



# SARS-CoV-2 in emergency care professionals in central Brazil: the need for continuing education


## SARS-CoV-2 em profissionais do atendimento pré-hospitalar no centro-oeste do Brasil: a urgência da educação permanente


Marcela Aparecida Bertoldi de Melo<sup>1</sup> , Viviane Torqueti Felisberto Souza<sup>2</sup> , Carolina Amianti<sup>3</sup> , Larissa Melo Bandeira<sup>4</sup> , Sandra Maria do Vale Leone de Oliveira<sup>5</sup> , Ana Rita Coimbra Motta-Castro<sup>4</sup> 

<sup>1</sup> Serviço de Atendimento Móvel de Urgência, Secretaria Municipal de Saúde Pública de Campo Grande, Mato Grosso do Sul, MS, Brasil.

<sup>2</sup> Fundação Instituto Oswaldo Cruz, Rio de Janeiro, RJ, Brasil. 

<sup>3</sup> Faculdade Medicina, Universidade Federal de Mato Grosso do Sul, Mato Grosso do Sul, MS, Brasil. 

<sup>4</sup> Faculdade de Ciências Farmacêuticas, Alimentos e Nutrição, Universidade Federal de Mato Grosso do Sul, Mato Grosso do Sul, MS, Brasil. 

<sup>5</sup> Fundação Instituto Oswaldo Cruz, Mato Grosso do Sul, e Universidade Federal de Mato Grosso do Sul, Mato Grosso do Sul, MS, Brasil. 

\* Corresponding author/Autor de correspondência: mabertoldi81@gmail.com

Received/Recebido: 06.10.2025

Accepted/Aceito: 04.02.2026

Publication/Publicação: 14.04.2026

Editor-in-chief/Editor Chefe: Adriana Bugno

### ABSTRACT

This study aimed to assess the prevalence, predictive factors, and post-COVID-19 symptoms of SARS-CoV-2 infection among Mobile Emergency Medical Service (SAMU) professionals in Mato Grosso do Sul, Brazil. A cross-sectional design was used, based on primary quantitative data. SARS-CoV-2 infection was defined based on self-reported information indicating at least one positive real-time reverse transcription quantitative polymerase chain reaction (RT-qPCR) or rapid antigen/protein test result. Among 197 participants (mean age 42.4 years), 57.0% were male and 72.0% had higher education. Most were overweight/obese (74.0%), and 22.0% reported previous comorbidities. Nursing technicians represented 31.0% of the sample. Although 87.0% received training on personal protective equipment (PPE) use, 40.0% admitted to not using it at some point. A high prevalence of SARS-CoV-2 infection was found (55.3%; 95.0% CI: 48.30-68.20). Multivariate analysis showed that infection was associated with prior contact with infected individuals, fewer than two training sessions, and lack of training on proper PPE use. Additionally, 51.2% reported persistent symptoms lasting up to five months after infection. These findings indicate that SAMU professionals face a high risk of SARS-CoV-2 exposure. Proper PPE training is essential to reduce infection risk in healthcare workers.

**Keywords.** COVID-19, Health Personnel, Emergency Medical Services, Emergency Responders.

### RESUMO

O estudo teve como objetivo a avaliação da prevalência, os fatores preditivos e os sintomas pós-COVID-19 da infecção por SARS-CoV-2 entre profissionais do Serviço Móvel de Urgência no Mato Grosso do Sul (SAMU), Brasil. Foi realizado um estudo transversal com dados primários quantitativos. Considerou-se infecção por SARS-CoV-2 o autorrelato de um resultado positivo na detecção do RNA do SARS-CoV-2 por reação em cadeia da polimerase em tempo real por transcrição reversa (RT-qPCR) ou de proteína/antígeno viral por teste rápido. Participaram 197 indivíduos, com idade média de 42,4 anos. A maioria era do sexo masculino (57,0%), relatou ter ensino superior (72,0%), apresentava excesso de peso/obesidade (74,0%). Técnicos de enfermagem representaram 31,0% dos participantes. Embora 40,0% tenham admitido não utilizar equipamento de proteção individual (EPI) eventualmente, 87,0% receberam formação sobre a sua utilização. Na análise multivariada, contato com pessoa infectada, menos de dois treinamentos e ausência de capacitação adequada no uso de EPI mantiveram-se associados à infecção. Ademais, 51,2% relataram sintomas persistentes até cinco meses após a infecção. Estes achados sugerem que os profissionais de saúde estão em elevado risco de exposição ao SARS-CoV-2, reforçando a importância crucial da formação sobre o uso correto de EPI para a sua proteção.

