

Management Strategies and Their Impact on COVID-19 Mortality: An Ecological Study

Estratégias de Gestão e Impacto na Letalidade por COVID-19: Um Estudo Ecológico
Estrategias de Gestión e Impacto en la Letalidad por COVID-19: Un Estudio Ecológico

RESUMO

Objetivo: Analisar a associação entre estratégias programáticas de mitigação implementadas na Atenção Primária à Saúde e os óbitos por COVID-19 em municípios de regiões de saúde do Rio Grande do Sul. **Método:** Trata-se de estudo ecológico, com uso de dados primários e secundários, baseado em análises de frequência e correlação de Pearson. **Resultados:** Observou-se correlação positiva entre as estratégias implementadas e o percentual de testes confirmados, bem como entre as taxas de casos e de óbitos; além de correlação inversa entre taxa de testagem e letalidade. Sugere-se que a ampliação da testagem, associada à implementação de estratégias organizadas no âmbito regional, relaciona-se à maior capacidade de detecção de casos e à redução da letalidade nos municípios analisados. **Conclusão:** Os resultados reforçam o papel da Atenção Primária à Saúde na organização da resposta territorial à pandemia, indicando a importância de estratégias integradas para o fortalecimento do sistema de saúde.

DESCRIPTORES: COVID-19; Atenção Primária à Saúde; Regionalização da Saúde.

ABSTRACT

Objective: To analyze the association between programmatic mitigation strategies implemented in Primary Health Care and COVID-19 deaths in municipalities within health regions of Rio Grande do Sul. **Method:** This is an ecological study using primary and secondary data, based on frequency analyses and Pearson's correlation. **Results:** A positive correlation was observed between the implemented strategies and the percentage of confirmed tests, as well as between case rates and mortality rates. An inverse correlation was also found between testing rates and case fatality. It is suggested that expanding testing, combined with the implementation of organized strategies at the regional level, is associated with a greater capacity to detect cases and a reduction in case fatality in the municipalities analyzed. **Conclusion:** The findings reinforce the role of Primary Health Care in organizing the territorial response to the pandemic, highlighting the importance of integrated strategies to strengthen the healthcare system.

DESCRIPTORS: COVID-19; Primary Health Care; Regional Health Planning.

RESUMEN

Objetivo: Analizar la asociación entre las estrategias programáticas de mitigación implementadas en la Atención Primaria de Salud y las muertes por COVID-19 en municipios de regiones sanitarias de Rio Grande do Sul. **Método:** Se trata de un estudio ecológico, con uso de datos primarios y secundarios, basado en análisis de frecuencia y correlación de Pearson. **Resultados:** Se observó una correlación positiva entre las estrategias implementadas y el porcentaje de pruebas confirmadas, así como entre las tasas de casos y de mortalidad; además, se identificó una correlación inversa entre la tasa de pruebas y la letalidad. Se sugiere que la ampliación de las pruebas, asociada con la implementación de estrategias organizadas a nivel regional, se relaciona con una mayor capacidad para detectar casos y con la reducción de la letalidad en los municipios analizados. **Conclusión:** Los resultados refuerzan el papel de la Atención Primaria de Salud en la organización de la respuesta territorial a la pandemia, indicando la importancia de estrategias integradas para el fortalecimiento del sistema de salud.

DESCRIPTORES: COVID-19; Atención Primaria de Salud; Regionalización de la Salud.

RECEIVED: 06/01/2026 APPROVED: 07/08/2026

How to cite this article: Barbieri J, Melo RC, Carlotto F, Riquinho DL. Management Strategies and Their Impact on COVID-19 Mortality: An Ecological Study. Saúde Coletiva (Brazilian Edition) [Internet]. 2026 [cited year month day];18 (111):20644-20661. Available from: DOI: 10.36489/saudecoletiva.2026v18i11p20644-20661



Janaina Barbieri

Master of Science in Nursing. Federal University of Rio Grande do Sul.

ORCID: <https://orcid.org/0000-0001-8441-3993>



Franciela Carlotto

Master of Science in Nursing. Federal University of Rio Grande do Sul.

ORCID: <https://orcid.org/0000-0003-4187-0603>



Rafael Cerva Melo

PhD in Nursing. Federal University of Rio Grande do Sul.

ORCID: <https://orcid.org/0000-0002-0525-0741>



Deise Lisboa Riquinho

PhD in Nursing. Federal University of Rio Grande do Sul.

ORCID: <https://orcid.org/0000-0002-6604-8985>

INTRODUCTION

COVID-19 has spread across the globe, with varying levels of incidence and impact in each region. In October 2021, Brazil reached the milestone of 600,000 deaths, ceding the top spot to the United States in terms of absolute number of deaths worldwide and the highest mortality rate among countries with more than 100 million inhabitants. Throughout the pandemic, the country had the sixth-worst case fatality rate (2.8%), trailing Mexico, Bulgaria, Indonesia, South Africa, and Romania⁽¹⁾.

