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Characterization of COVID-19 cases in a poor community in Rio de Janeiro/Brazil focusing on the agglomeration-poverty dichotomy

Caracterização dos casos de COVID-19 em uma comunidade carente no Rio de Janeiro/Brasil com foco na dicotomia aglomeração-pobreza

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Abstract *This study aims to characterize the morbidity of COVID-19 in the year 2020 by identifying the most vulnerable areas and areas of clustering of cases in a favela from Rio de Janeiro/Brazil known as Manguinhos. This is a cross-sectional descriptive study performed from March 16, 2020, to August 12, 2020. We described the sociodemographic profile of the cases and performed spatial analysis using point and Kernel maps. Incidence rates were calculated by sex, age, and sub-regions. The incidence rate was 202/10,000. We detected clusters of cases west, central-north, and central-south of Manguinhos. High incidence rates were observed also in sub-regions of central-north, central-south, and southwest. In the sub-regions with high incidence, the percentage of people depending on financial governmental aid ranged between 13% and 21%. The sub-regions with the highest agglomeration of cases in the territory of Manguinhos coincide with the regions with the highest incidence rates, but not with the poorest regions of the territory.*
Key words *Spatial analysis, COVID-19, Coronavirus, Epidemiology, Brazil*

Resumo *O objetivo deste estudo é caracterizar a morbidade da COVID-19 no ano de 2020, identificando as áreas mais vulneráveis e áreas de aglomeração de casos em uma favela do Rio de Janeiro/Brasil conhecida como Manguinhos. Trata-se de um estudo descritivo transversal realizado de 16 de março a 12 de agosto de 2020. Descrevemos o perfil sociodemográfico dos casos e fizemos análise espacial por meio de mapas de pontos e Kernel. As taxas de incidência foram calculadas por sexo, idade e sub-regiões. A taxa de incidência foi de 202/10.000 habitantes. Detectamos aglomerados de casos a oeste, centro-norte e centro-sul de Manguinhos. Altas taxas de incidência foram observadas também nas sub-regiões centro-norte, centro-sul e sudoeste. Nas sub-regiões com alta incidência, o percentual de pessoas dependentes de ajuda financeira governamental variou entre 13% e 21%. As sub-regiões com maior aglomeração de casos no território de Manguinhos coincidem com as regiões com as maiores taxas de incidência, mas não com as regiões mais pobres do território.*
Palavras-chave *Análise espacial, COVID-19, Coronavírus, Epidemiologia, Brasil*

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Introduction

With the arrival of the SARS-CoV-2 virus that causes COVID-19, the world faced the need to think about the constant challenges of modern society, which require science's development to understand the evolution of new events[1,2]. COVID-19 is a highly contagious disease, transmissible mainly by exposure to respiratory secretions, droplets, and aerosols containing the infecting virus[3-5].

The favelas (subnormal settlements) are vulnerable areas to the spread of infectious diseases, which encourages us to investigate the agglomeration-poverty dichotomy as a predictor of greater risk for COVID-19. In Brazil, the SARS-CoV-2 virus' morbidity and mortality have been worsened by socioeconomic issues, especially in vulnerable communities such as the favelas[6]. The precarious conditions and the lack of public sanitation systems have contributed to many people in vulnerable conditions not complying with the health guidelines established for the prevention and control of the disease – such as social distancing[6-11].

The COVID-19 pandemic in the city of Rio de Janeiro generated significant impacts throughout the entire period. In November 2020, there were 302,746 confirmed cases – 117 deaths per 100,000 inhabitants and by the end of that same year, approximately 193 thousand cases with 18 thousand deaths. The city ranked first in lethality and ranked second in mortality in Brazil[12,13].

According to the 2010 census conducted by Instituto Brasileiro de Geografia e Estatística, over 20% of the population in the city of Rio de Janeiro lived in favelas, which causes a great concern face of pandemics[13-15]. The COVID-19 lethality, for example, is higher in favelas (9.08%) than in other neighborhoods (4.87%) where there are better socioeconomic conditions[6].

Analyzing the distribution of COVID-19 in poor communities is essential to understanding the transmission dynamics in these areas and focusing on measures best suited[16]. In this sense, what is the knowledge about the characteristics of the spatial distribution of COVID-19 in the most vulnerable areas? Would faster and more efficient targeted actions be needed to minimize the spread of the disease in these locations?

