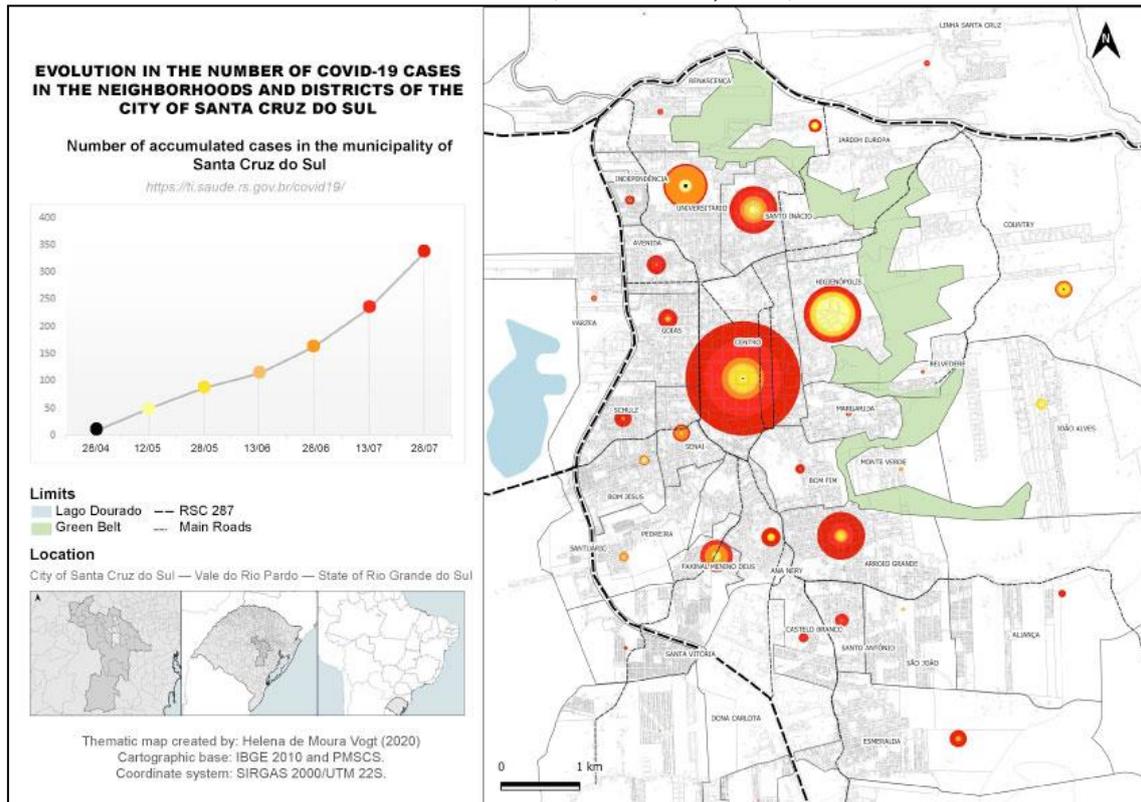
Image 5: Socioeconomic characteristics of neighborhoods in the municipality of Santa Cruz do Sul (RS)



Created by: Helena de Moura Vogt (2020) based on census tracts (IBGE, 2010).

Regarding the third and fourth indicators represented in Image 5, it is possible to see that, as in Lajeado, the highest average in the number of residents in permanent private households (greater than three residents) is also found in the western, eastern and southern peripheries of the city. As for the largest number of people over 60 years of age, some neighborhoods are highlighted, such as Higienópolis, Centro, Santo Inácio, Independência, Universitário, Avenida, Goiás, Schutz, Senai, Bom Jesus, Faxinal Menino Deus, Bom Fim, Arroio Grande, Margarida, and Esmeralda.

Image 6 shows the territorial dispersion of confirmed cases of COVID-19 in the neighborhoods of the city of Santa Cruz do Sul, on April 28, May 12 and 28, June 13, and July 13 and 28. The total number of cases, until July 28, is 336, with 320 cases in the primary district and in urban areas and 16 in other districts. In the urban area, the highlights are the neighborhoods that have a high number of people over 60 years of age, according to IBGE 2010 data, namely Centro (60 cases), Higienópolis (30 cases), Arroio Grande (25 cases), Santo Inácio (25 cases), Universitário (23 cases), and Faxinal Menino Deus (19 cases).

Image 6: COVID-19 cases in Santa Cruz do Sul (28/04–28/07, 2020)

Created by: Helena de Moura Vogt (2020) based on data from SES-RS (2020b).

The growth in the number of cases in each neighborhood in the city has occurred differently. When observing the high number of confirmed cases in the Higienópolis neighborhood, compared to other neighborhoods in the municipality, it is necessary to take into account the outbreak that hit the two units of Laranjeiras geriatric clinic in the beginning of May (GAZETA DO SUL, 2020). The neighborhoods Centro and Arroio Grande have shown greater growth in recent weeks, due to the reopening of trade and services and the location of basic health services. The Santo Inácio and Independência neighborhoods have high demographic density and concentration of elderly population. The Faxinal and Menino Deus neighborhoods have a high average number of inhabitants per household and very low family income.

