Clinical and Epidemiological Description of Covid-19: Data from a Sentinel Study in Health Units in Rio de Janeiro

Descrição Clínica e Epidemiológica da Covid-19: Dados de um Estudo Sentinela em Unidades de Saúde do Rio de Janeiro

Descripción Clínica y Epidemiológica de la Covid-19: Datos de un Estudio Centinela en Unidades de Salud de Río de Janeiro

RESUMO

Objetivo: Investigar a distribuição e características clínicas da COVID-19 em indivíduos atendidos em unidades de saúde do estado do Rio de Janeiro, entre junho e outubro de 2020. **Método:** Estudo observacional seccional seriado com 10.329 participantes. Foram coletados dados clínico-epidemiológicos por meio de formulário eletrônico, com testagem RT-PCR para SARS-CoV-2 e sorologia IgM/IgG. A análise estatística incluiu processamento de dados no software R, categorização de variáveis e uso de ferramentas descritivas. **Resultados:** A positividade foi de 14% para RT-PCR, 8,4% para IgM e 10% para IgG. Mulheres (60%) e pardos (45%) predominaram. Centros de testagem apresentaram maior taxa de positividade (RT-PCR: 16%; IgM: 13%). Cefaleia (41%) e mialgia (33%) foram os sintomas mais comuns, enquanto a anosmia foi relatada por 18%. **Conclusão:** O estudo destacou a relação temporal entre métodos diagnósticos e o perfil clínico da COVID-19, ressaltando a importância de estratégias integradas de testagem para manejo epidemiológico e clínico.
DESCRITORES: COVID-19; Testes Diagnósticos; Sorologia; Epidemiologia; Unidades de Saúde.

ABSTRACT

Objective: To investigate the distribution and clinical characteristics of COVID-19 in individuals treated at health units in the state of Rio de Janeiro, between June and October 2020. **Method:** A serial cross-sectional observational study with 10,329 participants. Clinical-epidemiological data were collected through an electronic form, with RT-PCR testing for SARS-CoV-2 and IgM/IgG serology. The statistical analysis included data processing using R software, categorization of variables, and descriptive tools. **Results:** The positivity rate was 14% for RT-PCR, 8.4% for IgM, and 10% for IgG. Women (60%) and individuals of mixed race (45%) were predominant. Testing centers showed a higher positivity rate (RT-PCR: 16%; IgM: 13%). Headache (41%) and myalgia (33%) were the most common symptoms, while anosmia was reported by 18%. **Conclusion:** The study highlighted the temporal relationship between diagnostic methods and the clinical profile of COVID-19, emphasizing the importance of integrated testing strategies for epidemiological and clinical management.
KEYWORDS: COVID-19; Diagnostic Tests; Serology; Epidemiology; Health Units.

RESUMEN

Objetivo: Investigar la distribución y las características clínicas de la COVID-19 en individuos atendidos en unidades de salud del estado de Río de Janeiro, entre junio y octubre de 2020. **Método:** Estudio observacional seriado de corte transversal con 10.329 participantes. Se recolectaron datos clínico-epidemiológicos mediante un formulario electrónico, con pruebas RT-PCR para SARS-CoV-2 y serología IgM/IgG. El análisis estadístico incluyó el procesamiento de datos en el software R, categorización de variables y el uso de herramientas descriptivas. **Resultados:** La tasa de positividad fue del 14% para RT-PCR, 8,4% para IgM y 10% para IgG. Predominaron las mujeres (60%) y las personas de raza mixta (45%). Los centros de prueba presentaron una mayor tasa de positividad (RT-PCR: 16%; IgM: 13%). Cefalea (41%) y mialgia (33%) fueron los síntomas más comunes, mientras que la anosmia fue reportada por el 18%. **Conclusión:** El estudio destacó la relación temporal entre los métodos diagnósticos y el perfil clínico de la COVID-19, resaltando la importancia de estrategias integradas de pruebas para el manejo epidemiológico y clínico.
PALABRAS CLAVE: COVID-19; Pruebas Diagnósticas; Serología; Epidemiología; Unidades de Salud.

