**ORIGINAL ARTICLE**

# METHODOLOGICAL ASPECTS AND RESULTS OF THE BASELINE OF THE MONITORING OF HEALTH IN ADULTS AND ELDERLY INFECTED BY SARS-COV-2 (SULCOVID-19)


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**Highlights:** 1. Methodological studies are crucial for health. 2. Symptom prevalence increased as economic class decreased. 3. Symptom distribution varies by gender, age, and economic class.


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(as accepted)

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## ABSTRACT

AIM: To describe the methodology and sample used in the study, as well as the prevalence of symptoms during the acute phase of infection according to socioeconomic variables. METHODS: A cross-sectional study conducted in Rio Grande with individuals infected by SARS-CoV-2 from December 2020 to March 2021. Nineteen symptoms present during the acute phase of infection were investigated and analyzed separately and categorized as "0-4," "5-9," and "10 or more," according to sex, age, and economic class. RESULTS: 2,919 individuals were included in the sample. The most prevalent symptoms were fatigue (73.7%), headache (67.2%), loss of taste (65.9%), loss of smell (63.9%), and muscle pain (62.3%). Regarding the occurrence of symptoms stratified by sex, all symptoms except productive cough were statistically higher in females. Regarding age, it was found that headache, pain/discomfort breathing, loss of taste, loss of smell, fatigue, sore throat, nasal congestion, diarrhea, joint pain, and muscle pain were statistically higher among adults (18-59 years old). Regarding economic class, the prevalence of symptoms such as shortness of breath, pain/discomfort breathing, altered sensitivity, and joint pain increased linearly with decreasing economic class. CONCLUSION: The results of this study allowed identifying the most frequent symptoms during the acute phase of COVID-19 and their distribution among groups, providing data for the implementation of public policies by managers and support for healthcare professionals in assisting this population.

Keywords: COVID-19; SARS-CoV-2; Pandemics; Cross-Sectional Studies; Methods

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## INTRODUCTION

Initiated in the province of Hubei, China, the epidemic caused by the SARS-CoV-2 virus, the agent responsible for COVID-19, rapidly spread across all continents[1]. Infection with SARS-CoV-2 affects multiple organs, mainly the respiratory system, and can range in severity from asymptomatic to very severe[2]. Since the pandemic was declared in January 2023, there have been over 657 million reported cases of COVID-19 worldwide, resulting in over 6.6 million deaths. In Brazil, the number of cases has exceeded 36.4 million, with over 694 thousand deaths[3].

The course and severity of the pandemic have led governments to adopt health confinement strategies to contain the spread of the virus and reduce the number of infected[4].

Beyond health issues, such measures have brought abrupt changes in the social, economic, political, and cultural spheres of the global population[5]. Due to the disease's impact on people's health, both in acute and chronic forms, and facing a pandemic with still unknown effects, researchers quickly focused on better understanding this new infection and its short, medium, and long-term consequences[6].

Several studies, employing different methodologies, have been developed to assess the effects of COVID-19, aiming to obtain valid, reproducible, and comparable data[7]. Although the need for rapid dissemination of information to the community and healthcare systems about COVID-19 was imperative, significant concerns were raised regarding scientific rigor because studies conducted with inadequate methodologies can lead to data flaws, yielding biased and unreliable results. To prevent this, the choice of research question, design, adequacy of publication, and quality of reports are important steps in the methodological construction of research[8].

Thus, the importance of methodological studies is highlighted, describing the development, validation, and evaluation of their instruments and methods, aiming to present solid and reliable results, rigorous tests of interventions, and sophisticated data acquisition procedures in health areas[9].

Given the importance of the topic, the need for monitoring studies during this pandemic is emphasized, as they can identify solutions to reduce morbidity and mortality from COVID-19, assist in the technological development of vaccines, and develop diagnostic tests, making it possible to obtain a significant amount of resources in a short time[10]. Monitoring COVID-19 and its outcomes is a recommended strategy to strengthen health services through a set of indicators that should be regularly evaluated and disseminated. The World Health Organization (WHO) launched in 2020 the guide "Maintenance of Essential Health Services: Operational Guidance in the Context of COVID-19", which provides an integrated framework to support countries in their efforts and strategies to maintain safe health provision for the population[11].

In light of the above, aiming to contribute to the realization of more studies in this field with the necessary methodological rigor, allowing the reproducibility of findings in different contexts and populations, the objective is to describe the methodology used in the study, its sample, and the prevalence of symptoms of the acute phase of infection according to socioeconomic variables.

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## METHODOLOGY

The present study was entitled "Health monitoring research of adults and elderly after COVID-19 infection in Rio Grande – Sulcovid-19". It is a prospective cohort study with follow-up. The baseline measured health indicators in adults and the elderly between 6 and 10 months after infection, and the first follow-up will monitor health indicators between 20 and 25 months after SARS-CoV-2 infection.

