Revista O Mundo da Saúde

The COVID-19 Pandemic and Health Inequities in the State of Sergipe

João Batista Cavalcante Filho[1] Roberto Meneses de Oliveira[2] Rynat Dasaev Oliveira Chagas[2]
Marco Aurélio de Oliveira Góes[2] Marcus Valerius da Silva Peixoto[2] Marco Antônio Prado Nunes[1]

[1] Programa de Pós-Graduação em Ciências da Saúde - Universidade Federal de Sergipe - UFS. Aracaju/SE, Brasil.
[2] Universidade Federal de Sergipe – UFS. Aracaju/SE, Brasil.
E-mail: joao.cavalcante@academico.ufs.br

Abstract

This study analyzes the association of incidence and mortality rates by COVID-19 in the municipalities of the state of Sergipe, Brazil with indicators of social vulnerability and human development used in the country, as well as with the rate of RT-PCR exams for the diagnosis of the disease performed by each municipality. This is an ecological study of COVID-19 cases and deaths accumulated from March 2020 to March 2021, which occurred in the State of Sergipe by municipality; and its correlation with the Social Vulnerability Index (SVI), Municipal Human Development Index (MHDI), and number of RT-PCR tests performed to diagnose the disease, using Spearman's correlation (ρ). Contrary to our hypotheses and the scientific literature, municipalities with higher rates of social vulnerability and lower human development had fewer cases of the disease and deaths per inhabitant, while testing less for the diagnosis of COVID-19. The study points to inequity as a factor to be overcome in the face of the pandemic, as it impairs a proper diagnosis of the scenario closer to reality, compromising the planning and implementation of collective health measures.

Keywords: COVID-19. Health Inequity. RT-PCR test for COVID-19.

INTRODUCTION

Since the characterization of COVID-19 as a pandemic on March 11, 2020 by the World Health Organization, health systems around the world have been facing the greatest challenge of our generation, which will unprecedentedly affect the quality of life of people of all nations[1].

The first diagnosed case of COVID-19 in South America was registered in Brazil on February 26, 2020, in the city of São Paulo[2]. In Sergipe, the smallest state in the Brazilian federation, the first case was diagnosed on March 14, 2020[3].

According to the Epidemiological Report published on March 31, 2021 (https://todoscontraocorona.net.br/boletim-covid-19-31-03-2021/), the panorama of the disease in Sergipe had 174,600 cases of the disease and 3,501 subsequent deaths.

Studies show that the COVID-19 pandemic, like other pandemics, disproportionately affected the most vulnerable population in different parts of the world, whether due to economic, geographic, and cultural difficulties in accessing health services, or even issues related to prejudice[4–6].

Brazil is a country with high regional inequalities. The 134 municipalities with the lowest Human Development Indexes (HDI) are located in

DOI: 10.15343/0104-7809.202246301310

the North and Northeast regions of the country. Among the members of the Organization for Economic Co-operation and Development (OECD) is Brazil with the third highest concentration of income and this depletes material conditions for the survival of an important part of the population, contributing to social vulnerability[7].

The economic disparity of the Northeast Region of Brazil is also characterized by higher Social Vulnerability Indexes (SVI) and lower Municipal Human Development Indexes (MHDI)[8]. The state of Sergipe is located in the Northeast Region and according to Andrade *et al.*[9], in a study analyzing the Atlas of Social Vulnerability of Brazilian Municipalities[10], most municipalities in the state of Sergipe have high social vulnerability.

Equity in health – as equal access to services and care for health needs regardless of gender, race, social, and economic situation of individuals or any other factor that can generate exclusion – is one of the pillars of the Brazilian Unified Health System[11]. The term iniquity is used here as the antonym of equity. Inequities can generate differences between the health indicators of the analyzed populations, to the detriment of the most vulnerable individuals.

This study is part of a series of analyses on the first year of the COVID-19 pandemic in the state of Sergipe and aimed to analyze the correlation of the incidence rate and mortality rate from the disease in its 75 municipalities with indicators of social vulnerability and human development used in the country; as well as the rate of diagnostic tests performed by RT-PCR (reverse transcription polymerase chain reaction) for COVID-19 detection.