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INTRODUCTION

The first cases of COVID-19 were initially linked to the Huanan Seafood Market, located in Jianghan District, which is known for trading live animals and seafood. This market has been identified as the likely zoonotic transmission point for the virus, which is believed to have originated in bats and been transmitted to humans. [1] Of the 41 people hospitalized as of January 2, 2020, two-thirds were directly linked to the market, suggesting a common origin and rapid spread of the infection. [2] In January 2020, Chinese authorities confirmed that the causative agent of the disease was a novel coronavirus, designated SARS-CoV-2, and the associated condition was named COVID-19. Classified as belonging to the subgenus Sarbecovirus, genus Betacoronavirus, and family Coronaviridae, SARS-CoV-2 has emerged as a significant global threat. [2]

The spread of SARS-CoV-2 across China and subsequently around the world was alarmingly rapid. On January 30, 2020, the World Health Organization (WHO) declared COVID-19 a public health emergency of international concern. Just two months later, in March 2020, the WHO declared COVID-19 a pandemic, highlighting the magnitude of the global health crisis. [1]

In Brazil, the response to the pandemic was equally swift. The first confirmed case of COVID-19 was recorded on February 26, 2020, and by February 3, even before the first case was confirmed, the country had declared COVID-19 a public health emergency, anticipating the imminent arrival of the virus. [3]

To date, COVID-19 has resulted in more than 760 million confirmed cases and approximately 6.8 million deaths globally. In Brazil, the numbers are equally devastating, with more than 37 million cases and approximately 700,000 deaths recorded. [4] These data reflect not only the severity of the public health crisis, but also the profound social and economic repercussions that continue to unfold. The pandemic has highlighted global vulnerability and the urgent need for coordinated and effective responses to mitigate future health crises.

SARS-CoV-2 likely originated in bats, with pangolins acting as intermediate hosts before transmission to humans. The main route of transmission between humans is through respiratory droplets expelled during speech, coughing, or sneezing. These droplets can be inhaled directly or deposited on surfaces, leading to contact transmission. In addition, smaller particles called aerosols remain suspended in the air for longer periods, increasing the risk of infection in closed, poorly ventilated environments. [5]

SARS-CoV-2 infection presents a varied clinical spectrum, ranging from asymptomatic cases to severe viral pneumonia with respiratory failure. Approximately 40% of infections are asymptomatic. Mild cases account for about 40% of infections and include symptoms such as cough, body aches, headache, fatigue, fever, sore throat, runny nose, nasal congestion, diarrhea, difficulty breathing, and loss of the senses of smell and taste. Moderate cases account for about 8% of infections and involve more severe symptoms that often require medical care or hospitalization. Severe cases account for approximately 2% of infections and are characterized by pneumonia and severe respiratory failure, usually requiring hospitalization and intensive care. The duration of symptoms varies among patients; on average, symptoms persist for 8 to 9 days. [6]

Laboratory testing for SARS-CoV-2 is essential in managing the pandemic. It enables early identification of cases and facilitates control of the spread of the disease, as well as the effective allocation of health resources. Testing provides critical data on the prevalence of infection and helps health authorities adjust their control and prevention strategies. Testing is essential to protect vulnerable groups by isolating infected individuals and reducing the spread among at-risk populations. [7]

The reverse transcription-polymerase chain reaction (RT-PCR)-based assay is

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considered the gold standard for diagnosing COVID-19. [7] However, point-of-care tests that offer rapid results and reduced cost are particularly valuable in public health settings due to their practicality. In this context, serological tests based on the detection of IgM and IgG antibodies stand out. [8]

IgM antibodies are the first antibodies produced in response to SARS-CoV-2 infection; seroconversion usually occurs approximately six days after the onset of infection. IgM levels peak at approximately day 18 and return to baseline levels by about a month after the onset of infection. These antibodies are useful for early detection of infection. IgG antibodies appear in the serum by day 10 and often become positive by day 21; their presence indicates more advanced infection or recovery and plays a crucial role in the sustained immune response to the virus. [7]

During the study period, several epidemiological studies were conducted globally to estimate the prevalence of COVID-19 based on serological and PCR tests. These studies have been essential for guiding public health decisions and have shown varied results depending on the specific context of each country or region; this approach has also been used in Brazil. [9]

This study seeks to contribute to this discussion by presenting relevant data on the prevalence and clinical characteristics of COVID-19 in the population treated at sentinel units in the state of Rio de Janeiro from June to October 2020.