- **Study Location**

It is being conducted in the municipality of Rio Grande, located in the extreme south of Rio Grande do Sul, Brazil. Rio Grande is a coastal, port city, close to the border with Uruguay, with an estimated population of 191,900 inhabitants[12]. The municipality has a Municipal Human Development Index (MHDI) of 0.744 (high), a value close to the estimated for Brazil in the same period (MHDI 0.724)[13]. Rio Grande's Gini index is 0.52, slightly below the national (0.54)[14]. Since the beginning of the pandemic, there have been 53,394 confirmed cases of COVID-19 infection and a mortality rate of 328.4 per 100 thousand inhabitants in the city[15].

- **Target Population**

It consisted of all individuals aged 18 or older, infected between December/2020 and March/2021, diagnosed with COVID-19 through RT-PCR, residing in the urban area of Rio Grande, symptomatic during the infection, and monitored by the municipality's epidemiological surveillance.

- **Exclusion Criteria for Study Participants**

Individuals without cognitive conditions to respond to the instrument and without a caregiver/responsible party to respond on their behalf, without available telephone contact and address in the epidemiological surveillance record, deprived of liberty, and no longer residing in the city during data collection were excluded.

- **Sampling and Data Collection**

The sample was identified from a list of infected individuals obtained from municipal epidemiological surveillance. Based on the list, inclusion and exclusion criteria were applied, resulting in 3,822 eligible participants for the study. Four interviewers, along with four

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postgraduate students, were selected for data collection. They were previously trained to conduct interviews by phone and in person.

The list with the telephone contacts of the target population was equally divided among the interviewers, to conduct 40 interviews per week. Each interview lasted an average of 20 minutes. Data collection was conducted in two consecutive stages:

1. **Telephone Collection**: Up to five telephone contacts were made with each eligible individual for the study. These contacts were made on alternating days and times. After five unsuccessful contacts, a standardized message was sent to WhatsApp numbers. In cases where the person responded to the message sent via WhatsApp, a telephone or in-person interview was scheduled according to the respondent's preference. Cases that did not answer the phone and did not respond to the message were allocated to the next stage, home collection.
2. **Home Collection**: In this stage of the study, the interviewer, properly equipped, went to the interviewee's home to conduct the interview in person with eligible individuals for the study who were not interviewed during the telephone collection stage. They received at least one home visit for the interview. The instrument and method of application were the same as for telephone collection. Those whose addresses were not found were considered lost.

The collection stages took place between June and October 2021.

- **Data Collection Instrument**

The data were collected using the Redcap program installed on tablets. The instrument was developed for both telephone and in-person application, covering semi-structured questions, preferably based on standardized instruments. Questions included socio-economic variables, COVID symptomatology during and after the acute phase, use of health services, health conditions, fatigue, physical activity, behavior and food safety, functional capacity, musculoskeletal symptoms, and behavioral characteristics. The instrument was previously tested through a pilot study conducted with individuals who met the inclusion criteria for the research but who had been infected in a period before that recommended in our study.

For this study, we chose to present the sample description based on the following variables: gender (female, male), age (18-59 years, 60 years or older), marital status (married/living with

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partner, single/living without partner), self-reported skin color (white, black/brown/yellow/indigenous), education level (no education/primary education, secondary education, university), income in reais (0 – 1,000, 1,001 – 2,000, 2,001 – 4,000, 4,001 or more), severity of COVID-19 illness (i.e. need for hospitalization – ward and intensive care unit - low, moderate, high).

Results regarding the presence of symptoms during the acute phase of infection are also presented. A total of 19 symptoms were investigated, including headache, shortness of breath, dry cough, productive cough, breathing discomfort/pain, loss of taste, loss of smell, sensitivity alteration, fatigue, sore throat, runny nose, nasal congestion, nausea/vomiting, diarrhea, joint pain, muscle pain, memory loss, attention loss, and skin alterations, based on the question: "Which of these symptoms did you experience after COVID-19 infection?", with a dichotomous response option (yes/no). Symptom presence was operationalized in tertiles (0-4, 5-9, 10 or more). The prevalence of each symptom, separately and in categories of several symptoms investigated, was stratified by gender, age, and economic class[16].

- **Data Analysis**

The data were exported and analyzed using Stata®15.0 software. Descriptive analyses were performed, estimating proportions and 95% confidence intervals (CI). Proportions were compared using the chi-square test. For all analyses, a p-value $< 0.05$ was considered significant.

- **Quality Assurance and Control**

To ensure data quality and reduce the risk of result bias, the following measures were adopted: 1) Elaboration of instruments and instructions manual for interviewer use; 2) Standardized interviewer training; 3) Pilot study with data collection conducted by interviewers; 4) Use of REDCap®, a software and platform for data collection and management that can be used on any mobile device without an internet connection. Its use is derived from a partnership with Vanderbilt University (available at https://www.project-redcap.org/). The software ensures complete filling of the instrument, signaling to the interviewer the incompleteness of responses; 5) Daily verification of inconsistencies in the database; 6) Telephone contact with 10% of the sample, selected through random drawing, for application of a reduced questionnaire and identification of inconsistencies and possible frauds in the interviews.