In a retrospective context marked by underfunding of the Unified Health System (SUS), states and municipalities coordinated their efforts—either jointly or separately—to address the spread of the virus and its consequences. At the start of the pandemic, the Ministry of Health (MS) took steps to address the crisis, issuing guidelines on quarantine, isolation, and restrictions on international travel. However, this was soon followed by problems with federal coordination and difficulties in defining effective strategies to manage the “ ” phase of the pandemic. These difficulties negatively impacted the intergovernmental transfer of financial resources and the distribution of supplies (diagnostic tests, protective equipment, etc.). *At the same time*, the federal government was slow to define strategies to mitigate the socio-economic impacts of the related crisis⁽²⁾.

Taking this situation into account and backed by a court ruling, states and municipalities adopted unilateral initiatives and measures to address the pandemic. Many of these subnational governments presented contingency plans emphasizing strategies for mitigation, control, and the suppression of social mobility, with the aim of limiting exposure and restricting chains of viral transmission⁽³⁻⁴⁾.

In May 2020, the government of Rio Grande do Sul (RS) implemented the “Controlled Distancing Model,” prioritizing mitigation measures and analyzing indicators that signaled an increase in cases, deaths, and the risk of hospital capacity being overwhelmed, and regions received a weekly color-coded risk classification based on which they were required to follow specific protocols⁽⁴⁾.

In RS, strategies focused on strengthening Primary Health Care (PHC) stood out, with nurses playing a key role in organizing and leading actions within the Health Care Networks (RAS). Nurses proved to be instrumental in organizing patient flows, establishing priorities, and working on the “front lines” of COVID-19 testing and, later, vaccination⁽⁵⁾.

The experience of the COVID-19 pandemic has helped deepen understanding of the importance of organizing work through the RAS, which has been gaining ground in national policy, leading to a reevaluation of health planning from a regional perspective, as it requires a new model of

territorial organization for the SUS. This perspective points to Regionalized Municipal Planning, which highlights the need for a systemic and coordinated municipal organization, acting cooperatively and in solidarity across the different levels of care⁽⁶⁾.

This interpretation allows for an analysis of regionalization as a means to address and implement COVID-19 mitigation measures. It should be noted that, while political bargaining subordinates planning—hindering the development of innovative and effective tools for regional development⁽⁷⁾—the crisis triggered by the COVID-19 pandemic has enabled municipalities to unite so they could identify vulnerabilities and strengths and, thus, organize themselves as a region, coordinating shared services and strategies.

The study is based on the hypothesis that greater regional investment in mitigation measures led to a reduction in the number of COVID-19 deaths. In this regard, the present study seeks to evaluate mitigation strategies in primary health care (PHC) and their association with the number of COVID-19 deaths, based on a regional analysis.

METHOD

This is an ecological study of regional aggregates, based on primary and secondary data sources, guided by the recommendations of the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE)

guidelines⁸ and the extension *The Reporting of studies Conducted using Observational Routinely-collected health Data* (RECORD)⁹.

The study was conducted in two Health Regions located in the northern region of Rio Grande do Sul: “Caminho das Águas” (Region 15), comprising 26 municipalities and 166,764 inhabitants; and “Rota da Produção” (Region 20), also comprising 26 municipalities and 191,333 inhabitants, according to IBGE estimates (2022). The two regions were included in the study because most of their constituent municipalities initiated and implemented measures related to the pandemic context at an early stage; that is, this was a purposive sample, with the limitations and potential biases characteristic of this method⁽¹⁰⁾.

Data collection took place in two phases: the first phase, focused on characterizing municipal actions, was conducted between July and August 2020; the second phase, aimed at assessing outcomes and consolidating surveillance data, took place in March 2021.

The units of analysis for the study consisted of the 52 municipalities in the included regions and their municipal managers (health secretaries or primary care coordinators). Purposive sampling was used, and the inclusion of these regions was justified by the fact that their municipalities had implemented mitigation measures early on in the pandemic. The managers were invited via telephone, following a structured script to ensure standardization of the invitation and clarification of the objectives, with acceptance formalized through tacit consent.

In the first stage, conducted via telephone with all 52 municipal managers, a *checklist* of COVID-19 mitigation strategies recommended by international and national agencies that emphasized mitigation strategies for COVID-19—was applied, including the World Health Organization

(WHO)⁽¹¹⁾, the Pan American Health Organization (PAHO)⁽¹²⁾ and Brazilian researchers⁽¹³⁾.

For quantitative analysis, a mitigation strategy score was constructed for each municipality, obtained by the simple sum of the 20 dichotomous variables on the checklist, with 1 point assigned for each implemented strategy and 0 for each non-implemented strategy. Thus, the total score could range from 0 to 20 points, with higher values indicating greater adherence to programmatic strategies to combat COVID-19. We opted for the simple sum of the variables because they are indicators of the same nature and operational relevance within the instrument, assuming equivalent analytical weight among the strategies.