METHOD

This study performed an exploratory data analysis to investigate the distribution and characteristics of the collected data, including variables related to symptoms suggestive of influenza-like illness, epidemiological profile, and serological test results. This is a serial, cross-sectional observational study conducted between June and October 2020 in 25 Health Units in different municipalities in the state of Rio de Janeiro. These units included COVID-19 testing centers, emergency care units (UPAs), polyclinics, hospital emergencies, family clinics, health centers, and regional emergency coordination offices. Systematic testing was performed over six cycles to ensure continuous data collection. The sample consisted of 10,329 individuals, representing the population served by the Health Units during the study period. The inclusion criteria covered all individuals who attended the units, regardless of the reason. No exclusion criteria were applied, ensuring broad representation of the population, including people with and without symptoms related to COVID-19. The sample size calculation was performed to detect estimated differences in proportions of 0.1 and 0.07, with a statistical power of 80% and a significance level of 5%, resulting in a minimum sample of 1,347 individuals per group. This calculation was performed using the EnvStats package in the R software.

The main outcome of the study was the diagnosis of COVID-19, determined based on the results of RT-PCR tests, which analyzed the N1, N2, and RP genes. In addition, immunochromatographic serological tests (lateral flow test) were performed to detect IgM and IgG antibodies against SARS-CoV-2. The analyzed variables included demographic data (age, gender, ethnicity, and education), current and previous respiratory symptoms, history of pre-existing diseases, and diagnostic test results. Clinical-epidemiological data were collected using a standardized electronic form developed in the FormSUS system, gathered via mobile devices, and subsequently exported in Excel format for statistical analysis.

Data collection followed a strict protocol to ensure standardization of the information. The electronic form included questions about presented symptoms, medical history, and demographic profile, designed to reduce inconsistencies and increase the accuracy of the records. To minimize biases, data collection was carried out comprehensively, ensuring both symptomatic and asymptomatic individuals were included. Furthermore, the data were analyzed by independent researchers, and appropriate statistical techniques were applied to adjust for potential confounding factors and remaining biases.

Statistical analysis was conducted using R software. Data processing involved standardizing variable names, transforming categories into factors, and creating new relevant variables, such as the classification of RT-PCR and serological test results. Categorical variables were generated to distinguish symptomatic, asymptomatic, and respiratory symptomatic patients. The interval between symptom onset and collection was categorized, distinguishing periods of up to seven days and longer than seven days. A descriptive analysis was conducted using the tbl_summary function of the Gtsummary package, allowing a detailed visualization of sociodemographic, clinical, and unit-related variables.

This study was approved by the Research Ethics Committee (CEP) of the Institute of Studies in Public Health of the Federal University of Rio de Janeiro (IESC-UFRJ), registered under the Certificate of Presentation for Ethical Assessment (CAAE) number 58202222.2.0000.5286, with substantiated opinion number 5,499,127. Ethical approval guarantees compliance with the ethical and regulatory standards applicable to research involving human beings.

RESULTS

Analysis of the sample of 10,329 participants shows that 40% were male and 60% female. The ethnic composition of the participants revealed that 43% identified themselves as white, while 45% were mixed race, 11% black, 1.1% yellow and less than 0.1% indigenous, with 4 participants not specifying their

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color. Regarding educational level, 59% of the participants had completed high school, with a distribution that included 18% with elementary education, 41% with high school, 21% with higher education and only 0.1% with a doctorate. The median age of the participants was 42 years.

Table 1 explores the relationship between RT-PCR results and IgM and IgG serologies in a total of 7,319 participants, of whom 1,000 had detectable RT-PCR and 6,319 had undetectable RT-PCR, with 3,010 missing data for this variable.

Among the participants with detectable RT-PCR, 787 had negative IgM and 187 had positive IgM. Additionally, 26 cases with detectable RT-PCR had missing results for IgM. In the group with undetectable RT-PCR, 5,776 participants had negative IgM, while 480 were positive for IgM. There are also 63 missing cases for IgM in this group.

For IgG serology, among the participants with detectable RT-PCR, 825 had negative results, while 126 had positive IgG. There were 49 missing cases for IgG in this group. In the group with undetectable RT-PCR, 5,600 participants had negative IgG and 641 had positive IgG. In this group, 78 cases had missing data for IgG.