**Palavras-chave.** COVID-19, Profissionais de Saúde, Serviços Médicos de Emergência, Socorristas.

## INTRODUCTION

The global fight against the Coronavirus Disease 2019 (COVID-19) pandemic has had a devastating impact worldwide, with high rates of morbidity, mortality, and lethality across various population groups. Health services have faced structural and labor challenges since the onset of the crisis, affecting the physical and mental health of healthcare professionals<sup>1</sup>. Although healthcare professionals in Brazil and other countries played a crucial role in tackling the pandemic, they faced many challenges and vulnerabilities, including high viral loads, precarious working conditions, increased working hours, and constant risk of contamination<sup>2-5</sup>.

The Brazilian health system comprises several care networks organized into thematic areas. The Mobile Emergency Care Service (SAMU) is the mobile component of the emergency network responsible for urgent and emergency care in the prehospital environment. SAMU operates based on emergency calls from the community, which generate primary occurrences and transfers between health units, resulting in secondary occurrences<sup>6,7</sup>. SAMU professionals face specific challenges at work, including providing prehospital care in uncontrolled outdoor environments, exposure to aerosol-generating procedures, use of uncomfortable personal protective equipment (PPE), adverse weather conditions, limited resources, and reduced team sizes<sup>8-10</sup>.

Although SAMU professionals were essential responders during the pandemic, limited research has been conducted in Brazil regarding the consequences of SARS-CoV-2 infection among this population. This study was conducted in Mato Grosso do Sul (MS), Brazil, to estimate the prevalence and predictive factors associated with SARS-CoV-2 infection among SAMU professionals. This study aimed to assess the prevalence, predictive factors, and post-COVID-19 symptoms of coronavirus infection among professionals working in a Mobile Emergency Medical Service in Mato Grosso do Sul, Brazil.