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- **Ethical Principles**

After approval of the study by the Health Department of the municipality of Rio Grande, through Opinion 029/2020, the project was submitted for review and approval by the Research Ethics Committee of the Federal University of Rio Grande, opinion 4,375,697 / CAAE: 39081120.0.0000.5324, the research respected the specific resolutions of the National Health Council (466/2012 and 510/2016). All participants were informed about the research objectives and the informed consent form. Telephone interviews were recorded, and affirmative consent to the oral consent form was duly recorded in the recording. The informed consent form for face-to-face interviews was signed before the interview.

- **Funding**

This study was conducted in partnership with the Federal University of Rio Grande (FURG) and Federal University of Pelotas (UFPel), with the support of the Foundation for Research Support of the State of Rio Grande do Sul (FAPERGS) - public notice 08/2020 PPSUS.

## RESULTS

Out of the 3,822 eligible for the study, 2,919 were interviewed, with 631 and 272 considered losses and refusals, respectively. The interviews were conducted on average 6.4 months after the infection was diagnosed by RT-PCR. Approximately 60.0% of the interviewees were female, 83.3% were between 18 and 59 years old, 60.6% were married or living with a partner, and 77.5% were white-skinned. Regarding education and economic level, 44.1% had completed high school, and 38.9% had an income between R$1,001-2,000 reais. Nearly all of the sample had a mild form of the disease (i.e., no hospitalization during the acute phase) (96.6%) and an average of 7.2 symptoms (Table 1).

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**Table 1.** Sample description according to demographic, socioeconomic variables, and symptoms during the acute phase of SARS-CoV-2 infection. Sulcovid-19 Research, Rio Grande, Brazil, 2021.

| Variable | N | % |
|---|---|---|
| **Sex** | | |
| Male | 1,208 | 41.6 |
| Female | 1,711 | 58.4 |
| **Age (years)** | | |
| 18-59 | 2,420 | 83.3 |
| 60 or older | 484 | 16.7 |
| **Marital Status** | | |
| Married/living with partner | 1,757 | 60.6 |
| Single/living without partner | 1,144 | 39.4 |
| **Skin Color** | | |
| White | 2,244 | 77.5 |
| Black/brown/yellow/indigenous | 650 | 22.5 |
| **Education** | | |
| No education/primary education (1st grade) | 728 | 25.4 |
| Secondary education (2nd grade) | 1,264 | 44.1 |
| University (3rd grade) | 871 | 30.4 |
| **Income (Brazilian reais)** | | |
| 0 - 1,000 | 668 | 26.1 |
| 1,001 - 2,000 | 995 | 38.9 |
| 2,001 - 4,000 | 604 | 23.6 |
| 4,001 or more | 288 | 11.3 |
| **Severity of COVID-19 Disease** | | |
| Low | 2,313 | 96.6 |
| Moderate/high | 82 | 3.4 |
| **Presence of Symptoms (number of symptoms)** | Mean | SD |
| | 7.2 | 3.7 |
| **Presence of Symptoms (terciles)** | | |
| 1st (0-4 symptoms) | 977 | 35.0 |
| 2nd (5-9 symptoms) | 1,033 | 37.0 |
| 3rd (10 or more symptoms) | 783 | 28.0 |

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Table 2 shows the prevalence of investigated symptoms during the acute phase of COVID-19 infection. Out of the 19 symptoms investigated, the most prevalent ones were fatigue (73.7%), headache (67.2%), loss of taste (65.9%), loss of smell (63.9%), and muscle pain (62.3%), while productive cough (9.6%) and skin changes (7.2%) showed the lowest prevalences (Table 2).

**Table 2.** Prevalence and confidence intervals of COVID-19 symptoms during the acute phase of infection. Sulcovid-19 Research, Rio Grande, Brazil, 2021.