METHODS

Study design

This is an ecological study of the incidence and mortality rates by COVID-19 accumulated in the period from March 2020 to March 2021, which occurred in the State of Sergipe, in association with social indicators of human development and social vulnerability, considering the municipalities as units of analysis. These indices were also associated with the rate of RT-PCR exams performed by municipalities.

Sergipe is the smallest state in Brazil in terms of territory (except the Federal District) with 21,938,184 km² (Figure 1); and the 22nd in population size, estimated at 2,318,822 people in 2020 (https://cidades.ibge.gov.br/brasil/se/panorama).

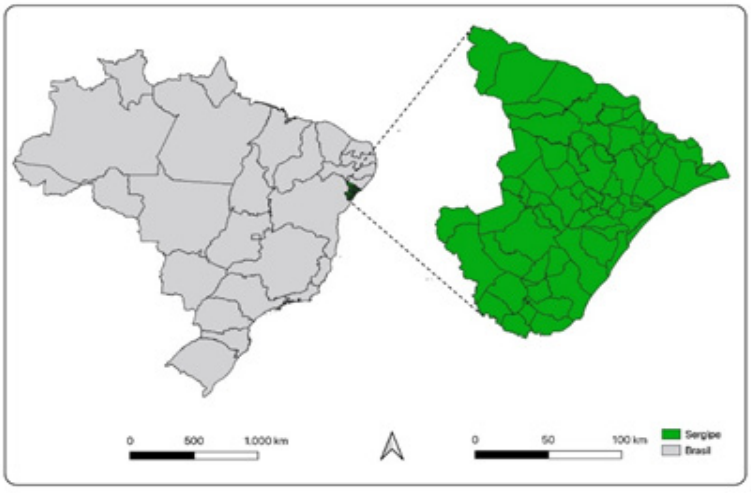


Figure 1 - Location of the state of Sergipe - Brazil

Techniques and Procedures for Data Production

Population data were extracted from the website of the Brazilian Institute of Geography and Statistics (https://cidades.ibge.gov.br/brasil/se/panorama).

Data on COVID-19 cases and deaths by each city of Sergipe, by date, considering the residence of the notified individual, were extracted from the Epidemiological Bulletins for Update on COVID-19, made available daily by the Sergipe State Department of Health. The consolidated database until March 31, 2021 is available at https://todoscontraocorona.net.br/boletim-covid-19-31-03-2021/. Data were tabulated using the Microsoft Excel 2019 program.

The values of the Social Vulnerability Index (SVI) and Municipal Human Development Index (MHDI) are constructed by the Institute of Applied Economic Research, calculated from variables from the last Brazilian Demographic Census carried out by IBGE in 2010, and made available on its website. The values of the Social Vulnerability Index (SVI) were obtained from http://ivs.ipea.gov.br/index.php/pt/planilha, while the values of the Municipal Human Development Index (MHDI) were obtained from http://www.atlasbrasil.org.br/consulta/planilha.

The Social Vulnerability Index (SVI) is a synthetic index composed of 16 indicators structured in three dimensions: urban infrastructure, human capital, and income and work. It allows for a diagnosis of exclusion and social vulnerability for Brazilian municipalities. The index varies between 0 and 1 and the closer to 1, the greater the social vulnerability of a municipality is[10].

Inspired by the Global Human Development Index (HDI) developed by the United Nations Development Program (UNDP), the Municipal Human Development Index (MHDI) adjusts the dimensions of health, education, and income as well as the HDI methodology to the Brazilian context, incorporating indicators that make it more adequate to the reality of Brazilian municipalities. The MHDI is an index that varies between 0 and 1 and the closer to 1, the greater the human development of a municipality is[12].

RT-PCR is the gold standard method for diagnosing COVID-19. This method basically consists of genetically testing the disease-causing virus using a reverse transcription polymerase chain reaction (RT-PCR) kit[13].

The RT-PCR data for SARS-CoV-2 were extracted from the state bank of the Laboratory Environment Manager (LEM), considering the individual's municipality of residence. The LEM is a computerized system developed for Public Health Laboratories whose functions include generating production reports.

Data on incidence, mortality and rate of RT-PCR tests were obtained by dividing the absolute number of cases and deaths by the number of inhabitants in each municipality. For the three data analyzed, the rate was calculated for every 1,000 inhabitants.