## MATERIAL AND METHODS

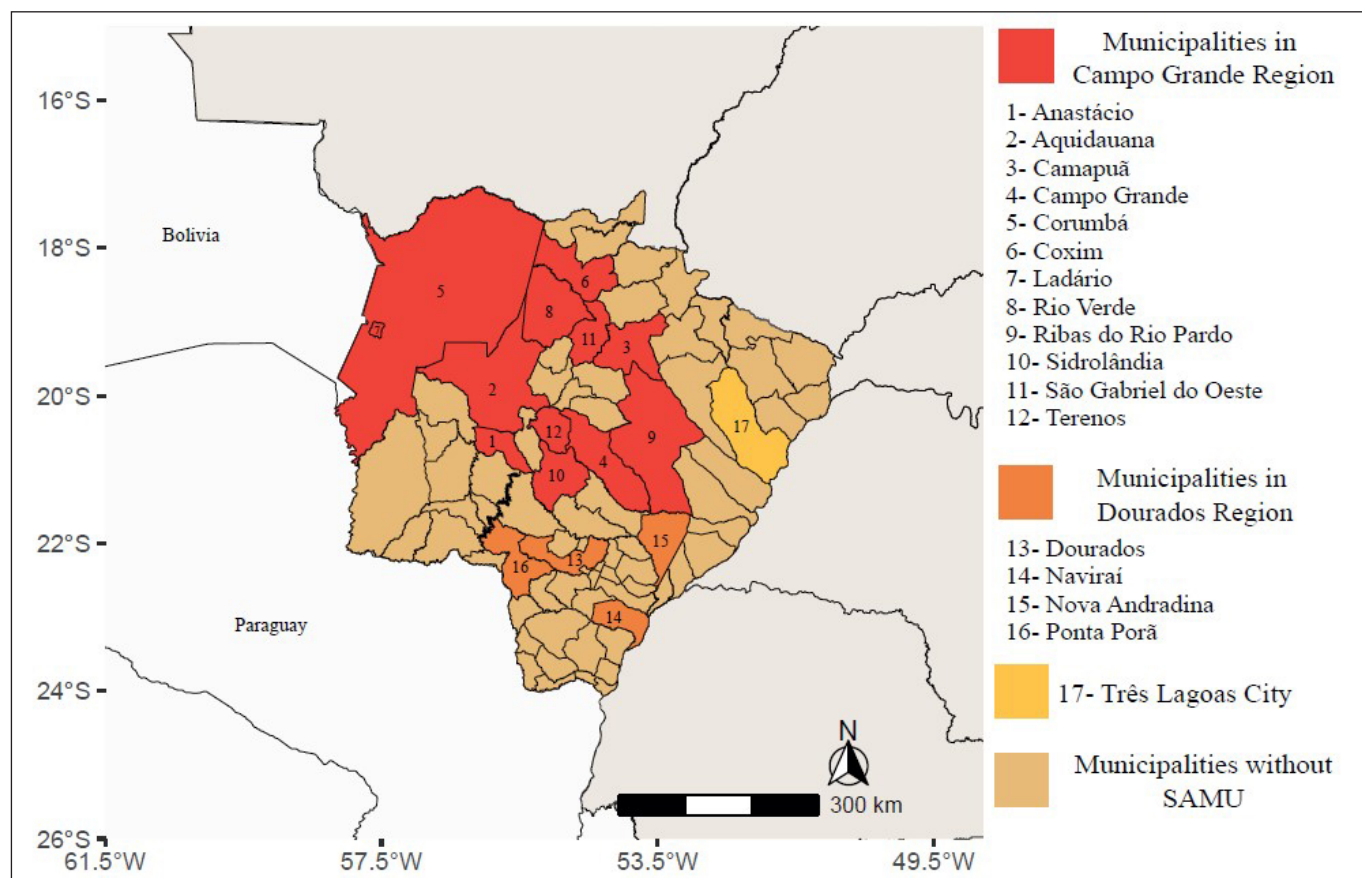
### Study design

This cross-sectional study was conducted between November 2022 and May 2023 in 17 municipalities in the state of Mato Grosso do Sul, Brazil, that house SAMU units. Given that the state's health system is classified into 3 health regions (**Figure**) and considering that the capital has the highest number of ambulances and professionals, the smaller municipalities were grouped into a comparison group.

### Study population

According to data from November 2022, the SAMU program in Mato Grosso do Sul comprises approximately 340 professionals registered in the National Registry of Health Establishments.

The study obtained responses from 197 participants, representing approximately 60% of the total SAMU workforce in Mato Grosso do Sul. Participants' ages ranged from 26 to 68 years, with a mean of 42.4 years, and included both male and female professionals. The study population comprised different professional categories, including physicians, nurses, nursing technicians, and rescue drivers, with varying levels of education and work experience. Additional sociodemographic and occupational characteristics of the participants are presented in **Table 1** and **Table 2**.



**Figure.** Three health regions in the state of MS that have the SAMU program

**Table 1.** Sociodemographic and labor characteristics of SAMU professionals in the state of MS, Brazil, according to status of SARS-CoV-2 infection (N = 197)

Characteristics	Positive N = 109 (55.33%)	Negative N = 88 (44.67%)	Total N = 197 (100%)
<b>Sex</b>			
Male	58 (51.3%)	55 (48.6%)	113 (57.3%)
Female	51 (60.7%)	33 (39.4%)	84 (46.7%)
<b>Age (years)</b>			
20 to 42	65 (61.3%)	41 (38.7%)	106 (53.8%)
≥ 43	44 (48.4%)	47 (51.6%)	91 (46.2%)
<b>Education</b>			
Postgraduate	48 (64.0%)	27 (36.0%)	75 (38.0%)
Graduate	33 (48.5%)	35 (51.5%)	68 (34.5%)
Technical-level and undergraduate	28 (51.8%)	26 (48.2%)	54 (27.5%)