| **Symptoms** | **N** | **%** | **95% CI** |
|---|---|---|---|
| Fatigue (2.909) | 2,143 | 73.7 | 72.0-75.2 |
| Headache (2.905) | 1,951 | 67.2 | 65.4-68.8 |
| Loss of taste (2.909) | 1,918 | 65.9 | 64.2-67.6 |
| Loss of smell (2.907) | 1,857 | 63.9 | 62.1-65.6 |
| Muscle pain (2.910) | 1,813 | 62.3 | 60.5-64.0 |
| Joint pain (2.905) | 1,586 | 54.6 | 52.8-56.4 |
| Dry cough (2.906) | 1,314 | 45.2 | 43.4-47.0 |
| Sore throat (2.902) | 1,019 | 35.1 | 33.4-36.9 |
| Shortness of breath (2.914) | 992 | 34.0 | 32.2-35.8 |
| Diarrhea (2.909) | 988 | 34.0 | 32.2-35.7 |
| Pain/discomfort breathing (2.908) | 861 | 29.6 | 28.0-31.3 |
| Runny nose (2.897) | 798 | 27.6 | 25.9-29.2 |
| Memory loss (2.897) | 717 | 24.8 | 23.2-26.4 |
| Nasal congestion (2.895) | 673 | 23.3 | 21.7-24.8 |
| Sensitivity changes (2.898) | 665 | 22.9 | 21.4-24.5 |
| Nausea or vomiting (2.908) | 644 | 22.2 | 20.7-23.7 |
| Loss of attention (2.895) | 589 | 20.4 | 18.9-21.9 |
| Productive cough (2.900) | 277 | 9.6 | 8.5-10.7 |
| Skin changes (2.914) | 211 | 7.2 | 6.3-8.2 |

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When evaluating the presence of each symptom according to gender, it is observed that only productive cough did not show a statistically significant higher prevalence in females. Regarding the occurrence of symptoms stratified by age, it was found that headache, shortness of breath, loss of taste, loss of smell, fatigue, sore throat, nasal congestion, diarrhea, joint pain, and muscle pain were statistically higher among adults (18-59 years old), while productive cough and loss of memory showed higher prevalences among the elderly (60 years old or older) (Table 3).

**Table 3. Prevalence and confidence intervals of COVID-19 symptoms during the acute phase of infection according to sex and age. Sulcovid-19 Research, Rio Grande, Brazil, 2021.**

| Symptoms | Sex (Male) | Sex (Female) | P-value | Age 18-59 years | Age 60 or older | P-value |
|---|---|---|---|---|---|---|
| | % (95% CI) | % (95% CI) | | % (95% CI) | % (95% CI) | |
| Fatigue (2.909) | 67.3 (64.6-66.9) | 78.1 (76.1-80.0) | 0.000 | 75.6 (73.9-77.3) | 63.7 (59.3-67.9) | 0.000 |
| Headache (2.905) | 62.2 (59.4-64.9) | 70.7 (68.5-72.8) | 0.000 | 71.9 (70.1-73.7) | 44.2 (39.8-48.7) | 0.000 |
| Loss of taste (2.909) | 60.8 (58.0-63.5) | 69.6 (67.3-71.7) | 0.000 | 68.5 (66.6-70.4) | 52.8 (48.3-57.2) | 0.000 |
| Loss of smell (2.907) | 56.4 (53.5-59.2) | 69.2 (66.9-71.3) | 0.000 | 67.0 (65.1-68.8) | 48.3 (43.9-52.8) | 0.000 |
| Muscle pain (2.910) | 65.3 (63.0-67.5) | 58.0 (55.2-60.8) | 0.000 | 63.5 (61.6-65.4) | 56.4 (51.9-60.8) | 0.003 |
| Joint pain (2.905) | 49.1 (46.3-52.0) | 58.5 (56.1-60.8) | 0.000 | 55.5 (53.5-57.5) | 49.5 (45.0-53.9) | 0.015 |
| Dry cough (2.906) | 42.1 (39.3-44.9) | 47.4 (45.1-49.8) | 0.004 | 44.9 (42.9-46.9) | 47.0 (42.5-51.5) | 0.401 |
| Sore throat (2.902) | 29.7 (21.1-32.3) | 38.9 (36.6-41.3) | 0.000 | 36.3 (34.4-38.2) | 29.4 (25.4-33.6) | 0.004 |
| Shortness of breath (2.914) | 29.3 (26.8-31.9) | 37.4 (35.1-39.7) | 0.000 | 34.7 (32.8-36.6) | 30.9 (26.9-35.2) | 0.108 |
| Diarrhea (2.909) | 27.4 (24.9-30.0) | 38.6 (36.3-40.0) | 0.000 | 34.8 (32.9-36.7) | 29.5 (25.5-33.7) | 0.023 |
| Pain/discomfort breathing (2.908) | 24.0 (21.6-26.4) | 33.6 (31.4-35.9) | 0.000 | 30.4 (28.6-32.2) | 25.6 (21.9-29.7) | 0.035 |
| Runny nose (2.897) | 22.8 (20.5-25.2) | 30.9 (28.8-33.2) | 0.000 | 27.4 (25.7-29.2) | 28.8 (24.9-33.0) | 0.524 |
| Memory loss (2.897) | 15.3 (13.4-17.5) | 31.4 (29.2-33.6) | 0.000 | 23.8 (22.1-25.5) | 29.2 (25.3-33.5) | 0.011 |
| Nasal congestion (2.895) | 19.1 (17.0-21.5) | 26.1 (24.1-28.3) | 0.000 | 24.7 (23.0-26.5) | 16.0 (13.0-19.6) | 0.000 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Sensitivity changes (2.898) | 19.7 (17.6-22.1) | 25.2 (23.2-27.3) | 0.001 | 23.0 (21.4-24.7) | 22.0 (18.5-26.0) | 0.649 |
| Nausea or vomiting (2.908) | 14.7 (12.8-16.8) | 27.4 (25.3-29.6) | 0.000 | 22.2 (20.6-23.9) | 21.6 (18.1-25.5) | 0.775 |
| Loss of attention (2.895) | 13.0 (11.2-15.0) | 25.5 (23.5-27.7) | 0.000 | 20.3 (18.7-22.0) | 20.3 (16.9-24.2) | 0.989 |
| Productive cough (2.900) | 9.0 (7.5-10.8) | 9.9 (8.6-11.5) | 0.396 | 8.8 (7.7-10.1) | 12.7 (10.0-16.0) | 0.009 |
| Skin changes (2.914) | 4.5 (3.5-5.9) | 9.1 (7.8-10.6) | 0.000 | 7.3 (6.3-8.4) | 6.6 (4.7-9.2) | 0.596 |