Data analysis

The study indicators, considering the 75 municipalities in the state of Sergipe, were analyzed using the BioEstat Software (version 5.3, Instituto de Desenvolvimento Sustentável Mamirauá, Belém, Pará, Brazil), obtaining the maximum and minimum values, average, median, and standard deviation per indicator.

The Spearman correlation (ρ) was performed with the BioEstat Software -version 5.3 to test the correlation of the vulnerability and development indices described - in addition to the rate of RT-PCR exams performed - with the incidence and mortality rates by COVID-19 per municipality of Sergipe. Correlations with statistical significance were considered those with $p \leq 0.05$. As for the classification of the degree of correlation, a weak correlation was considered when $0 < \rho < 0.4$; moderate when $0.4 \leq \rho \leq 0.7$; and strong when $0.7 < \rho < 1.0$.

The Spearman correlation coefficient was chosen because it is a non-parametric alternative that is more suitable for variables that do not have a two-dimensional normal distribution, with asymmetric data such as those observed in this study[14].

The study was approved by the Research Ethics Committee of the Federal University of Sergipe under Opinion No. 4.404.280.

RESULTS

On March 31, 2021, Brazil had an incidence of 6.07 cases/100 inhabitants, a mortality of 0.15 deaths/100 inhabitants, and a case fatality rate of 2.52% (https://covid.saude.gov.br/).

In the period from March 14, 2020 to March 31, 2021, according to official reports, Sergipe recorded 174,600 cases of COVID-19 and 3,501 deaths as a result of the disease. Mortality in the state was 0.15 deaths/100 inhabitants and a case fatality rate of 2.0.

Analyzing the incidence of COVID-19 by municipality of Sergipe in the period, the average incidence was 50.31 cases per thousand inhabitants, with a median of 46.69 and a standard deviation of 25.1. The lowest incidence was observed in the municipality of Itabi, with a population estimated at 4,972 people by the IBGE in 2021 (https://cidades.ibge.gov.br/brasil/se/itabi/panorama), with 12.89 cases per 1000 inhabitants. The highest incidence was found in Barra dos Coqueiros (144.75 cases per 1000 inhabitants), a city located in the metropolitan region of Aracaju – the state capital – which has an estimated population of 31,439 inhabitants (https://cidades.ibge.gov.br/brasil/se/barra-dos-coqueiros/panorama).

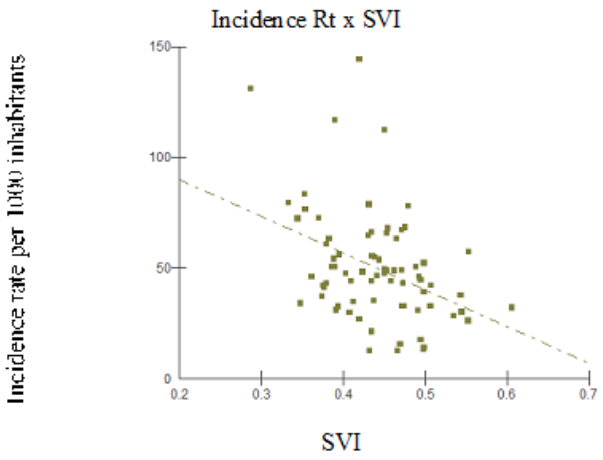
Mortality ranged from 0.20 deaths to 2.20 deaths per thousand inhabitants among the 75 municipalities in the state, with a median of 1.2 and standard deviation of 0.43. The city of Itabi, as well as the incidence, had the lowest mortality per 1000 inhabitants, while the city of Cedro de São João, with an estimated population of 5,929 inhabitants (https://cidades.ibge.gov.br/brasil/se/cedro-de-são-joao/panorama), had the highest mortality rate.

Regarding vulnerability and human development indicators, Sergipe has an average SVI of 0.439 (0.287 – 0.605) – considered an average of high social vulnerability 10 – with a median of 0.44 and standard deviation of 0.06; and an average MHDI of 0.597 (0.529 – 0.770), which places the state in the classification of low municipal human development, with a median of 0.59 and standard deviation of 0.04.

When analyzing the relationship between the incidence of COVID-19 and the SVI and MHDI indicators of the municipalities of Sergipe, a weak negative correlation was found between the incidence of the disease and the SVI (ρ = - 0.3468; p = 0.0023) and weak positive correlation with the MHDI (ρ =0.3655; p = 0.0012) (Figure 2).