This study aims to characterize the morbidity of COVID-19 in 2020 by identifying the most vulnerable areas and areas of clustering of cases in a poor community (known as Manguinhos' favela) located in the city of Rio de Janeiro/Brazil.

Methods

This is a cross-sectional descriptive exploratory study. Morbidity data were obtained from the Health Surveillance sector of the Escola Nacional de Saúde Pública Germano Sinval Faria Sergio Arouca/Fundação Oswaldo Cruz (CSEGSF/ENSP/FIOCRUZ), Primary Care Unit. Population data were collected from CSEGSF/ENSP/FIOCRUZ, in March 2022. Data from the present study refer to the territory of Manguinhos. The choice of this location for the investigation was due to the precarious sociodemographic conditions of the population, similar to several other favelas in the city of Rio de Janeiro.

The community of Manguinhos is located in the northern part of the city of Rio de Janeiro, comprises 261.84 hectares, 13 community sub-regions, 40,586 thousand inhabitants in 2022, and 10,622 households. The region is fully covered by the government's "Family Health Strategy" program, with 13 health teams providing the community with primary health care[16].

The territory shows rapid population growth potential. There are up to 6 individuals living in the same household, with each household only a wall or ceiling away from the other[14]. The COVID-19 mortality rate in Manguinhos is 28 deaths per 100,000 inhabitants (5/11/2020), ranking 30th among the neighborhoods in the city of Rio de Janeiro[17,18].

The incidence rates were calculated from the number of notifications divided by the resident population and multiplied by 10,000. The total study run went from March 16, 2020, to August 12, 2020, however, we added the cases' information in 1-year (March 16, 2020, to March 15, 2021), only for the calculation of the annual incidence.

For spatial analysis, two 75-day span periods were analyzed besides the total run period: the first went from March 16, 2020, to May 29, 2020, and the second went from May 30, 2020, to August 12, 2020. The choice of periods was based on equal observation times. In the two periods analyzed, the circulating Sars-Cov2 virus was its original version, the Wuhan strain[13,14].

The area partition of the Manguinhos' territory followed the division implemented by the community's health care teams. The population demographic density in each area was calculated using the number of residents in the numerator and the area in square kilometers (km^2) in the denominator. It ranged from 3,996 to 59,453 inhabitants per km^2. As an indicator of social vulner-

ability, the percentage of people benefiting from the government financial aid program (Bolsa Família Program) per sub-region was calculated based on the number of beneficiaries divided by the respective population.

Since test kits were not available in public primary care services during the beginning of the pandemic, this study included all the cases reported in the Epidemiological Surveillance Service of the Manguinhos territory between March 16, 2020, to August 12, 2020, even those which have been diagnosed only by clinical-epidemiological criteria, without carrying out laboratory tests.

The profile of this population was described based on the absolute and relative frequency of age group (10-year interval) and gender.

The spatial analysis of the distribution of cases was carried out both for the total period and for the two partial periods. A choropleth map was built from the percentage of people receiving government financial aid. The geographic coordinates (latitude and longitude) were extracted from the residence address of the cases to build point and Kernel density maps.

For the point maps, a vector file of points was generated in the shapefile format, with Coordinate Reference System: EPSG:4326 - WGS 84 - Geographic, Coding: UTF8, Geometry: Point (Point). From that, a layer was added with the geometry: Polygon (MultiPolygonZ) and Coordinate Reference System EPSG:4326 - WGS 84 – Geographic with the population density of the Manguinhos territory.

Kernel density maps were made from a vector file of points generated in shapefile format, with Coordinate Reference System: EPSG:31983 - SIRGAS 2000 / UTM zone 23S – Projected, Coding: UTF8, Geometry: Point (Point). A layer with the geometry: Polygon (MultiPolygonZ) and Coordinate Reference System EPSG:4326 – WGS 84 – Geographic of the territory of Manguinhos was added. The point cloud containing information about cases served as the basis for the constitution of the Kernel density map.