*P-value from chi-square test

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The data presented in Table 4 show that the prevalence of symptoms such as shortness of breath, pain/discomfort breathing, altered sensitivity, and joint pain exhibited an inverse association, with a tendency of increasing prevalence as economic class decreases, with differences of up to 11 percentage points between the lower economic class compared to the highest economic class (shortness of breath).

**Table 4. Prevalence and confidence intervals of COVID-19 symptoms during the acute phase of infection according to economic class. Sulcovid-19 Research, Rio Grande, Brazil, 2021.**

| Symptoms | A/B | C | D/E | P-value |
|---|---|---|---|---|
| | % (95% CI) | % (95% CI) | % (95% CI) | |
| Fatigue (2.909) | 72.1 (67.6-76.3) | 75.4 (73.1-77.5) | 73.7 (70.5-76.6) | 0.359 |
| Headache (2.905) | 63.7 (58.9-68.3) | 68.5 (66.1-70.8) | 67.7 (64.3-70.8) | 0.186 |
| Loss of taste (2.909) | 63.8 (59.0-68.3) | 68.1 (65.7-70.4) | 65.3 (62.0-68.6) | 0.172 |
| Loss of smell (2.907) | 65.5 (60.7-70.0) | 65.4 (62.9-67.7) | 63.1 (59.7-66.4) | 0.525 |
| Muscle pain (2.910) | 62.2 (58.8-65.5) | 64.7 (62.2-67.1) | 58.8 (54.0-63.5) | 0.082 |
| Joint pain (2.905) | 49.4 (44.5-54.2) | 56.1 (53.6-58.6) | 56.0 (52.5-59.4) | 0.044 |
| Dry cough (2.906) | 43.1 (38.4-48.0) | 45.8 (43.3-48.4) | 45.5 (42.1-49.0) | 0.624 |
| Sore throat (2.902) | 35.5 (32.2-38.9) | 36.4 (33.9-38.9) | 32.8 (28.4-37.6) | 0.419 |
| Shortness of breath (2.914) | 27.6 (23.5-32.2) | 34.0 (31.6-36.5) | 38.6 (35.3-42.0) | 0.001 |
| Diarrhea (2.909) | 35.5 (31.0-40.3) | 34.7 (32.3-37.2) | 32.9 (29.7-36.2) | 0.573 |
| Pain/discomfort breathing (2.908) | 23.5 (19.6-27.9) | 29.6 (27.3-32.0) | 34.0 (30.8-37.3) | 0.001 |
| Runny nose (2.897) | 24.1 (20.2-28.6) | 28.2 (26.0-30.6) | 29.2 (26.1-32.4) | 0.166 |
| Memory loss (2.897) | 22.9 (19.0-27.2) | 24.6 (22.4-26.8) | 26.0 (23.1-29.2) | 0.459 |
| Nasal congestion (2.895) | 19.2 (15.6-23.3) | 24.0 (21.9-26.3) | 24.5 (21.7-27.6) | 0.087 |
| Sensitivity changes (2.898) | 21.4 (17.6-25.6) | 22.0 (20.0-24.2) | 26.6 (23.6-29.7) | 0.031 |
| Nausea or vomiting (2.908) | 22.3 (18.5-26.6) | 20.2 (18.2-22.3) | 26.1 (23.2-29.2) | 0.005 |
| Loss of attention (2.895) | 18.4 (18.4-22.4) | 21.4 (19.3-23.6) | 20.3 (17.6-23.2) | 0.400 |
| Productive cough (2.900) | 7.8 (5.6-10.9) | 9.6 (8.2-11.2) | 9.8 (7.9-12.1) | 0.490 |
| Skin changes (2.914) | 6.9 (4.7-9.7) | 7.5 (6.2-9.0) | 7.2 (5.6-9.1) | 0.875 |

*P-value from chi-square test

The prevalence of 10 or more symptoms was higher in females (34.6%), in adults aged 18 to 59 years (29.2%), and in individuals from lower economic class (31.1%) (Figure 1).