Therefore, in the cities of Lajeado and Santa Cruz do Sul, there are different places where the virus emerged. In Lajeado, the virus first appeared and spread in neighborhoods where slaughterhouses are located, and in Santa Cruz do Sul, this occurs in the neighborhood near the university and in the neighborhood where the residences of high-ranking employees of tobacco companies are concentrated.

However, the spread of the virus in both cities is progressively worsening in the central crowded neighborhoods, given the concentration of commercial establishments and health services that attract an intense flow of people daily. This expansion of COVID-19 cases has also occurred in the peripheral neighborhoods of the two cities, which have a high average number of residents per household and a low average wage income for their residents.

Final considerations

In the present context in which we live, the emergence and rapid global spread of the COVID-19 pandemic are associated with the conditions of the current technical/scientific/informational content of the geographical space, which accelerates diverse flows and brings together and articulates regions and places, facilitating the circulation of the virus in the context of economic globalization.

The spread of the virus in the world has revealed spatial patterns of dispersion, intensities of contagion and distinct social and economic consequences in different national territories and in their regions. This is a result not only of the uneven content of the available health structures, but also of the social and economic dynamics existing in these places, of the way the work is territorially

organized and distributed, of the structure, scope, and integration of the urban network, and of the effectiveness of public policies for prevention, control and mitigation adopted in each territory. In other words, territories and their uses are important both in the analysis of this pandemic and in the pursuit of solutions to overcome it.

It is possible to see that the dynamics of territorial dispersion of COVID-19 in the Vales region and in its medium-sized cities of Santa Cruz do Sul and Lajeado, in Rio Grande do Sul, presents characteristics similar to what is observed in other regions and cities in Brazil and abroad, but it also reveals peculiarities (particularly among its sub-regions) related to the uses of the territory.

Despite showing similarity in terms of the worst rates of social distance among the regions of the state of RS, the spatial pattern of the territorial dispersion of COVID-19 has been different between the sub-regions of Vale do Rio Pardo and Vale do Taquari. This difference is strongly associated with the territorial division of regional work and the spatial configuration and the dynamics of the regional urban network flows in each of the sub-regions. The fact that there are 15 slaughterhouses and processing units for meat products — 12 of them in Vale do Taquari — with high humidity and temperature variations in production lines with little distance between the expressive number of workers involved in the industrial activity of the production chain of poultry and pork meat has been one of the variables that explain the high number of cases of the disease in this sub-region. The other variable that has contributed significantly to this greater intensity and territorial diffusion of COVID-19 has been the regionalized structure of production of this productive chain, which involves intense flows not only of inputs and products, but also of people residing in a city and commuting to another, therefore contributing to the virus spreading more intensely through cities in that area. Among them, Lajeado stands out (given the higher concentration of slaughterhouses and population), having remained for a few weeks, between mid-May and June 2020, as the municipality with the highest number of cases of COVID-19 in the state.

In Vale do Rio Pardo, the dispersion of COVID-19 was different, as the regional economy is strongly structured in the tobacco production chain, whose production dynamics involves a simpler territorial division of labor, with most of the productive structures concentrated in Santa Cruz do Sul and, secondarily, in Venâncio Aires, which results in less intensity in urban flows between cities in this sub-region.

Such economic and social characteristics of how production and work are organized and distributed in the territory distinguish the territories of these two sub-regions, promoting different dynamics in the regional urban structure. Such territorial processes and conditions also show particularities in the volume of cases of the disease and in the intensity of its territorial dispersion in the scale of the medium-sized cities of Lajeado and Santa Cruz do Sul. Lajeado is among the five cities with the highest number of cases in Rio Grande do Sul, with the greatest spatial concentration of COVID-19 cases in neighborhoods with slaughterhouses and/or with households whose residents are employed by these companies. In this sense, the Centro, Moinhos, Jardim do Cedro, Santo Antônio, and Moinhos D'água neighborhoods had the highest number of cases, unlike the Alto do Parque neighborhood, which has residential characteristics and whose residents enjoy a higher standard of living. In Santa Cruz do Sul, the dispersion occurred related to outbreaks in geriatric clinics and the movement of people in the context of commerce and services. The Centro, Higienópolis, Santo Inácio, Universitário, and Arroio Grande neighborhoods had the highest numbers of infection cases.

Among the similarities in the dynamics of expansion of the new COVID-19 cases in the urban space of both cities, it is possible to see that the increase in cases has occurred both in central neighborhoods and in peripheral neighborhoods of these municipalities — in the central areas, due to the concentration of commercial and service establishments, the greater demographic density, and the reduction of social distance caused by crowding resulting from consumption; in the peripheral areas, due to the precarious conditions of urban infrastructure, the higher average number of residents per household, and the low family income and higher unemployment rates among its residents.

The results analyzed herein are not definitive. The pandemic is still advancing in the Vales region and in its medium-sized cities, as well as in other regions and cities in the state, the country, and abroad. There are many uncertainties and insecurities. Its consequences and impacts in the different territories are and will be many, reinforcing our belief that particularities and territorial assets also need to be considered for the creation of solutions to this health and economic crisis. Territories matter.

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