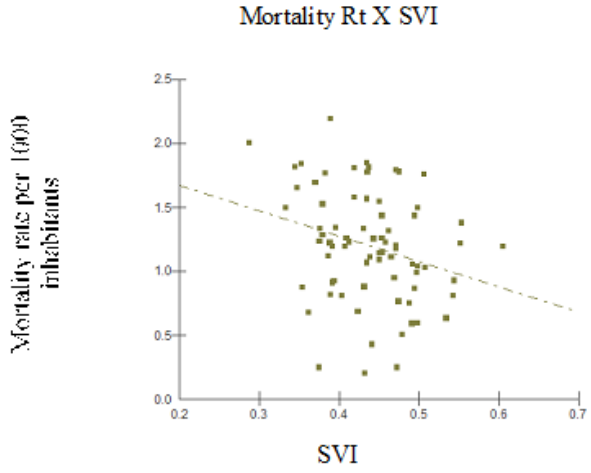
Analyzing the relationship between COVID-19 mortality with the same indicators, a weak negative correlation was found with SVI (ρ = - 0.2872; p = 0.0124) and a moderate positive correlation with the MHDI (ρ = 0.5003; p < 0.0001) (Figure 2).

A)



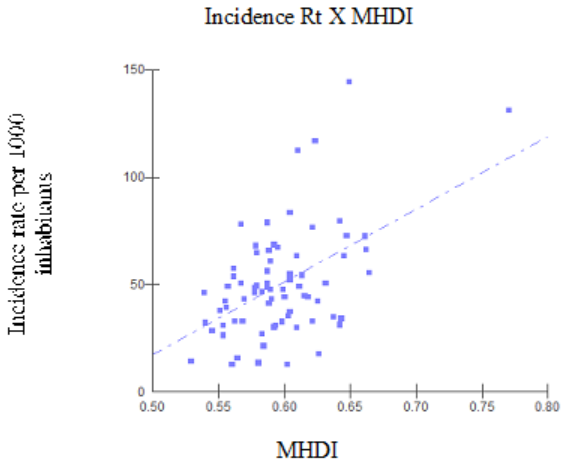
Correlation coefficient: -0.3468; (p): 0.0023

B)



Correlation coefficient: -0.2872; (p): 0.0124

C)



Correlation coefficient: 0.3655; (p): 0.0012

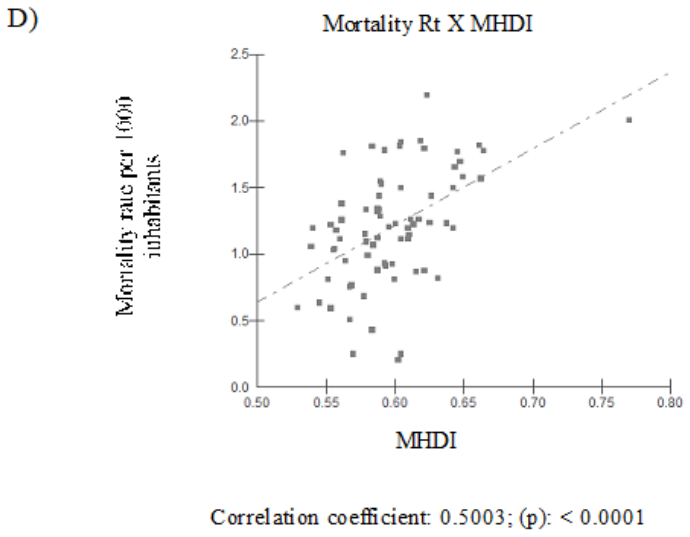
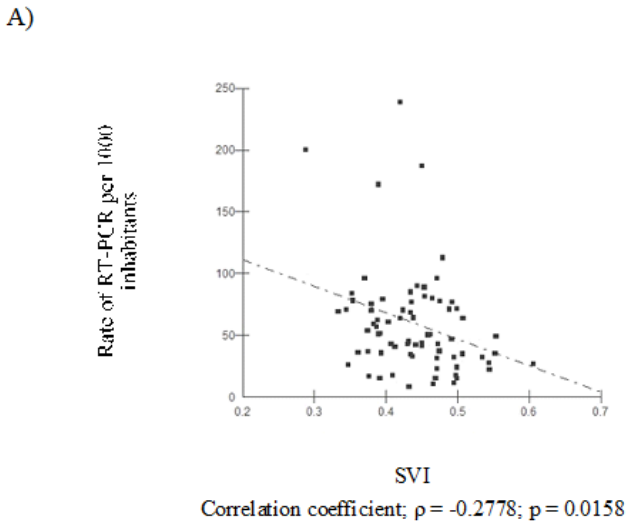