The Kernel map was built using the following parameters: radius of 100 meters, size of the pixel X and Y 10.000000 with the following settings: a) Symbology - Rendering type (single band false-color), band (band 1: gray), min (0.0000005), max (43.9698982); b) Min/Max value setting - (cumulative cut-off count: 2.0 – 98.0%), (min/max: no marker), (mean +- standard deviation: 2.00), (statistics range: integer raster), (precision : estimated: fast); c) Interpolate - Linear; d) Label precision – 4; e) Legends specifications: 1) Total study period - blue color: 0.0000, orange color: 10.9925, yellow color: 1.9849, green color: 32.9774, red color: 43.9699; 2) First period - blue color: 0.0000, orange color: 6.3877, yellow color: 12.7753, green color: 19.1630, red color: 25.5506; and 3) Second period - blue color: 0.0000, orange color: 4.5588, yellow color: 9.1177, green color: 13.6765, red color: 18.2353; f) Mode – continuous; Class - 05; g) Color rendering – Blending mode (normal), brightness (-29), gamma (2.43), contrast (-3), saturation (25), grayscale (off); h) Resampling - Approximate at (nearest neighbor), absent (nearest neighbor), oversampling (2.0).

The maps were built using the QGIS software (Quantum Geographic Information System) version QGIS-OSGeo4W-3.16.11-1-Setup-x86_64 and the other analyzes were performed using the statistical software R-Project version 4.2.1.

The study was approved by the Ethics Committee of FIOCRUZ, CAEE: 43691721700005240.

Results

The number of cases during 1 year was 4009. Considering the population of 40,586 inhabitants, the incidence rate of COVID-19 cases in the population of Manguinhos between March 16, 2020, and March 15, 2021, was 987.8 cases per 10,000 inhabitants. If we consider only the cases that occurred in 2020 in the period from March 16, 2020, to December 31, 2020, the notification rate would be 750.8 cases per 10,000 inhabitants.

The highest incidence rate was observed in females, especially in 1-year (1,110.7/10,000). The highest incidence rates were observed in the age groups of 30 to 39 years and 40 to 49 years. The observed annual rate and in the 1st and 2nd periods were around 1,250/10,00 and 300/10,000, respectively. The lowest notification rate is observed in the 10-19 age group (annual rate: 429.7/10,000) (Table 1).

The Manguinhos region has 13 sub-regions divided to organize the action of the Primary Care health teams. The population demographic density is higher than 40,000 inhabitants per km^2 in sub-regions "Confiança", "Renovação" and "Aconchego"; and higher than 30,000 inhabitants per km^2 in the previous sub-regions and "Amizade" and "Harmonia" (Table 2).

About 19% of the population of Manguinhos receives governmental financial aid ("Bolsa Família"), which is reserved for the poorest fam-

Table 1. Distribution of the frequency of COVID-19 cases, by sex and age, in the Manguinhos (Rio de Janeiro)

Variables	Period	n	n	%	%	Population	Incidence rate/10,000			
		1st	2nd	1st	2nd		1st	2nd	1st & 2nd	1 year
Sex	Female	289	204	56.12	62.96	21,870	132.1	93.3	225.4	1,110.7
	Male	226	120	43.88	37.04	17,933	126.0	66.9	192.9	872.1
Age (years)	0 - 9	53	58	10.29	17.90	5,541	95.7	104.7	200.3	1,037.7
	10 - 19	28	29	5.44	8.95	6,098	45.9	47.6	93.5	429.8
	20 - 29	60	49	11.65	15.12	6,939	86.5	70.6	157.1	931.0
	30 - 39	106	34	20.58	10.49	6,361	166.6	53.5	220.1	1,128.8
	40 - 49	99	65	19.22	20.06	5,259	188.3	123.6	311.9	1,319.6
	50 - 59	89	50	17.28	15.43	4,243	209.8	117.8	327.6	1,235.0
	>= 60	80	39	15.53	12.04	5,362	149.2	72.7	221.9	1,038.8

Periods: 1st = March 16, 2020, to May 29, 2020; 2nd = May 30, 2020, to August 12, 2020; 1st & 2nd = March 16, 2020, to August 12, 2020; 1 year = March 16, 2020, to March 15, 2021.

Source: Authors.

Table 2. Distribution of the population demographic density and the percentage of people receiving government financial aid (Bolsa Família Program) in Manguinhos' sub-regions, 2022.