The variables were: 1) Telemedicine; 2) Dedicated triage pathway at the Basic Health Unit (UBS) for suspected COVID-19 cases; 3) Dedicated unit for symptomatic COVID-19 patients in the municipality; 4) Strategy for handling routine demand at the UBS; 5) Strategy in the event of hospital network capacity being exhausted; 6) Dispensing of medications and renewal of long-term prescriptions; 7) Remote work strategy for at-risk workers who have been temporarily removed from work activities; 8) Strategy for caring for pregnant women and providing pediatric care; 9) Strategy for caring for patients with mental health issues; 10) Immunization strategy during the flu campaign; 11) Strategy for dental care; 12) Strategy for care provided by a multidisciplinary team; 13) Strategy for Community Health Agents (ACS); 14) Strategy for monitoring suspected cases of flu-like syndromes in isolation; 15) Strategy for organizing work processes; 16) Strategy for addressing illness and mental distress among PHC team professionals; 17) Strategy for addressing PPE shortages; 18) Strategy for coordination with other municipal and/or state agencies (Response

Committee); 19) Municipal strategy for COVID-19 testing, using its own resources and establishing a municipal protocol; and 20) Strategies for non-pharmacological interventions (NPIs), disseminated and implemented among the population.

In the second stage, conducted in March 2021, publicly available data related to diagnostic testing (the e-SUS Notifica and Sivepgrisp reporting systems) and COVID-19 deaths (the State Health Department’s *dashboard*) were consulted. Information on testing rates and confirmed cases was obtained from reports by municipal epidemiological surveillance departments. Population data related to the aforementioned events (urban and rural settings, population density, etc.) extracted from the Brazilian Institute of Geography and Statistics (IBGE) were also verified and updated.

The data obtained were tabulated in an *Excel* spreadsheet and processed using the *Statistical Package for the Social Sciences* (SPSS) version 18.0. Normality for continuous variables was assessed using the Shapiro-Wilk test. Variables with a normal distribution were described by mean and standard deviation, and those with a skewed distribution by median and interquartile range. A t-test was performed to compare means, and correlations were calculated using Pearson’s correlation coefficient; correlations were considered significant when the p-value was less than 0.05.

The study followed the guidelines of Resolution No. 466/12 of the National Health Council regarding submission to and approval by the Research Ethics Committee of the Hospital de Clínicas of the Federal University of Rio Grande do Sul, under CAAE 31545920.2.0000.5327. This research was part of a broader project submitted to and approved under the FAPERGS Call for Proposals—Notice 06/2020—on the topic

“Assessment of impacts on the mental health of healthcare professionals and the general population, as well as socioeconomic impacts and mitigation strategies.”

RESULTS

Among the respondents who participated in the study, 23 were municipal health managers from Region 15 and 19 were from Region 20, accounting for 80.8% of all municipalities. Among this same group, 43% (n=18) had been in their positions for more than one year but less than two years; 34% (n=14) for between one and two years and up to five years; and 23% (n=10) for more than five years. Regarding educational background, 38% (n=16) had completed high school or were enrolled in a technical program, and 62% (n=26) had a college degree; of these, 50% (n=13) had a degree in the health field.

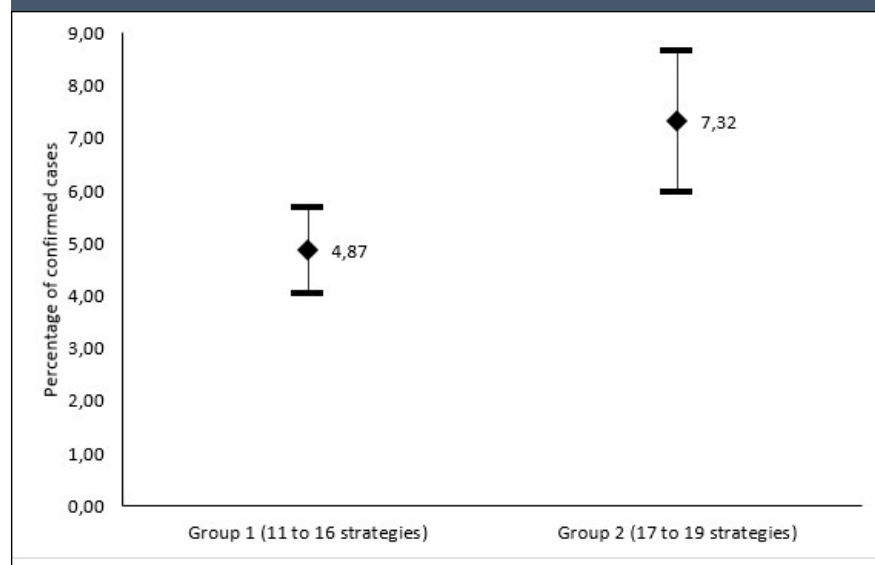
Among the participating municipalities, 47.6% (n=20) had estimated populations of fewer than 5,000 inhabitants. Based on responses to the checklist questionnaire, government officials reported having implemented, on average, 17 (85%) of the 20 strategies listed in the instrument, corresponding to an average score of 17 points, with a range observed between 11 (55%) and 19 (95%) points. Based on the median score for implemented strategies, the municipalities were stratified into two groups: the first comprised 20 municipalities with scores between 11 and 16 points; the second comprised 22 municipalities with scores between 17 and 19 points.

Regarding testing, the municipalities in the sample had populations ranging from 1,527 to 34,328 inhabitants, with a predominantly rural population (55.6%). Testing coverage ranged from 7.1% to 44%, with an average positivity rate of 5.6%. When the municipalities were stratified by the median score for implemented

strategies, it was observed that the group with the lowest adherence—(11 to 16 strategies) had an average of confirmed cases of 4.9%, while the

group with the highest adherence (17 to 19 strategies) had 7.3% (Figure 1), and this difference was statistically significant ($p=0.003$).