Figure 2 - The relationship between COVID-19 incidence and mortality rates and vulnerability and development indicators in cities in the state of Sergipe. (A) Correlation between incidence rate and SVI; (B) Correlation between mortality rate and SVI; (C) Correlation between incidence rate and MHDI; and (D) Correlation between mortality rate and MHDI.

Seeking explanations for this scenario, this study analyzed and correlated the number of RT-PCR exams performed by municipality with the vulnerability and development indices (Figure 3).

Evidence of a relationship was found between the number of RT-PCR tests performed and the vulnerability and development indices of the municipalities. The municipalities with the highest index of social vulnerability tested less (weak negative correlation; ρ = - 0.2778; p = 0.0158) and those with the highest index of municipal human development tested more (weak positive correlation; ρ = 0.3104; p = 0.0067).



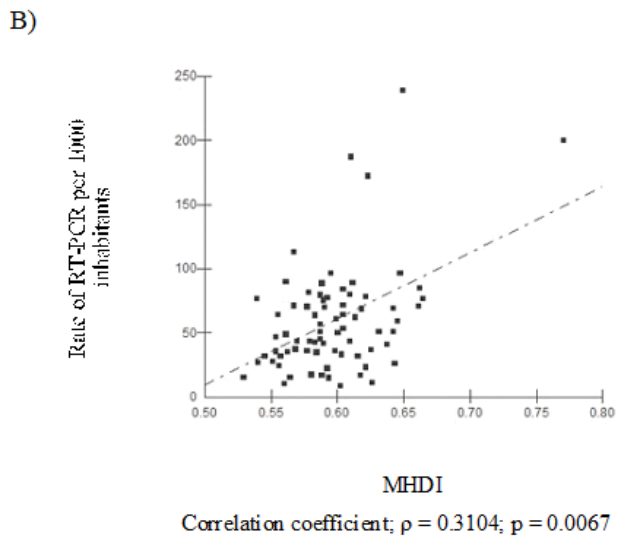


Figure 3 - Relationship between the number of RT-PCR tests performed and vulnerability and development indicators in cities in the state of Sergipe. (A) Correlation between the number of tests per one thousand inhabitants per municipality and SVI; (B) Correlation between the number of tests per one thousand inhabitants per municipality and MHDI.

DISCUSSION

The statistical analysis of the association between the social vulnerability and human development indices and the incidence and mortality rates by COVID-19 in the state of Sergipe showed that, in the first year of the pandemic, the least vulnerable municipalities and with greater human development had more cases and more deaths from the disease.

National and international studies have demonstrated the influence of social inequality on the numbers of COVID-19 cases and deaths, causing greater morbidity and mortality in the most vulnerable populations[6,15–17]. Our analysis found an inverse relationship, while demonstrating that municipalities with greater social vulnerability and less human development performed fewer diagnostic tests for COVID-19.

Bambra *et al.*[6] published an essay to dispel the myth that the COVID-19 pandemic affects everyone equally, citing evidence from studies and official reports in the United States, Spain, and the United Kingdom[18–20]. They reinforce that social issues such as socioeconomic inequalities, inequalities in access to health services, and structural racism are related to the severity of diseases and risk of mortality.

The great social inequality in Brazil, amplified by the pandemic, causes millions of Brazilians to live in unsanitary conditions, clustered in the worst housing conditions, without basic sanitation, fighting for their livelihood, sometimes crowding into inefficient public transport, unable to follow basic protection guidelines with social distancing and proper hand hygiene[15]. The lack of a coordinated, effective, and equitable response by the Brazilian government[21] likely contributed to the inequity.

Although Brazil has a public, free and uni-

versal health system; with a lot of experience in the management of epidemics and with a National Immunization Program recognized for its efficiency, the deep political and economic crisis experienced by the country in recent years and the approval of constitutional amendment 95, which established a cap on government spending in some sectors, including health, weakened the system. There was a shortage of tests at first and there is still a structural dependence on the import of diagnostic components[22].