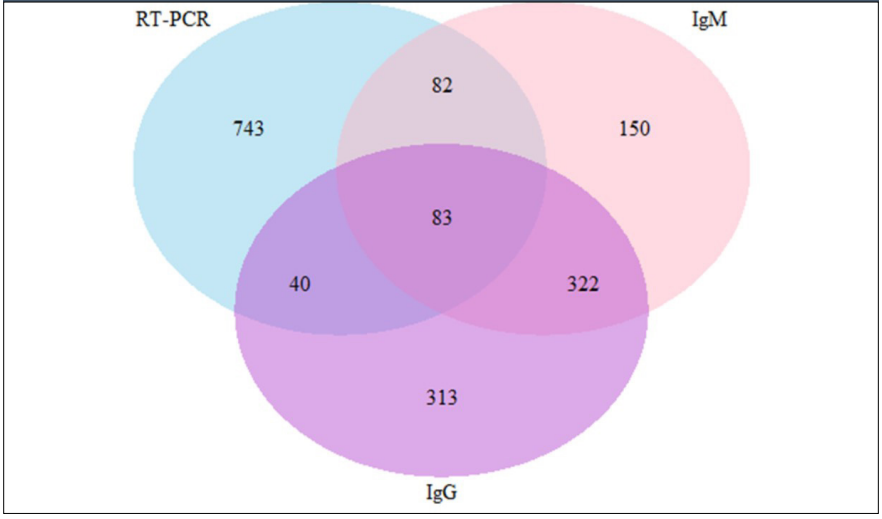
The analysis of the results of the serological tests showed that the presence of IgM antibodies was positive in 8.4%, while 10% had IgG antibodies. The RT-PCR test detected the presence of the virus in 14% of the samples analyzed.

Table 1: Correlation between IGM and IGG serology results with RT-PCR, in the study.

RT-PCR	Detectable, N = 1,000[1]	Non-detectable, N = 6,319[1]	p-value[2]
IGM_Result			<0.001
Negative	787 (81%)	5,776 (92%)	
Positive	187 (19%)	480 (7.7%)	
Unknown	26	63	
IGG_Result			0.006
Negative	825 (87%)	5,600 (90%)	
Positive	126 (13%)	641 (10%)	
Unknown	49	78	

Intersecting the participants' test results with all present data showed that 948 participants tested positive for RT-PCR, 637 for IgM, and 758 for IgG. Additionally, 165 participants tested positive for both RT-PCR and IgM, while 123 tested positive for both RT-PCR and IgG. The positive combination of IgM and IgG was observed in 405 cases, and only 83 individuals tested positive for all three tests (RT-PCR, IgM, and IgG), as shown in Figure 1.

Graph 1: Intersection between the elements of the RT-PCR, IgM and IgG variables



Of the services provided, 16% were provided at testing centers, while 35% were provided at emergency rooms and 49% at SMS/CF/Others.

Regarding serology, IgM positivity was significantly higher at testing centers (13%) compared to emergency rooms (5.4%) and SMS/CF/others (9%). IgG serology positivity was similar among the different service units, with approximately 10% in each of them. The RT-PCR test also showed a higher positivity rate at testing centers (16%).

In addition, data were collected in six different cycles, with the first cycle having the highest participation with 2,021 (20%)

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participants, followed by cycle three with 1,706 (17%) and cycle four with 1,844 (18%). The data collection cycle with the lowest number of participants was the sixth, with only 1,288 (13%).

The most common symptoms reported by participants in the past 30 days included cough (35%), headache (41%), myalgia (33%), fatigue (27%), fever (26%), anosmia (18%), dyspnea (18%), odynophagia (27%), nasal congestion (20%), and diarrhea (17%).

Approximately 60% of patients treated at testing centers reported flu-like symptoms in the last 30 days, compared to 54% in SMS/CF/other services and 49% in emergency rooms.

As for respiratory symptoms, it was observed that 83% of patients treated at testing centers and emergency rooms presented respiratory symptoms, while 80% of those treated at SMS/CF/other services reported the same.

The categorization of symptoms revealed that only 19% of participants presented symptoms for up to seven days.

The care units were also analyzed and showed that 16% of participants were treated at testing centers, while 35% sought care at emergency services and 49% at other types of health services.