Sub-region	Population	Demographic density/km²	People receiving government financial aid	
			n	%
Aconchego	3,405	42,746.5	551	16.2
Amizade	3,284	36,612.9	591	18.0
Confiança	3,425	59,452.8	815	23.8
Coragem	2,921	39,95.9	717	24.6
Felicidade	3,035	21,978.6	476	15.7
Fortaleza	2,911	8,420.5	281	9.7
Fraternidade	3,453	11,153.3	363	10.5
Harmonia	3,077	34,596.0	438	14.2
Liberdade	2,916	28,038.5	684	23.5
Renovação	2,855	48,389.8	833	29.2
Sabedoria	3,151	15,534.0	801	25.4
Serenidade	3,200	24,140.5	529	16.5
Vida	2,953	4,076.7	461	15.6
Total	40,586		7,540	18.6

Source: Authors.

ilies in the country. The "Renovação" sub-region showed the highest percentage of beneficiaries of financial aid, 29%, while the "Fortaleza" sub-region showed the lowest percentage, around 10%. Only sub-regions "Liberdade", "Confiança", "Coragem", "Sabedoria" and "Renovação" showed percentages greater than 20%, indicating that in these sub-regions the families are poorer than in the others (Table 2, Figure 1).

Incidence rates in these sub-regions ranged from 3.6/10,000 to 466.3/10,000 in the first 150 days of the pandemic. In the first 75 days, the total incidence rate was higher than in the subsequent 75 days (122.9/10,000 vs. 79.1/10,000). The "Vida" sub-region showed the highest rate in the first and second periods: 280.9/10000 and 185.3/10,000, respectively. On the other hand, the "Sabedoria" sub-region, showed low rates in both periods (3.1/10,000). The sub-region "Felicidade" did not report any cases in the second period (Table 3, Figure 1).

The spatial distribution of incidence rate points that "Vida" and "Aconchego", sub-regions located in central-north and south-central areas, showed the highest incidence rates, and an intermediate percentage of people who receive financial assistance from the government (around 16%) (Figure 1, Table 2).