Figure 1: Mean percentage of confirmed COVID-19 tests, according to groups stratified by the median score of strategies implemented in the municipalities.



Source: produced by the authors, 2026.

The average COVID-19 case fatality rate during the period was 1.33%, ranging

from zero to 3.70%, and the death rate per 1,000 cases ranged from zero to 2.31% (Table 1).

Table 1: Demographic characteristics, testing data, and COVID-19 deaths in municipalities within Health Regions 15 and 20 of the State of Rio Grande do Sul, 2021

Variable	Mean ($\pm$ SD*)	Minimum - Maximum
Total Population (inhab.)	5.178 (2.809 ; 9.471)**	1.527-34.328
Rural Population (%)	55,6 ($\pm$ 17,39)	13,1-79,6
Population Density (people/m ²)	30,65 ($\pm$ 20,65)	8,83-108,85
Confirmed COVID-19 Tests (%)	5,60 ($\pm$ 2,75)	1,91-13,17
Testing rate (%)	20,48 ($\pm$ 9,77)	7,06-43,98
Lethality rate (%)	1,33 ($\pm$ 0,89)	0,0-3,70
Death Rate (per 1,000 inhabitants)	0,65($\pm$ 0,55)	0-2,31
Score for Implemented Strategies	17 (15,75 ; 18)**	11-19

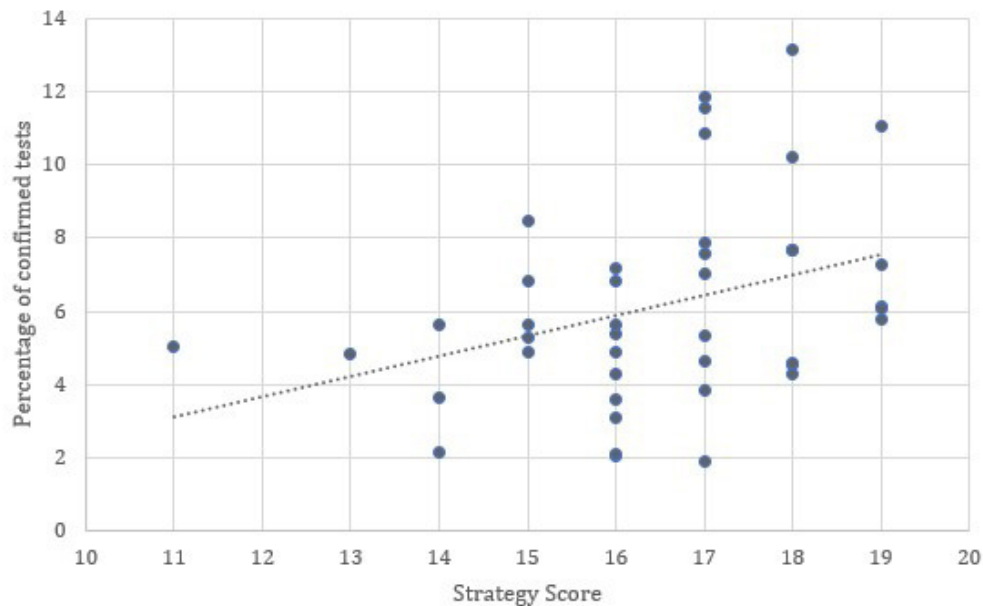
Source: compiled by the authors, 2026.

* Standard Deviation (SD)

**Median and interquartile range (25%–75%).

The Pearson correlation analysis between the score for strategies imple-

mented in each municipality and the percentage of confirmed COVID-19 tests showed statistical significance ($p=0.003$) and a weak positive correlation ($r=0.38$), as shown in Figure 2.

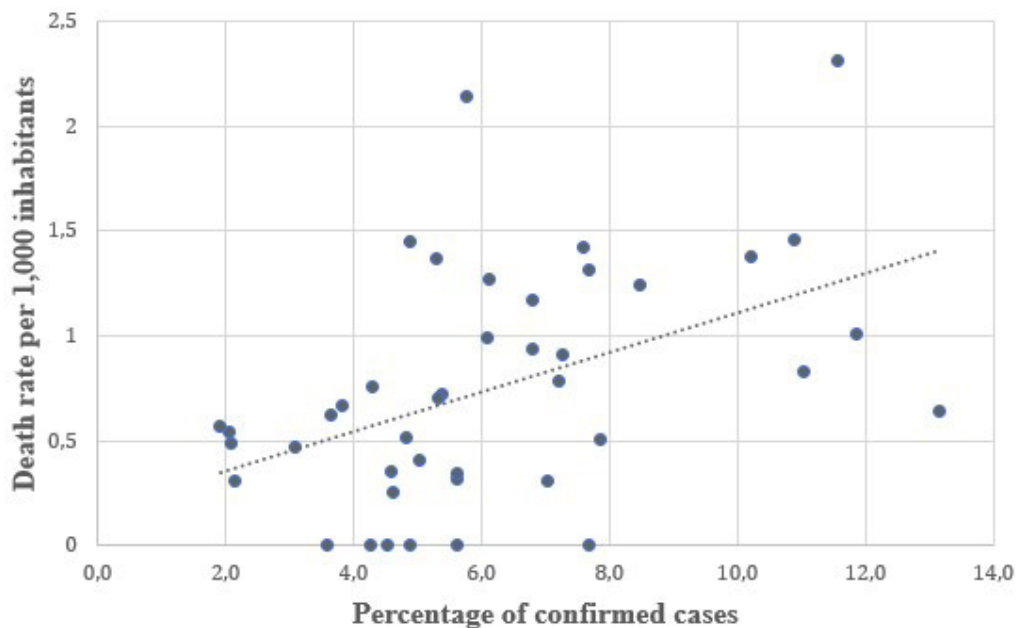
Figura 2: Correlação de Pearson entre o escore das estratégias implementadas em cada município e o percentual de testes confirmados para COVID-19.