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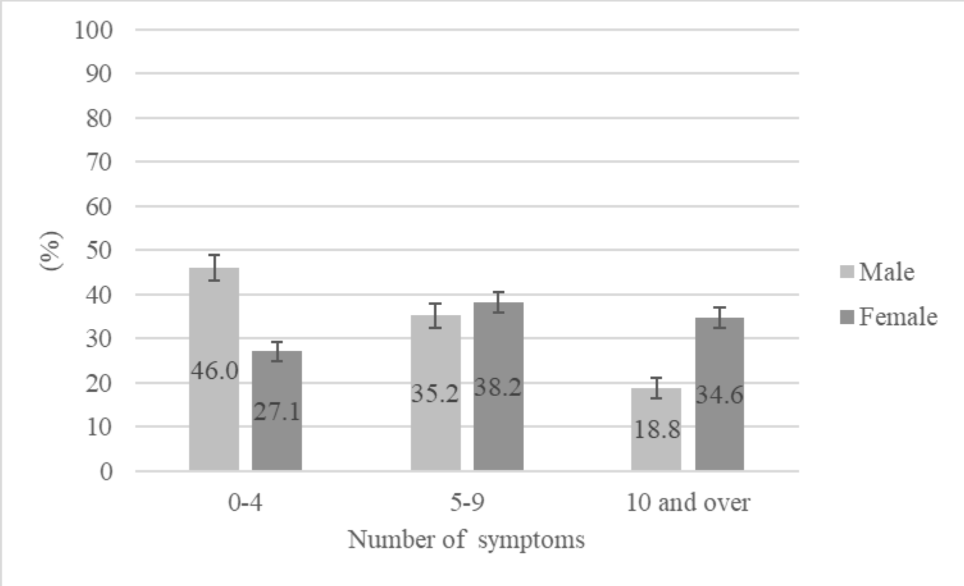
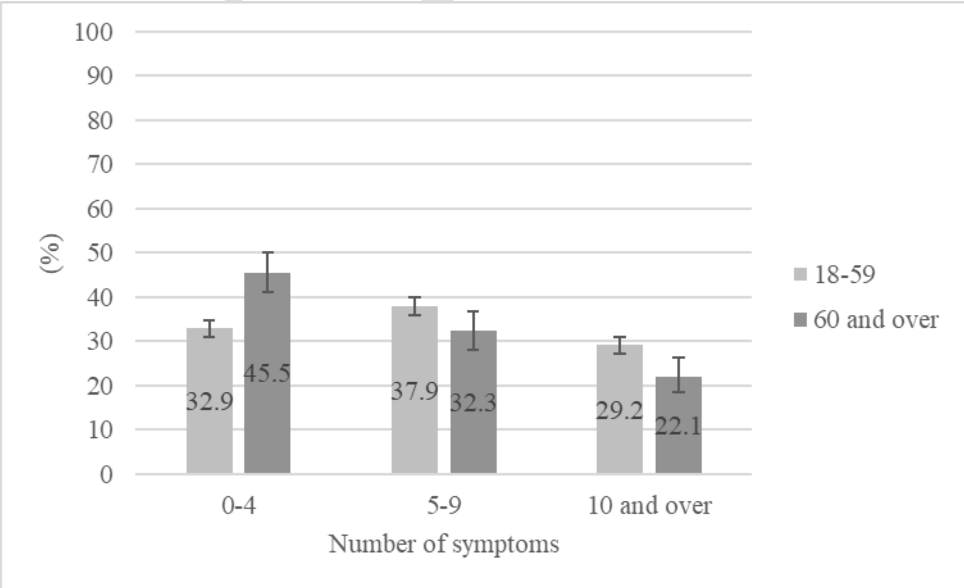
Figure 1. Prevalences and confidence intervals of the number of COVID-19 symptoms (tercile) during the acute phase of infection according to sex (A), age (B), and socioeconomic class (C). Sulcovid-19 Survey, Rio Grande, Brazil (N= 2,793).*