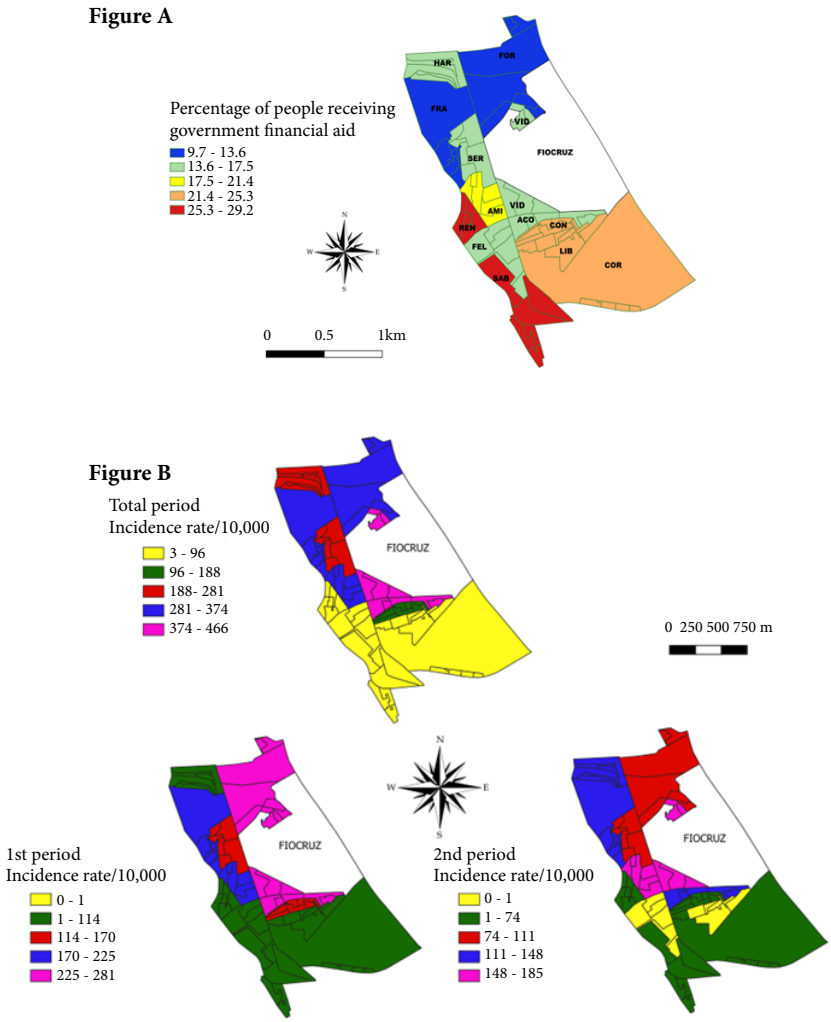

Figure 1. Spatial distribution in Manguinhos' sub-regions. A) Distribution of the number of people receiving government financial aid ("Bolsa Família"); B) Distribution of the notification rate of COVID-19.

Figure A e Figure B
ACO = Aconchego; AMI = Amizade; COM = Confiança; COR = Coragem; FEL = Felicidade; FOR=Fortaleza); FRA=Fraternidade; HAR=Harmonia; LIB=Liberdade; REN = Renovação; SAR = Sabedoria; SER = Serenidade; VID = Vida; FIOCRUZ = Fundação Oswaldo Cruz. Total period = March 16, 2020, to August 12, 2020, 1st period = March 16, 2020, to May 29, 2020, 2nd period = May 30, 2020, to August 12, 2020; FIOCRUZ = Fundação Oswaldo Cruz.

Source: Authors.

In the southwest, northwest, and south-central, we observed incidence rates between 281/10,000 and 466/10,000. In the southwest, we find high percentages of people receiving government aid, between 17.5% and 21.4%. However, in the northwest and south-central, we find very low percentages of people receiving government aid, between 9.7% and 13.6%. Comparing the two periods, we observed a small reduction in rates in the northern region of Manguinhos (Figure 1).

In the Kernel Map of total cases, we observed clusters of cases located mainly in three regions of the map. The first is to the west of the territory (mainly in the southwest), where there is a large cluster of cases that goes as far as the limits of the territory; the second is in the south-central area

Table 3. Distribution of the incidence of COVID-19 by Manguinhos' sub-regions

Sub-region	Cases			Incidence rate/10,000		
	1st per	2nd per	Total	1st per	2nd per	Total
Aconchego	82	38	123	270.2	125.2	395.4
Amizade	70	53	112	205.6	155.7	361.2
Confiança	37	12	74	117.4	38.1	155.5
Coragem	2	2	61	6.8	6.8	13.6
Felicidade	1	0	120	3.2	0.0	3.3
Fortaleza	76	36	93	231.4	109.6	341.1
Fraternidade	54	39	161	185.5	134.0	319.5
Harmonia	35	39	1	102.2	113.9	216.1
Liberdade	3	0	3	10.3	0.0	10.3
Renovação	7	10	17	24.5	35.0	59.5
Sabedoria	1	1	49	3.1	3.1	6.3
Serenidade	34	27	2	116.4	92.4	208.8
Vida	97	64	4	280.9	185.3	466.3
Total	499	321	820	122.9	79.1	202.0

1st per = March 16, 2020, to May 29, 2020; 2nd per = May 30, 2020, to August 12, 2020; Total = March 16, 2020, to August 12, 2020.

Source: Authors.

of the map, and the third is in the central-north area (Figure 2).

In the first period, clusters of cases seem to be concentrated mainly in the north-central and south-central regions of the map, while in the second period, case clusters predominate in the north-central and southwest regions (Figure 2).

In the total period of the study, as well as in the first and second periods, the reported cases came from places with higher demographic density, except for the central-north area, where demographic density is lower than 5,000 inhabitants per Km^2 (Figure 2, Table 2).

Discussion

Main finding of this study

We detected 820 COVID-19 cases in the community of Manguinhos during 150 days of observation, with an incidence rate of 202 per 10,000 inhabitants (123/10,000 in the first period, and 79/10,000 in the second).

We find that the spatial distribution of cases in the territory is concentrated in three sub-regions of the community (central-north, southwest, and central-south). The central-north cluster appeared in both periods.

The main clusters of cases were in the areas with the highest level of population density, except in the central-north area. The highest incidence rate was identified in sub-regions located in central-north and south-central areas which shows 16% of its population receiving financial assistance from the government due to their poverty condition.