Source: produced by the authors, 2026.

There was no statistically significant correlation between population den-

sity and the testing rate ($r = 0.28$; $p = 0.069$). The rate of confirmed cases and the death rate showed statistical signifi-

cance ($p = 0.002$) and a moderate positive correlation ($r = 0.47$), as shown in Figure 3.

Figure 3: Pearson correlation between the rate of confirmed cases and the COVID-19 death rate.

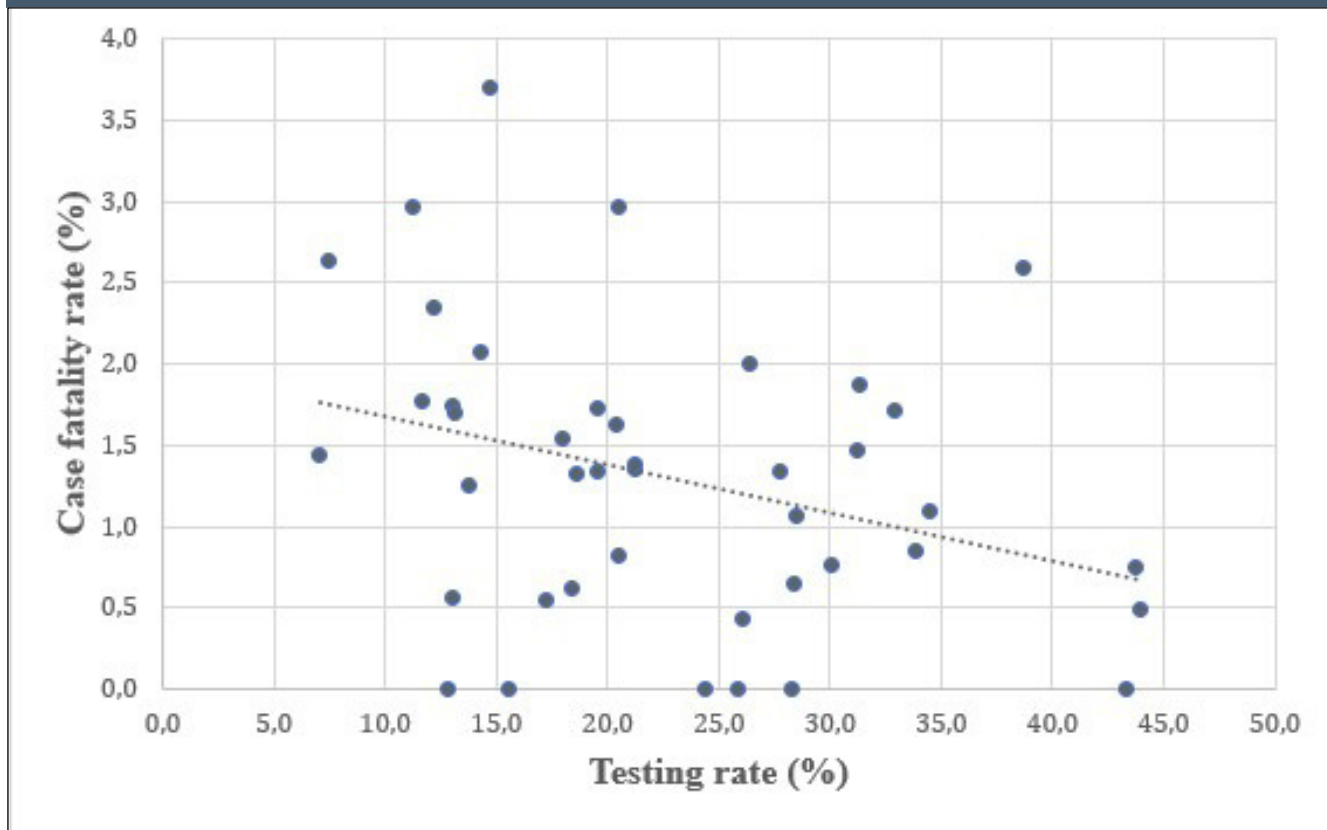
Source: produced by the authors, 2026.

However, the testing rate and case fatality rate showed statistical significance ($p=0.038$) but a moderate

inverse and negative correlation ($r=-0.32$); that is, a lower testing rate was associated with a higher case fatality

rate, as shown in Figure 4.

Figure 4: Pearson correlation between the testing rate and the COVID-19 case fatality rate.



Source: created by the authors, 2026.