The negative correlation, even if weak, of the SVI with the incidence and mortality by COVID-19 and the weak positive correlation of the MHDI with the incidence and a moderate correlation with the mortality observed in Sergipe generate hypotheses about the spread of the disease in the Brazilian territory.

In the state of Ceará, a positive correlation was found between the incidence rate of COVID-19 and the MHDI[23]. As in Sergipe, the first case in the state was reported in a neighborhood with lower vulnerability and higher MHDI in the state capital, in people who had returned from a trip abroad.

Analyzing the spread pattern of the disease, Castro *et al.*[21] showed that, despite the varied pattern between the states, the highest percentage of cases and deaths in the capitals of Brazilian states - which have less social vulnerability and greater human development - persisted until the 20 (May 10 to 16, 2020) and 22 (May 24 to 30, 2020) epidemiological weeks.

Municipalities with less vulnerability and greater development tend to have a higher proportion of elderly people, due to longer life expectancy. Admittedly, advanced age is a risk factor for severity or death from COVID-19[24,25].

With greater or lesser rigor, states and municipalities have been adopting social distancing measures. However, this process was hampered by the lack of national coordination and the pressure for commercial and economic activities to continue to take place, to the detriment of the ongoing pandemic[26]; especially in places with the highest MHDI.

The World Health Organization (WHO) has recommended countries to expand their testing programs as a strategy to face the pandemic. Countries with different levels of development have been successful with this strategy, such as Vietnam, Rwanda, South Korea, and Thailand[22].

Our study also showed inequality in the performance of exams, where municipalities with greater human development and less social vulnerability performed more tests for diagnoses, which can directly affect incidence rates: the greater the access to services and diagnostic tests, the more cases of the disease reported. It should be noted that mortality is less susceptible to this bias[27].

This study has limitations inherent to the use of secondary data, subject to inaccuracies, especially in the records of the beginning of the pandemic, due to the lack of definitions of flows and protocols. The SVI and MHDI data were constructed based on the 2010 census - due to the Brazilian government not carrying out the 2020 census until May 2022 - not considering the socioeconomic changes of the period. Furthermore, the inherent limitations of ecological studies make them vulnerable to aggregation bias or ecological fallacy[28].

Despite these limitations, the results made it possible to characterize the correlation of human development and vulnerability indicators with the rates of diagnostic tests, incidence and mortality by COVID-19, contributing to the scenario analysis.

CONCLUSION

Municipalities with greater human development and greater social vulnerability generally have a higher percentage of elderly people - who are more susceptible to the severity of illness and death from COVID-19 -; greater access to the health system for assistance and diagnosis; and they suffered more pressure to keep their economic and commercial activities active, in a period when social distancing was the indicated measure to prevent the spread of the disease.

This scenario, associated with the beginning of the spread of the COVID-19 pandemic in state capitals - cities with better indicators of social vulnerability and human development - helps us to understand the positive correlation of the MHDI and the negative correlation of the SVI found in our study.

COVID-19 has a broad clinical spectrum, probably with many asymptomatic cases and others with mild symptoms. Difficulty in accessing health services for assistance or diagnostic tests has likely impacts on incidence rates, which are lower in mortality rates. When verifying the correlation between the rate of performance of RT-PCR and SVI and MHDI, we observed that the most vulnerable and least developed cities tested less, which impairs a clear diagnosis of the scenario's reality and compromises the planning and implementation of collective health measures.

New studies will be needed to analyze elements that may influence the scenario, including addressing inequality within the municipality's territory, which has neighborhoods and sectors with discrepancies between indicators of social vulnerability.

The study carried out points to the need to overcome inequities as a way of facing the COVID-19 pandemic, ensuring the population's access to care and diagnosis, regardless of socioeconomic conditions or place of residence, as a principle of the Brazilian Unified Health System.