What is already known on this topic

During the entire period of the pandemic, social movements organized themselves to give health information on COVID-19 to the poor communities[14,15]. Due to the scarcity of public policies to improve the quality of life of poor communities, the disorderly occupations, with agglomerations of large numbers of people living in small spaces in the households, COVID-19 spread rapidly in these communities[13,19].

"Vida" and "Aconchego", located in the case cluster areas (central-north and south-central), also showed the highest incidence rate in this study. These two sub-regions have a percentage of 16% of people who depend on government financial assistance, which can be considered intermediate, considering the other sub-regions.

In poor communities, most residents are informal workers with low education. A large portion has difficulty adhering to established guidelines. Social distancing, for example, is tricky for large families who live in a single small space, and/or share a wall and/or slab with other families[10,18,20].

In the first month of the pandemic, March 2020, the notification rate in Manguinhos was 21.8/10,000. In the same period, neighborhoods with better socioeconomic development, such as Gávea, Jardim Botânico, Lagoa, and Ipanema, had notification rates of 24.72/10,000, 22.6/10,000, 20.9/10,000, and 18.18/10,000, respectively[13].

It is important to mention that the city of Rio de Janeiro has major problems of socioeconomic inequality. The scenario on the outskirts of the city differs from most Brazilian cities, as there is a mix of people with different socioeconomic levels in upscale neighborhoods. It is common to see impoverished communities located in neighborhoods with a high Human Development Index. This may explain why neighborhoods considered to be richer had similar notifications to those considered to be poorer.

In addition, the community of Manguinhos has peculiarities in access to the health system as it is a neighbor of the Fundação Oswaldo Cruz.

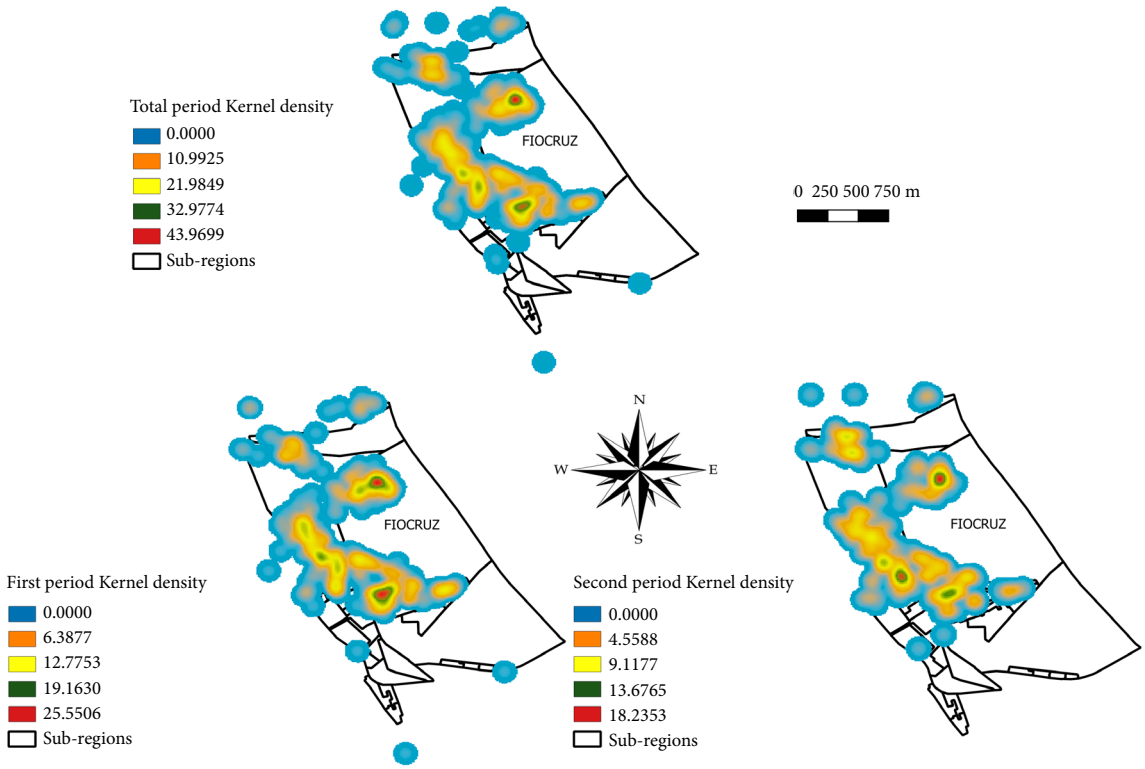

Figure 2. Spatial distribution of COVID-19 cases in the Manguinhos region, Rio de Janeiro through the Kernel Map (March 16, 2020, to August 12, 2020).