*Continues on next page*

Characteristics	Positive N = 109 (55.33%)	Negative N = 88 (44.67%)	Total N = 197 (100%)
<b>Region</b>			
Dourados/Três Lagoas	45 (50.0%)	45 (50.0%)	90 (45.7%)
Campo Grande	64 (59.8%)	43 (40.2%)	107 (54.3%)
<b>Professional category</b>			
Rescue driver	28 (49.1%)	29 (50.9%)	57 (28.9%)
Nursing technicians	31 (50.8%)	30 (49.2%)	61 (31.0%)
Doctor	21 (67.7%)	10 (32.3%)	31 (15.7%)
Nurse	29 (60.4%)	19 (39.6%)	48 (24.4%)
<b>Labor relationship</b>			
One labor bond	68 (55.3%)	55 (44.7%)	123 (62.7%)
Two or more	40 (54.8%)	33 (45.2%)	73 (37.3%)
Missing	–	–	1
<b>Work shift</b>			
One work shift	34 (47.9%)	37 (52.1%)	71 (36.0%)
Two or more work shift	75 (59.5%)	51 (40.5%)	126 (64.0%)
<b>Workload</b>			
0-36 hours/week	30 (56.6%)	23 (43.4%)	53 (27.9%)
37-60 hours/week	41 (49.4%)	42 (50.6%)	83 (43.7%)
>61 hours/week	33 (61.2%)	21 (38.8%)	54 (28.4%)
Missing	–	–	7

SARS-CoV-2 infection status was determined based on self-reported diagnostic test results. Participants who reported at least one positive result for SARS-CoV-2 by RT-qPCR or rapid antigen test between March 2020 and December 2021 were classified as positive cases. Participants who reported never having a positive test during this period were classified as negative cases.

**Table 2.** Health characteristics of SAMU professionals in MS State, Brazil, according to status of SARS-CoV-2 infection (N = 197)

Characteristics	Positive N = 109 (55.33%)	Negative N = 88 (44.67%)	Total N = 197 (100%)
<b>Body mass index (BMI)</b>			
Underweight and normal (18-24,9)	26 (52.0%)	24 (48.0%)	50 (25.4%)
Overweight (25-29,9)	47 (51.6%)	44 (48.4%)	91 (46.2%)
Obese I, II, and III (> 30)	36 (64.3%)	20 (35.7%)	56 (28.4%)

*Continues on next page*

Characteristics	Positive N = 109 (55.33%)	Negative N = 88 (44.67%)	Total N = 197 (100%)
<b>Smoking status</b>			
No	100 (56.5%)	77 (43.5%)	177 (89.8%)
Yes	8 (42.1%)	11 (57.9%)	19 (9.6%)
Missing	–	–	1 (0.6%)
<b>Alcohol intake</b>			
No	35 (48.6%)	37 (51.4%)	72 (36.5%)
Yes	74 (59.7%)	50 (40.3%)	124 (62.9%)
Missing	–	–	1 (0.6%)
<b>Physical activity</b>			
No	34 (55.7%)	27 (44.3%)	61 (31%)
Yes	75 (55.2%)	61 (44.9%)	136 (69%)
<b>Comorbidities</b>			
No	80 (52.6%)	72 (47.4%)	152 (77.2%)
Yes	28 (65.1%)	15 (34.9%)	43 (21.8%)
Missing	–	–	2 (1.0%)

Missing data resulted mainly from unanswered questions in the electronic questionnaire, either due to non-mandatory fields or limitations in participant recall. No data imputation was performed. Analyses were conducted using complete cases for each variable, and the number of observations varied according to data availability.

## Data collection

The study population comprised all intervention teams from seven SAMU Advanced Support Units, including doctors, nurses, and rescue drivers, and 27 SAMU Basic Support Units, including nursing technicians and rescue drivers, who were active in service between March 2020 and December 2021.

The local coordinators from each municipality served as intermediaries, recruiting as many participants as possible. Initially, an invitation with the research link was sent to the coordinators via email, and they sent the invitations through an instant messaging app in work groups. After 30 days from the initial invitation to participate in the study, two additional reminders were sent to participants at 30-day intervals via the messaging app on their mobile phones in those municipalities with lower participation. Data were collected via the Google Forms® platform online from November 2022 to May 2023 using a convenience sample, with a link to the questionnaire sent to participants by e-mail and an instant messaging application (WhatsApp®). This diversified contact strategy was adopted to ensure broad access to participants.