CRediT author statement

Conceptualization: Cavalcante Filho, JB; Nunes. MAP. Methodology: Cavalcante Filho, JB; Goes, MAO; Peixoto, MVS; Nunes, MAPA. Validation: Cavalcante Filho, JB; Goes, MAO; Peixoto, MVS; Nunes, MAPA. Statistical analysis: Cavalcante Filho, JB; de Oliveira, RM; Chagas, RDO; Nunes, MAPA. Formal analysis: Cavalcante Filho, JB; Nunes, MAPA. Research: Cavalcante Filho, JB; de Oliveira, RM; Chagas, RDO; Goes, MAO. Resources: Cavalcante Filho, JB; de Oliveira, RM; Chagas, RDO; Goes, MAO; Peixoto, MVS; Nunes, MAP. Elaboration of original writing: Cavalcante Filho, JB; de Oliveira, RM; Chagas, RDO. Writing-review and editing: Cavalcante Filho, JB; Goes, MAO; Peixoto, MVS; Nunes, MAPA. Visualization: Cavalcante Filho, JB; de Oliveira, RM; Chagas, RDO; Goes, MAO; Peixoto, MVS; Nunes, MAPA. Supervision: Góes, MAO; Peixoto, MVS; Nunes, MAPA. Project management: Cavalcante Filho, JB; Nunes, MAPA.

All authors have read and agreed to the published version of the manuscript.

REFERENCES

1.Ros F, Kush R, Friedman C, et al. Addressing the Covid-19 pandemic and future public health challenges through global collaboration and a data-driven systems approach. Learning Health Systems. 2021;5(1). doi:10.1002/lrh2.10253
2.Cavalcante JR, Abreu A de JL de. COVID-19 no município do Rio de Janeiro: análise espacial da ocorrência dos primeiros casos e óbitos confirmados. Epidemiologia e servicos de saude : revista do Sistema Unico de Saude do Brasil. 2020;29(3):e2020204. doi:10.5123/S1679-49742020000300007
3.Secretaria de Estado da Saúde de Sergipe. Governo de Sergipe confirma primeiro caso de coronavírus. Published 2020. Accessed March 26, 2021. https://www.saude.se.gov.br/governo-de-sergipe-confirma-primeiro-caso-de-coronavirus/
4.Brewer LPC, Woods C, Patel A, et al. Establishing a SARS-CoV-2 (COVID-19) Drive-Through Collection Site: A Community-Based Participatory Research Partnership With a Federally Qualified Health Center. Am J Public Health. 2021;111(4):658-662. doi:10.2105/AJPH.2020.306097