DISCUSSION

The weakness of national coordination in efforts to combat the coronavirus pandemic led states and municipalities to implement various measures based on their own perspectives. Some strategies were structured regionally with a focus on recommendations to expand testing, thereby facilitating the tracking and monitoring of cases. This study found a moderate positive correlation between the score of the strategies implemented in each municipality and the percentage of confirmed COVID-19 tests, as well as between the rate of confirmed cases and the case fatality rate. The correlation between

the testing rate and the case fatality rate was inverse and negative; the lower the testing rate, the higher the case fatality rate. These data suggest that the mitigation measures adopted in primary health care (PHC)—including testing—may be related to the low number of deaths and case fatality rates in the municipalities analyzed.

China successfully combated the coronavirus infection by implementing a model that combined suppression measures with mitigation measures, such as restricting population movement, investing in technologies for contact tracing, monitoring, and case identification, as well as ensuring efficient patient care⁽¹³⁾. The combination of mitigation measures—which

aim to reduce viral transmission—with suppression measures, which are more radical in nature and per ly involve restricting the movement of people, has a greater impact compared to the adoption of mitigation measures alone^(3,14,15).

The relaxation of rules established by governments, the prolonged maintenance of social distancing—influenced by risky behaviors often related to economic, cultural, or psychological needs, or by pandemic denialism—contributed to fluctuations in COVID-19 cases⁽¹⁵⁾.

The municipalities in the two regions under study adopted their protocols based on the state decree issued in March 2020, which included mea-

asures to suspend in-person classes and impose restrictions on non-essential commercial establishments and public transportation. However, the premature easing of suppression and mitigation measures, the population's lack of adherence to social distancing, and economic concerns and pressures contributed to the increase in COVID-19 cases in the municipalities⁽¹⁴⁾.

In parallel with mitigation measures, municipalities invested in primary health care (PHC) as a means of combating COVID-19⁽¹⁷⁾. PHC managers and professionals began tackling the pandemic amid inherent challenges. Among these were a shortage of healthcare professionals, structural inadequacies in physical facilities, and insufficient supplies to meet the demand necessary to ensure quality care while safeguarding the safety of healthcare teams and the population⁽¹⁸⁾. With reduced nursing staff, many municipalities had to expand their workforce to accommodate new patient flows with flu-like symptoms and maintain routine PHC services, in addition to enabling health surveillance activities for COVID-19.

In the present study, the low population density and the fact that most of the population resides in rural areas may hypothetically have contributed to the average case fatality rate and mortality rate remaining below those of the state of Rio Grande do Sul and the country as a whole. High population density is considered a factor facilitating the increase in COVID-19 infections and deaths⁽¹⁹⁾.

In Rio Grande do Sul, as of March 5, 2021, COVID-19 mortality stood at 193 per 100,000 inhabitants, with a case fatality rate of 2.5%. In Brazil, the mortality rate was 168 per 100,000 inhabitants, and the case fatality rate was 2.6%. The study found an average mortality rate of 0.65 per 1,000 inhabitants and a case fatality rate of 1.3%, which may suggest the positive impact of the measures highlighted

One strategy for controlling cases involves testing the population. The Pearson correlation in this study showed that the strategies implemented by municipalities—including COVID-19 testing—resulted in a higher number of positive tests for SARS-CoV-2. This finding may reflect greater capacity for epidemiological surveillance and a reduction in underreporting in municipalities with a higher density of strategies. Another study demonstrated that the more a testing strategy is implemented, the more positive cases will be identified⁽²⁰⁾, considering that 80% of cases are typically considered mild or moderate⁽²¹⁾ and often go undiagnosed.

In April 2020, the Ministry of Health (MS) began sending a small number of rapid antibody tests to municipalities for testing priority groups. Hospitalized patients with Severe Acute Respiratory Syndrome (SARS) followed the guidelines for collecting samples to perform the reverse transcription polymerase chain reaction (RT-PCR) molecular test and sending them to the Central Public Health Laboratories (Lacen), which, in the case of Rio Grande do Sul, are located in the state capital. The municipalities under study organized themselves regionally to manage this logistics process, thereby reducing the costs and time involved in sending samples to the capital, which is an average of 400 kilometers away.

During the same period, a group of business leaders from one of the municipalities under study purchased equipment to enable RT-PCR testing and donated it to the region's Federal University, which subsequently expanded testing capacity. With the support of intermunicipal consortia that organized the purchase of supplies, testing capacity was increased for the other municipalities in both regions, resulting in faster sample diagnosis times.

Even though it is currently not in

use, sufficient and effective mass testing of the population has proven beneficial in the countries that implemented it. This diagnostic approach helps break the chain of transmission, enabling infected individuals to remain in isolation and under surveillance by health teams—especially primary care providers—to assess disease progression and the need for referral to other levels of care. Alongside public health measures, economic support measures are necessary to enable people to maintain social isolation⁽²⁰⁾.

In this study, the relationship between population density and the testing rate showed no statistically significant association. The testing rate in the region ranged from 7.0% to 44%, and in the state of Rio Grande do Sul (RS), it was 30.2%. In Brazil, as of March 2021, the rate of molecular tests was 5,617 per 100,000 inhabitants (5.6% of the population). Rio Grande do Sul ranked 5th among the states that sent the most tests for analysis at Ministry of Health-affiliated laboratories⁽²²⁾.