FIOCRUZ = Fundação Oswaldo Cruz.

Source: Authors.

Some actions/interventions were implemented in Manguinhos during the pandemic, such as the use of telemonitoring, unlike other units in the municipality.

From April to August 2020, there was an increase in Rio de Janeiro's incidence rate, especially, in the northern area of the city, in the poorest neighborhoods, such as the Bonsucesso, Manguinhos, Olaria, and Ramos, with an incidence rate above 50 cases per 10,000 inhabitants[14,21].

Analyzing 27 neighborhoods whose territories comprehend favelas, it was observed that from April 22, 2020, to March 4, 2021, the highest COVID-19 incidence rate was in Bonsucesso. This neighborhood had 5091.84 per 10,000 inhabitants. The lowest incidence rate occurred in Complexo do Alemão with 33.61 cases per 10,000 inhabitants. Meanwhile, in Manguinhos the accumulated incidence rate was 195.76 per 10,000 inhabitants[22].

The government's shortcomings in preventing and controlling the spread of COVID-19 were generally observed in the different neighborhoods of the city, however, the window of vulnerability was more prominent in already vulnerable communities, such as favelas, where residents themselves mobilized to share information, collect donations, among other actions[13]. In Manguinhos, the Fundação Oswaldo Cruz supported these actions through research projects, technical support, and human resources[9, 19,23,24].

Difficulties in implementing preventive measures against COVID-19 among impoverished communities are observed in other Brazilian cities as well. In the city of Fortaleza, Northeast Brazil, the risk of COVID-19 infection was up to 5.26 times higher in impoverished neighborhoods than in developed neighborhoods[25]. In the city of Vitória, Southeast Brazil, the risk was as high as 17.8% in vulnerable neighborhoods[26].

The pattern observed in Brazil was reported in developed countries. In the United States, the number of COVID-19 cases was greater among African Americans compared to the overall population, demonstrating the impact of socioeconomic disparities[27]. In Stockholm, Sweden, the infection rate is 3 to 4 times higher in some socioeconomically vulnerable communities compared to the regional average[28], once again showing that living and working conditions strongly affect the risk of COVID-19 spread[29]. In England and Wales, the risk of related COVID-19 deaths was twice as high among low-income populations than the overall population[30].

The absolute frequency of observed cases in our study reflects the profile of the clientele of primary care units, which points out that women seek primary health care more frequently. On the other hand, women also showed the highest incidence in the present study.

One of the first studies that showed the profile of COVID-19 cases in the city of Rio de Janeiro displayed a very similar percentage of female and male cases (52% vs. 48 %, respectively)[31]. Data from the Epidemiological Observatory of the city of Rio de Janeiro also reported similar proportions of 54% to 55% in 2020 and 2021, respectively[32]. Likewise, the city of Fortaleza reported 3,554 COVID-19 cases on April 28, 2020, of which 1,880 (52.9%) were female[25].

A similar pattern seems to occur worldwide. In China, 365 cases of COVID-19 evaluated in the first year of the pandemic revealed that the incidence was equal in both sexes[33]. The Pan American Health Organization does not point to major gender differences in COVID-19 cases in the Americas[34].

The data from the metropolitan region of Detroit, which serves a large urban population (especially African-Americans), reveals that from 463 confirmed cases, 259 (55.9%) are female individuals[35].

The percentage of COVID-19 among women found in our study is likely related to the fact that women seek more health services than men[36]. In addition, we observed that the population registered in the Manguinhos Family Health Strategy has a slight female predominance (54%), which may also have contributed to explaining this small difference in the proportion of cases found according to sex[37].

In the present study, the highest incidence rates were observed in age groups 30-39 and 40-49. In a study of the first COVID-19 cases in the city of Rio de Janeiro, 945 (52%) were concentrated in the age group from 20 to 49 years and the lowest proportion was concentrated in the age group from 0 to 19 years with 27 (1.5%) of the cases[31].