5.Zangeneh M, Moradi N, Zarei L, Rezapour A, Lankarani KB. COVID-19: The challenge of disadvantaged groups and their access to care. Archives of Iranian Medicine. 2020;23(9):647-648. doi:10.34172/aim.2020.79
6.Bambra C, Riordan R, Ford J, Matthews F. The COVID-19 pandemic and health inequalities. Journal of Epidemiology and Community Health. 2020;74(11):964-968. doi:10.1136/jech-2020-214401
7.Pochmann M, Caetano LC da S. Concentração espacial da produção e desigualdades sociais. Revista Brasileira de Estudos Urbanos e Regionais. 2020;22:1-25.
8.Ribeiro CJN, Dos Santos AD, Lima SVMA, et al. Space-time risk cluster of visceral leishmaniasis in brazilian endemic region with high social vulnerability: An ecological time series study. PLoS Neglected Tropical Diseases. 2021;15(1):1-20. doi:10.1371/journal.pntd.0009006
9.Andrade CB, Santos AJ da R, Cruz F dos SL, et al. Vulnerabilidade social no estado de Sergipe. In: Marguti BO, Costa MA, Pino CV da S, eds. Territórios Em Números: Insumos Para Políticas Públicas a Partir Da Análise Do MHDI e Do IVS de Municípios e Unidades Da Federação Brasileira. 1st ed. IPEA/INCT; 2017:65-109.
10. Instituto de Pesquisa Economica Aplicada – IPEA. Atlas Da Vulnerabilidade Social Dos Municípios Brasileiros. Vol 53. (Costa MA, Maguti BO, eds.). IPEA; 2015. http://ivs.ipea.gov.br/images/publicacoes/Ivs/publicacao_atlas_ivs.pdf
11.Granja GF, Zoboli ELCP, Fracolli LA. O discurso dos gestores sobre a equidade: um desafio para o SUS. Ciência e Saúde Coletiva. 2012;18(12):3759-3764. doi:https://doi.org/10.1590/S1413-81232013001200032
12.Programa das Nações Unidas para o Desenvolvimento. Índice de Desenvolvimento Humano Municipal Brasileiro. PNUD Brasi.; 2013.
13.Oladipo EK, Ajayi AF, Odeyemi AN, et al. Laboratory diagnosis of COVID-19 in Africa: availability, challenges and implications. Drug Discoveries & Therapeutics. 2020;14(4):153-160. doi:10.5582/ddt.2020.03067
14.Vieira S. Medidas de Associação e de Correlação. In: Vieira S, ed. Bioestatística - Tópicos Avançados. Vol 1. 3rd ed. Elsevier; 2010:169-197.
15.Martins-Filho PR, Quintans-Júnior LJ, de Souza Araújo AA, et al. Socio-economic inequalities and COVID-19 incidence and mortality in Brazilian children: a nationwide register-based study. Public Health. 2021;190(September 2020):4-6. doi:10.1016/j.puhe.2020.11.005
16.Hawkins RB, Charles EJ, Mehaffey JH. Socio-economic status and COVID-19erelated cases and fatalities. Public Health. 2020;189(January):129-134. doi:10.1016 / j.puhe.2020.09.016
17.Maciel JAC, Castro-Silva II, de Farias MR. Initial analysis of the spatial correlation between the incidence of covid-19 and human development in the municipalities of the state of ceará in brazil. Revista Brasileira de Epidemiologia. 2020;23:1-17. doi:10.1590/1980-549720200057
18.Chen JT, Krieger N. Revealing the unequal burden of COVID-19 by income, race/ethnicity, and household crowding: US county versus zip code analyses. Journal of Public Health Management and Practice. 2021;27:S46-S56. doi:10.1097/PHH.0000000000001263
19.Catalan Agency for Health Quality and Assessment (AQuAS). Coronavirus SARS-Cov-2 interactive map. http://aquas.gencat.cat/.content/IntegradorServeis/mapa_covid/atlas.html.
20.Intensive Care National Audit and Research Centre. Report on COVID-19 in Critical Care 17 April 2020.; 2020.
21.Castro MC, Kim S, Barberia L, et al. Spatiotemporal pattern of COVID-19 spread in Brazil. Science (1979). 2021;1558(April):6. doi:10.1126/science.abh1558
22.Kameda K, Barbeitas MM, Caetano R, et al. Testing COVID-19 in Brazil: Fragmented efforts and challenges to expand diagnostic capacity at the Brazilian Unified National Health System. Cadernos de Saude Publica. 2021;37(3). doi:10.1590/0102-311X00277420
23.Maciel JAC, Castro-Silva II, de Farias MR. Initial analysis of the spatial correlation between the incidence of covid-19 and human development in the municipalities of the state of ceará in brazil. Revista Brasileira de Epidemiologia. 2020;23:1-17. doi:10.1590/1980-549720200057
24.Booth A, Reed AB, Ponzo S, et al. Population risk factors for severe disease and mortality in COVID-19: A global systematic review and meta-analysis. PLoS ONE. 2021;16(3 March). doi:10.1371/journal.pone.0247461
25.Parohan M, Yaghoubi S, Seraji A, Javanbakht MH, Sarraf P, Djalali M. Risk factors for mortality in patients with Coronavirus disease 2019 (COVID-19) infection: a systematic review and meta-analysis of observational studies. Aging Male. 2021;23(5):1416-1424. doi:10.1080/13685538.2020.1774748
26.Ximenes RA de A, de Albuquerque M de FPM, Martelli CMT, et al. Covid-19 in the northeast of brazil: From lockdown to the relaxation of social distancing measures. Ciencia e Saude Coletiva. 2021;26(4):1441-1456. doi:10.1590/1413-81232021264.39422020
27.Mena GE, Martinez PP, Mahmud AS, Marquet PA, Buckee CO, Santillana M. Socioeconomic status determines COVID-19 incidence and related mortality in Santiago, Chile. Science (1979). 2021;372(6545). doi:10.1126/science.abg5298
28.Carvalho MS, Souza-Santos R. Analise de dados em saúde pública: métodos, problemas e perspectivas. Cad Saúde Pública. 2005;21(2):361-378. Accessed May 30, 2022. https://www.scielo.br/j/csp/a/HJ3R3BCkPCbCsk9YTgKqRWN/?format=pdf&lang=pt

Submitted: 19 september 2021.
Approved: 30 june 2022.
Published: 31 august 2022.