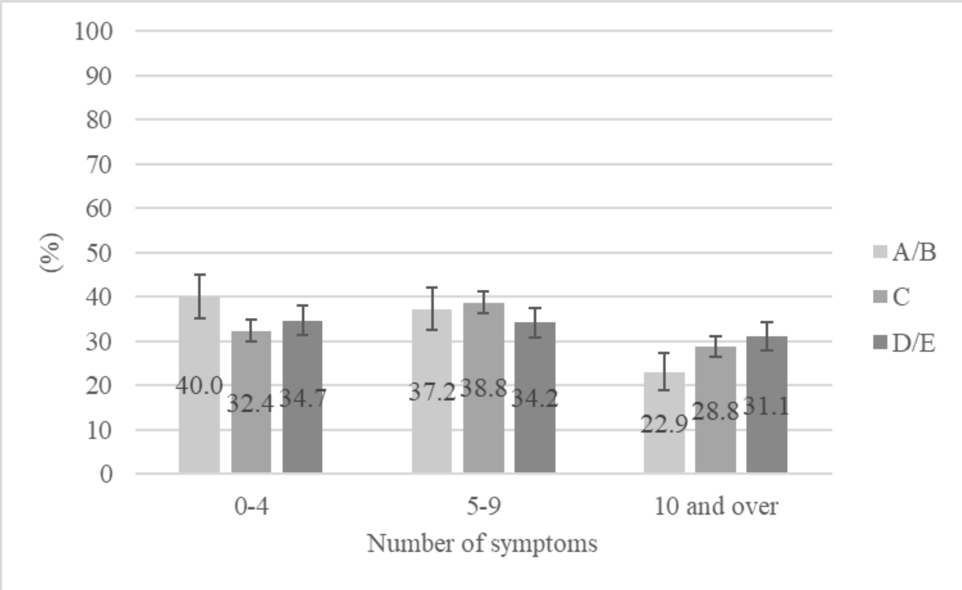
(A)




(B)



(C)




*Chi-square test

(Figure A) p-value=0,001

(Figure B) p-value=0,005

(Figure C) p-value=0,007

## DISCUSSION

This study evaluated the characteristics of individuals who were infected by SARS-CoV-2, showing that the most prevalent symptoms during the acute phase of the infection were fatigue, headache, loss of taste, loss of smell, and muscle pain, being more frequent in women, people with a high school diploma, and those who had an income between R$1,000-2,000. This profile of people infected by SARS-CoV-2 is in line with the literature that highlights inequalities in the occurrence of diseases, with the most vulnerable people being the most affected[17,18].

It is important to highlight that there is a great heterogeneity of symptoms, which include systemic manifestations, such as respiratory, neurological, and musculoskeletal, with the main symptoms reported in the literature present in the acute phase being dyspnea, fever, cough, runny nose, sore throat, body pain, headache, myalgias, anosmia, and dysgeusia[19]. The present study observed that around seven out of every ten had fatigue, while the findings of Han and collaborators (2020) identified fever (65.8%) and

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cough (48.1%) as the most prevalent symptoms[20]. Furthermore, Mesenburg et al. (2021) detected a predominance of headache (77.0%) and muscle pain (61.0%) in more than half of the studied sample, in approximate agreement with our findings, where these symptoms occurred in 67.2% and 62.3% of cases, respectively[21].

There is no consensus in the literature on the influence of demographic variables on the contagion and symptoms of COVID-19, being considered quite heterogeneous and varying according to geographic and cultural aspects[22]. Corroborating our results, studies show that there is a greater number of cases of COVID-19 in women, both nationally and internationally[23,24]. This difference between sexes may be related to the behavior of men and women about health guidelines, as women tend to seek out health establishments more frequently, having better self-care habits. Furthermore, most of them bear the responsibility of ensuring care for their family, further increasing the search for and use of health services[25].

In the longitudinal study carried out by Petersen et al., 2021, which described the symptoms in the acute phase of the COVID-19 disease, with 78.4% of its sample aged between 18 and 66 years, it revealed that this age group was the most affected, 32.2% presenting more than nine symptoms, including fatigue, fever, headache, chills, loss of smell and taste, myalgia, dry cough, rhinorrhea, and others, pointing in the same direction as our findings since the highest occurrence of symptoms was in the adult population up to 59 years old[26].

The possible origin of fatigue caused by SARS-CoV-2 appears to be related to the cellular infiltration of the virus through angiotensin-converting enzyme 2 (ACE-2) receptors, mainly affecting alveolar epithelial cells[27]. Studies indicate that viral replication initially occurs in the mucosa of the upper respiratory tract, followed by intensification in the lower tract: the infection generates cellular damage and the release of pro-inflammatory cytokines, resulting in hypercytokinemia[27]. Furthermore, acute lung injuries can reduce ACE-2 receptors, disrupting the renin-angiotensin system and worsening the individual's health status, which can maintain the symptom of fatigue even after acute infection[28,29].

The hypothesis for the loss of smell is attributed to the high affinity of the virus for ACE-2 receptors, which are abundantly found in the nasal cavity and olfactory bulb[30]. The SARS-CoV-2 virus invades cells through the connection between the S protein

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(spike) and the ACE-2 receptors, present on its surface. Although olfactory neurons do not have these receptors, the opposite occurs in supporting cells, which have a considerable number of these receptors. These support cells play a crucial role in the physical and metabolic support of cilia present in olfactory neurons, where the receptors responsible for detecting odors are concentrated. The deterioration of these cilia results in the loss of smell[30].