When analyzing testing rates in 50 countries through September 2020, a study ranked Brazil 26th and emphasized that testing infrequently or testing only symptomatic cases underestimates the number of people infected with SARS-CoV-2 and the number of COVID-19 deaths, in addition to undermining decision-making by health officials. When the testing rate is increased by 10%, it is possible to detect 9% of new SARS-CoV-2 cases, enabling a proportional reduction in the disease's case fatality rate⁽²³⁾.

The rate of confirmed tests correlated with the death rate, which may be associated with the fact that testing individuals with COVID-19 symptoms—in accordance with state and national protocols—results in a high rate of positive cases and, consequently, a higher likelihood of progression to death. A study analyzing SARS-related hospitalizations among COVID-19 patients in ICUs in Brazil found a

mortality rate of 53.8% ⁽²⁴⁾.

When analyzing the testing and case fatality rates across municipalities in this study, an inverse and negative correlation was found, demonstrating that the lower the testing rate in a municipality, the higher the case fatality rate. Thus, the study highlighted the importance of testing for the detection, monitoring, and isolation of cases to curb the chain of viral transmission ⁽²⁵⁾. Countries that tested only people with SARS and symptomatic health-care workers experienced adverse outcomes, such as the exhaustion of hospital capacity, as was the case in Spain ⁽²⁴⁾.

As of March 2021, the number of ICU beds in the regions under study was 5 COVID-19 ICU beds and 23 adult ICU beds, with a supply rate of 0.8 beds per 100,000 inhabitants. Considering that one to three beds are needed per 10,000 people under normal epidemiological conditions, the hospital system is on the verge of collapse. This situation points to chronic problems in the urgent and emergency care network, which have not yet been resolved through Integrated Regional Planning to make a macro-region self-sufficient in ICU beds, since these are concentrated in metropolitan areas within the states ⁽⁸⁾.

In this regard, strengthening regional negotiation—and, through it, the regulation and coordination of a health system—requires that system and policy actors/operators implement cooperative technologies that go beyond management techniques and produce health outcomes, with the capacity to improve the efficiency and effectiveness of the services offered to the population. In this way, municipalities can foster exchanges, organize strategies, and share experiences, challenges, obstacles, and resources, in order to interconnect and horizontalize municipal and regional relationships within the health system, based on Regionalized Municipal Planning ⁽⁷⁾. Consequently, it is important to con-

sider ways to technically guide municipalities and regions so that they can overcome the challenges posed by the pandemic, breaking through entrenched barriers such as a lack of planning, low technical capacity, and a lack of clarity in political negotiations and in the coordination of the relevant responsibilities ⁽²⁵⁾.

Starting in 2021, with the expansion of COVID-19 vaccination, a significant reduction in hospitalization and mortality rates was observed in several countries, marking a new phase in the fight against the disease, characterized by the transition from a public health emergency scenario to a model of continuous surveillance and an integrated response by health systems. In this context, PHC continued to play a strategic role in coordinating surveillance, vaccination, and case follow-up, in addition to ensuring continuity of care for other health conditions. Recent studies highlight that health systems with structured PHC demonstrated greater resilience during and after the pandemic, particularly in the territorial management of interventions and in the coordination between surveillance and care ^(22,25). This reinforces the need to move beyond reactive models and consolidate permanent capacities within the SUS.

CONCLUSION

The results of this study showed a positive correlation between the score for programmatic strategies implemented by municipalities and the percentage of confirmed COVID-19 tests, as well as between the rate of confirmed cases and the case fatality rate. An inverse correlation was also observed between the testing rate and the case fatality rate, indicating that municipalities with lower testing capacity had higher case fatality rates. These findings reinforce the importance of mitigation strategies implemented within the Primary Health

Care system, especially those related to expanding testing, monitoring cases, and the regional organization of response efforts.

The expansion of diagnostic capacity—made possible by regional cooperation strategies among municipalities and institutions—demonstrated the potential to improve case detection and follow-up, contributing to a reduction in the case fatality rate observed in the analyzed municipalities. In this regard, regional coordination and the strengthening of Primary Health Care (PHC) proved to be strategic elements for organizing the local response to the pandemic.

In the post-pandemic period, the experience gained in tackling COVID-19 reinforces the importance of primary health care as a cornerstone of health systems. The incorporation of strategies such as active surveillance, expanded testing, vaccination campaigns, and regional coordination among municipalities has demonstrated the potential to strengthen the response capacity of health services in the face of public health emergencies. Thus, the lessons learned during the pandemic can contribute to the improvement of public policies and to strengthening the resilience of the Unified Health System in the face of future epidemiological events.

Among the study's limitations is the use of data from secondary sources, which are subject to possible delays in reporting and underreporting during the analyzed period. Furthermore, the results reflect the reality of municipalities belonging to two specific health regions, which may limit the generalizability of the findings to other contexts. Nevertheless, the study contributes to advancing knowledge about strategies for managing and organizing Primary Health Care in response to public health emergencies, pointing to ways to strengthen municipal and regional capacities within the SUS.