DISCUSSION:

The study provides relevant insights into the epidemiology of COVID-19 and its clinical characteristics in the population treated at sentinel units in the state of Rio de Janeiro during the pre-vaccination period studied.

The sociodemographic distribution evidenced in the sample, composed mostly of women (60%) and with a higher proportion of participants of mixed race (45%), is representative of the diversity of the state of Rio de Janeiro. In addition, the predominance of individuals with up to high school education reflects the socioeconomic profile of the populations that sought care at the sentinel units.

The analysis of the results of serological tests (IgM and IgG) and RT-PCR revealed a critical panorama of the detection and immunological response to COVID-19. The positivity of RT-PCR in 14% of the samples analyzed indicates a significant presence of active cases during the study period, while the detection of IgM and IgG antibodies (8.4% and 10%, respectively) reflects the immunological response at different stages of the infection.

Table 1 explores the relationship between RT-PCR results and IgM and IgG serologies, showing participants with detectable RT-PCR and negative IgM, indicating that, in the early phase of infection, a significant proportion of patients had not yet developed an immune response detectable by serology.

On the other hand, in the group with undetectable RT-PCR, 5,776 participants had negative IgM, while 480 were positive for IgM. This data suggests that, in late infections or in situations where the viral load decreases, IgM positivity may persist even with an undetectable RT-PCR.

For IgG serology, among the participants with detectable RT-PCR, the majority had negative results. These results reinforce that IgG tends to be detected in later phases of infection, given that only a minority of individuals with active viral load (positive RT-PCR) had already seroconverted to IgG.

In the group with undetectable RT-PCR, 5,600 participants had negative IgG and 641 had positive IgG, reflecting the convalescent or late phase of infection, when the adaptive immune response is already established.

This demonstrates an expected dynamic in the temporal relationship between the detection of viral RNA (via RT-PCR) and the immune responses mediated by IgM and IgG (via serology). RT-PCR is more sensitive in the early phase of infection, before the development of a detectable immune response, as evidenced by the high proportion of negative IgM and IgG in individuals with positive RT-PCR.

As SARS-CoV-2 infection progresses, a significant diagnostic transition is observed. Initially, the viral load is high, which makes RT-PCR the most effective method for detection in the first seven days after the onset of symptoms. As the immune response develops, seroconversion occurs with increasing positivity for IgM, followed by IgG in more advanced stages of infection. This pattern reflects the temporal dynamics of the virus and the immune response, being fundamental to understanding the diagnostic windows of each test and its application in different clinical and epidemiological contexts.

The combination of RT-PCR and serological tests provides a comprehensive perspective on the infectious and immunological status of individuals. While RT-PCR is ideal for identifying infections in the acute phase, serological tests complement the diagnosis in later phases, allowing a more complete picture of the evolution of the infection. This combined approach is essential for case management, epidemiological monitoring, and tracking strategies.

Based on the data presented by Guaman-Bautista et al. (2021), the graphical analysis clearly demonstrates the temporal interrelationships between the diagnostic methods. Graph 2 summarizes this chronology, showing that RT-PCR predominates as a diagnostic tool in the initial phase, while serological tests stand out from the second week onwards, with a progressive increase in IgM and a predominance of IgG after the third week. This behavior reaffirms the complementarity of the methods and the potential for increasing diagnostic sensitivity throughout the clinical course of the infection[10].

Visually, Figure 2 conveys the importance of this diagnostic integration, highlighting its applicability both in the clinical context, for individual diagnosis and management, and in the epidemiological context, for population monitoring and large-scale immunity assessment. This integrated approach not only improves case detection at different stages of the disease, but also contributes to the planning of public health interventions, contact tracing and epidemiological surveillance in exposed populations.