In Rio de Janeiro´s neighborhoods comprising favelas (04/22/2020 to 03/04/2021), the age group most affected by COVID-19 was from 30 to 49 years, with an average of 40.1% of cases[22]. Data from the Epidemiological Observatory of the city of Rio de Janeiro (2020 and 2021) also corroborate our findings: a higher proportion of cases in the 20-49 age group (54%). The proportion in the age group from 0 to 19 years remained around 4%[32].

Out of Brazil, a triage clinic of a tertiary hospital in Peshawar, Pakistan had the highest number of confirmed cases in the same age group of 20 to 49 years with 63 (52.1%) of the cases, and the lowest number in the age group of 0 to 19 years with nine of the cases (7.4%)[38].

According to a report by the Pan American Health Organization (2021), the male population aged 60 to 69 years had the highest incidence in absolute cases, with 52% of records. However, this percentage decreased to 47.5% in subsequent age groups, due to the prevalence of the female population with higher life expectancy. In the 30-39 age group, the incidence was 36.54/1,000 for males and 29.83/1,000 for females, while in the 40-49 and 50-69 age groups, the incidence rate was around 29.61/1,000 and 26/1,000, respectively[34].

What this study adds

The study on the spatial distribution of COVID-19 cases in the communities of Manguinhos made it possible to track cases of the disease with the respective spread and location of hotspots, contributing to intervention actions and comprehensive care of individuals and families, such as preventive actions communication and information, case monitoring, therapeutic guidance, and social support.

Limitations of this study

As a study limitation, the absence of testing in the entire population assisted during the pandemic meant that the diagnosis was made based on clinical epidemiological criteria in primary health care of public health units, which may have led to the inclusion of a significant proportion of false-positive cases in the study database. The different types of tests performed (PCR-

RT and Antigen) on the participants may have influenced the proportion of false-negative or false-positive values in the diagnosis, but as the tests used did not prioritize any specific type of patient, it is believed that the proportion of false positives and negatives did not differ by sex, age, and place of residence. It is possible that a few cases included in the study are not residents of Manguinhos, and may have provided their work address to be assisted at the health unit. Likewise, cases residing in Manguinhos may have sought assistance from health services in neighboring neighborhoods and may have been erroneously reported as cases in these neighborhoods, causing under-reporting in their place of origin[13]. Finally, this study covers a cross-section of a specific period of the pandemic, which limits the understanding of the distribution of cases over the years of the pandemic, which would require a longitudinal investigation.

In addition, Manguinhos has a large homeless population (710 individuals in 2022). This amount, which was not accounted for in the calculation of rates, probably influenced the spread of cases in the community.

Conclusion

The highest incidence of COVID-19 in the Manguinhos community occurred in females and adults aged between 30 and 50 years. The dynamics of COVID-19 transmissibility indicate three main areas of clustering of cases. The first is to the west of the territory (especially in the south-west), where we observed a large cluster of cases that extends as far as the limits of the territory; the second is in the south-central area of the map; the third is in the north-central area. The sub-regions with the highest agglomeration of cases in the territory of Manguinhos coincide with the regions with the highest incidence rates, but not with the poorest regions of the territory.

The findings of this study contribute to reinforcing the need for political decision-making aimed at specific actions in the most vulnerable areas of large cities, as a way of minimizing the spread of infectious diseases.

Collaborations

Conceptualization: EGR Almeida, and NCP Rodrigues. Methodology: EGR Almeida, and NCP Rodrigues. Software: EGR Almeida. Validation: NCP Rodrigues, and JT Netto. Formal analysis: EGR Almeida and NCP Rodrigues. Investigation: JT Netto. Resources: JT Netto. Data curation: EGR Aalmeida, and NCP Rodrigue. Writing – original draft preparation: EGR Almeida. Writing – review and editing: EGR Almeida, NCP Rodrigues, JT Netto and MKN Andrade. Visualization: EGR Almeida, and NCP Rodrigues. Supervision: NCP Rodrigues and JT Netto. Project administration: EGR Almeida, and NCP Rodrigues. All authors have read and agreed to the published version of the manuscript.

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