REFERENCES

1. Johns Hopkins University. Coronavirus Resource Center: COVID-19 Dashboard [Internet]. Baltimore: Center for Systems Science and Engineering; 2021 [cited 2021 Oct 12]. Available from: <https://coronavirus.jhu.edu/map.html>
2. Zimler B, Alves FS. Governança e estratégias de enfrentamento da COVID-19 pelo Ministério da Saúde: diagnóstico da situação entre março e junho de 2020. *Coleção COVID-19*. 2021;2(1):52-65.
3. Silva LL, Lima AF, Polli DA, Razia PF, Pavão LFA, Cavalcanti MAF, et al. Medidas de distanciamento social para o enfrentamento da COVID-19 no Brasil: caracterização e análise epidemiológica por estado. *Cad Saude Publica*. 2020;36(9):e00185020.
4. Baron MV, Santos MP, Isa CP, Santos AC, Marangoni C, Werle TM, et al. Contenção, mitigação e supressão no combate à pandemia da COVID-19: levantamento e análise. *Saude Colet*. 2020;10(54):2653-60.
5. Weber BT. The uncertainties of the pandemic: the COVID-19 experience in Rio Grande do Sul state. *Hist Cienc Saude Mangueiras*. 2022;29(1):e20210014.
6. Pena KS, Rollo RM, Reuter CL, Santos VC, Riquinho DL, Ramos AR. A transição do cuidado às condições crônicas face ao planejamento municipal regionalizado. *Rev Gaucha Enferm*. 2020;41(spe):e20190168.
7. Mello GA, Pereira APM, Uchimura LYT, Demarzo MMP, Viana ALA. O processo de regionalização do SUS: revisão sistemática. *Cien Saude Colet*. 2017;22(4):1291-310.
8. Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement. *Lancet*. 2007;370(9596):1453-7.
9. Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D, Petersen I, et al. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. *PLoS Med*. 2015;12(10):e1001885.
10. Marconi MA, Lakatos EM. Técnicas de pesquisa: planejamento e execução de pesquisas, amostragens e técnicas de pesquisa, elaboração, análise e interpretação de dados. 3a ed. São Paulo: Atlas; 1996.
11. World Health Organization. Overview of public health and social measures in the context of COVID-19: interim guidance. Geneva: WHO; 2020.
12. Pan American Health Organization. Strengthening the health systems response to COVID-19: adapting primary health care services to more effectively address COVID-19. Washington (DC): PAHO; 2020.
13. Engstrom E, Giovanella L, Mendes A, Graboys V, Mendonça MHM. Linha de cuidado COVID-19 na rede de atenção à saúde: recomendações para a organização da Atenção Primária à Saúde no SUS. Rio de Janeiro: Fiocruz; 2020.
14. Lewnard JA, Lo NC. Scientific and ethical basis for social-distancing interventions against COVID-19. *Lancet Infect Dis*. 2020;20(6):631-3.
15. Calil GG. A negação da pandemia: reflexões sobre a estratégia bolsonarista. *Serv Soc Soc*. 2021;(140):30-47.
16. Murakami MN, Araújo FJ, Marques CP. A reorganização e atuação da Atenção Primária à Saúde no contexto da pandemia de COVID-19: revisão narrativa. *Braz J Dev*. 2022;8(2):12232-51.
17. Moraes RF. Determinantes do distanciamento físico durante a epidemia de COVID-19 no Brasil. *Cien Saude Colet*. 2020;25(9):3393-400.
18. Sanchez MC, Moraes EB, Braga ALVGS, Nassar PR, Xavier ML. Coronavirus pandemic and Primary Care: reflections on the challenges of managers. *Res Soc Dev*. 2020;9(7):e310974154.
19. Pilecco FB, Coelho CG, Fernandes QH, Silveira IH, Pescarini JM, Ortalan N, et al. O efeito da testagem laboratorial nos indicadores de acompanhamento da COVID-19. *Epidemiol Serv Saude*. 2021;30(2):e2020722.
20. Jin Y, Yang H, Ji W, Wu W, Chen S, Zhang W, Duan G. Virology, epidemiology, pathogenesis, and control of COVID-19. *Viruses*. 2020;12(4):372.
21. Brasil. Ministério da Saúde. Doença pelo coronavírus 2019: boletim epidemiológico especial. Brasília: Ministério da Saúde; 2021.
22. Aquino EM, Silveira IH, Pescarini JM, Aquino R, Souza-Filho JA, et al. Medidas de distanciamento social no controle da pandemia de COVID-19: impactos e desafios no Brasil. *Cien Saude Colet*. 2020;25(Suppl 1):2423-46.
23. Tanne JH, Hayasaki E, Zastrow M, Pulla P, Smith P, Rada AG. COVID-19: how doctors and healthcare systems are tackling coronavirus worldwide. *BMJ*. 2020;368:m1090.
24. Giovanella L, Franco CM, Almeida PF. Primary health care and universal health systems: challenges and opportunities after the COVID-19 pandemic. *Cad Saude Publica*. 2022;38(Suppl 1):e00250321.
25. Tasca R, Massuda A, Carvalho WM, Buchweitz C, Harzheim E. Primary health care and the coordination of care in the COVID-19 response in Brazil: strengths and challenges. *Rev Panam Salud Publica*. 2022;46:e102.