The most commonly reported symptoms, such as headache (41%), myalgia

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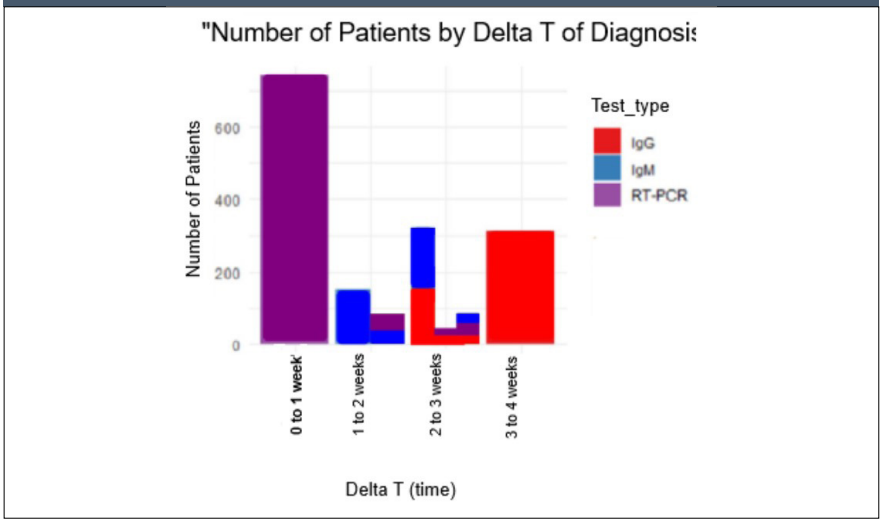
(33%), and cough (35%), are in line with global data on the clinical presentation of COVID-19. The high frequency of anosmia (18%) also highlights its relevance as a clinical marker of infection. However, the relatively low prevalence of severe respiratory symptoms (18% for dyspnea) is a positive indicator, suggesting that most cases assessed in sentinel units were mild or moderate in nature.

The short duration of symptoms (up to 7 days) reported by 19% of participants suggests timely diagnosis and management in part of the population, which may have contributed to the reduction of severe complications and the spread of the virus.

Graph 2: Distribution of Patients by Type of Diagnostic Test for COVID-19 and Time since Symptom Onset and Timeline for Detection of SARS-CoV-2 Using RT-PCR and Serological Tests.



The higher positivity rates in RT-PCR and IgM tests at testing centers (16% and 13%, respectively) indicate the relevance of these locations in identifying active cases. On the other hand, emergency services and other health services (SMS/CF/Others) played a complementary role in treating different stages of the infection.

This study corroborates findings previously described at the beginning of the pandemic, demonstrating that serological tests did not play a significant role in supporting the clinical diagnosis of COVID-19 for patient management, given their limitations in detecting infection in the acute phase. The low sensitivity of serology in the first days of symptoms restricted its applicability to the epidemiological context and retrospective evaluation of the infection.[11,12]

This limitation became even more evident with the advent of vaccines after the period analyzed in this study. With widespread immunization, seropositivity began to reflect both natural infections and vaccine response, further reducing its usefulness in individual diagnosis. In contrast, antigen tests have emerged as a viable alternative at the point of care, complementing RT-PCR by offering a rapid and accessible method for detecting infection in the acute phase, especially in settings with high viral circulation.[13,14]

Although the strategies employed in this study minimized potential sources of bias, such as the use of standardized electronic forms and the inclusion of a diverse sample, some limitations should be considered. The representativeness of the participants may not adequately reflect rural or hard-to-reach populations.

The findings reinforce the importance of expanding testing and continuous monitoring, especially in settings with higher viral circulation, such as testing centers. In addition, the role of clinical symptoms as diagnostic indicators should be explored more robustly, considering the impact of early identification on the management of COVID-19.

CONCLUSION

This study, conducted in a pre-vaccination period, provides a detailed view of the epidemiology and clinical characteristics of COVID-19 before the introduction of large-scale immunization. By analyzing the distribution of the disease in health units in Rio de Janeiro, it was possible to highlight the temporal relationship between the diagnostic methods RT-PCR, IgM and IgG and the evolution of the immune response, in addition to the importance of testing centers in the early detection of cases. The most prevalent symptoms, such as headache and myalgia, were identified in a population with wide sociodemographic diversity.

The lack of vaccine immunity gives additional value to the findings, allowing us to understand the progression of the disease in its initial phase and serving as a reference for comparative studies with later periods. In addition, the temporal diagnostic dynamics identified reinforce the potential for additional investigations that associate different diagnostic methods with the longitudinal monitoring of patients, enabling more targeted and effective interventions in pandemic scenarios.

Thus, the findings of this study contribute to the improvement of epidemiological surveillance and response strategies to health emergencies, highlighting the importance of integrated testing and population monitoring policies.

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