Concerning impaired taste, its occurrence can be attributed to damage caused by the virus to the mucosa of the oral cavity, triggering inflammation in the ACE-2[31] receptor region. It is known that SARS-CoV-2 binds and penetrates host cells through interaction with ACE-2 receptors, facilitating viral connection through the S glycoprotein present on the surface of the viral envelope[32]. In this process, the Transmembrane Protease, serine 2 (TMPRSS2), a protein present on the cell surface, which promotes the cleavage of the S glycoprotein, facilitating the fusion of the cell membrane and the subsequent endocytosis of the virus, is also involved[30]. This process of viral replication increases its capacity for invasive disease over time.

About headache, there are three possible mechanisms to trigger this symptom during the period of acute infection: the immune response generated to combat the infection, neurological inflammation, associated, above all, with the tropism of the virus to the central nervous system, and hyperactivation of ACE-[2] receptors.

Research conducted on SARS-infected patients demonstrates a notable musculoskeletal burden, including disorders[34,35]. ACE-[2] is present in the musculoskeletal system, and the virus reduces ACE-[2]-positive cells in the human spinal cord, thus leading to muscle pain[36,37]. Furthermore, cytokines and pro-inflammatory molecules originating from SARS-CoV-2 infection can also induce changes in skeletal muscle tissue[38,39].

Among the research participants, more than a third of the sample reported having an average income between R$1,001 – R$2,000, that is, the second-lowest income stratum among those affected by the disease. Similar to our results, the study carried out with a nationally representative sample of Brazilians aged 50 or over showed that almost more than half (65%) of all positive diagnoses for COVID-19 occurred among people from the second lowest income quintile[40].

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Individuals with a lower socioeconomic level are more affected by COVID-19, which reinforces the existence of inequalities in the country since this population has worse social conditions, becoming more susceptible to infection caused by the virus; This conclusion arises because socioeconomically disadvantaged individuals are more exposed to most of the known risk factors for COVID-19 due to a lifestyle that favors sedentary behaviors, inadequate diet and nutritional status, poor housing and sanitation conditions, precarious working conditions and income, among others that go beyond the health sector and directly impact the health-disease process of a population[40].

The COVID-19 pandemic hit the country amid a severe financial crisis that exacerbated existing social inequalities[41]. Therefore, it is possible to infer that the impact generated by these inequalities on the health status of these low-income people makes them more vulnerable, due to greater exposure to viral loads due to precarious living conditions and consequent difficulty in maintaining social distancing[42]. Income inequality has been demonstrated as an important predictor in the health-disease process of a population and can play a significant role in the impact of COVID-19 in the Brazilian territory[43].

In the present study, the results found must be interpreted considering their limitations and strengths. Survival bias must be considered, as only individuals who survived COVID-19 were analyzed, which may have underestimated the occurrence of symptoms. Furthermore, the fact that the symptoms are self-reported, and that we questioned only 19 of the more than 200 symptoms reported in the literature, however, it is worth highlighting that we questioned the most common ones.

As strengths, this research brings information from a representative sample of those infected with COVID-19, diagnosed using a gold standard test (RT-PCR), where the response rate was above 75.0%. It is also important to mention that there are few methodological studies on telephone surveys, a viable alternative, given the imposition of isolation present at the time of the study, and economically more accessible given the scarcity of resources for research in Brazil. At the same time, this study reveals unprecedented results on the characteristics of COVID-19 in the Brazilian population, especially in the extreme south of the country, whose peculiarities are not limited to the region, considering that it is a port city in addition to being home to a federal university, which guarantees the cultural and population diversity of the sample. Furthermore, it is

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considered that the literature on the subject is scarce, the few existing studies evaluated hospitalized people, and most of them evaluated small samples, and were mostly developed in high-income countries, such as Europe.

## CONCLUSION

Our findings identified that the majority of individuals interviewed after SARS-CoV-2 infection were female, aged 18 to 59 years, self-reported white, married or living with a partner, had completed secondary education, and belonged to the second lowest income stratum (between R$ 1,000-2,000). Among the prevalent symptoms identified, fatigue, headache, loss of taste, loss of smell, and muscle pain were the most frequent. The description of the studied sample and the identification of the prevalence of symptoms of the acute phase of infection according to demographic and socioeconomic variables allowed a better understanding of this new infection and its short- and medium-term consequences in the population of the southernmost region of the country. Thus, these findings call on researchers, healthcare professionals, and, above all, managers to make intersectoral efforts capable of overcoming the challenges posed to ensure comprehensive care capable of meeting the health needs of a population suffering from the effects of inequalities exacerbated by the new scenario imposed by the COVID-19 pandemic.

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