After digitally signing an Informed Consent Form (ICF), participants answered multiple-choice and descriptive questions comprising sociodemographic, clinical, labor, and vaccination variables. Questions related to PPE use were classified into regular use, defined as PPE use during all necessary periods,

and irregular use, defined as PPE reuse or lack of use. Reuse was considered the use of PPE beyond the manufacturer's recommendation.

## Data analysis

Data were analyzed using Stata version 13.0 (StataCorp LP, College Station, TX, USA). The primary outcome was positivity for at least once, one of the following: confirmed SARS-CoV-2 infection by real-time reverse transcription polymerase chain reaction (RT-qPCR) or SARS-CoV-2 rapid antigen screening test, both self-reported. The prevalence of SARS-CoV-2 infection was calculated with 95% confidence interval (CI). The chi-square test, Fisher's exact test, and logistic regression were used to determine associations between SARS-CoV-2 status and independent variables, expressed as odds ratios (OR). Variables with  $p < 0.10$  in the univariate analysis were included in the multivariable logistic regression model, with the number of events per variable entered as a covariate. Statistical significance was set at  $p < 0.05$ . Cases with missing information were excluded from all logistic regression analyses, as missingness was assumed to be MCAR (missing completely at random).

## Ethical approval

This study was approved by the Research Ethics Committee of the Federal University of Mato Grosso do Sul (CAAE number 61664622.0.0000.002). All participants were  $> 18$  years old. It was performed in accordance with relevant guidelines and regulations, and informed consent was obtained from all participants.

## RESULTS

Out of the total 197 professionals, 109 (55.3%; 95% CI: 48.30-68.20) tested positive for the presence of SARS-CoV-2 infection on RT-qPCR ( $n = 101$ , 61.2%) or test antigen detection ( $n = 41$ , 25.3%), at least one time during the study period. Among those who tested positive, 57 individuals (52.0%) reported more than one diagnosis of COVID-19. The mean age of the study population was 42.4 years. The majority were male (57.3%) and had completed higher education (72.5%), including both graduates and postgraduates. The main demographic and labor characteristics are listed in [Table 1](#). Few participants (21.8%) reported having a comorbid diagnosis before SARS-CoV-2 infection. The most frequently cited comorbidities were anxiety, mental disorders, hypertension, and respiratory diseases.

Notably, only three individuals reported obesity as a preexisting disease. However, weight and height assessment revealed a high prevalence (74.6%) of overweight/obesity (body mass index  $\geq 25.00$  kg/m<sup>2</sup>). Regarding physical activity, 69.0% of the participants reported practicing physical activity at least once a week. Only 9.6% reported smoking and 62.9% reported drinking alcohol at least once a week ([Table 2](#)).

Regarding social isolation, 11.0% admitted they were unable to follow the social isolation rules in effect at the time. The majority (64.5%) of participants reported having contact with people known to be infected 14 days before the onset of their symptoms, and 36.6% admitted having worked while showing symptoms of COVID-19.

The most frequent symptoms were headache (41.2%), fever (40.0%), cough (37.8%), sore throat (37.2%), runny nose (34.5%), loss of smell (32.4%), myalgia or arthralgia (29.1%), and loss of taste (27.0%).

Six individuals (3.0%) reported the need for hospitalization due to the disease, and only one required hospitalization in an intensive care unit. Symptoms were reported to persist for up to 30 days by 26.2% of participants, for up to 4 months by 22.5% of participants, and for more than 5 months by 51.2% of participants. Among symptoms persisting for more than 4 weeks, the most frequent were memory changes (21.5%), hair loss (15.4%), fatigue/headache/smell changes (11.4%), and anxiety (10.7%).

Most participants reported using PPE for as long as necessary (59.9%), and 40.1% reported not using PPE correctly at some time. Regarding the reuse of PPE, 8.1% said they did not reuse PPE, 27.9% reported rarely reusing PPE, 24.4% reused PPE most of the time, and 13.7% reused PPE throughout the shift. Thermal comfort, excessive heat, and inefficient air conditioning were the main factors reported to interfere with the decision not to use PPE (45.1%). Regarding training on the use and removal of PPE, 11.7% of participants reported not having received any training. Among all participants who received training (100%), considering those with available information on training sessions attended, 24.9% reported having access to three or more training sessions, and 51.3% reported attending one or two training sessions, and 9.6% did not receive training. Among participants who received training, the majority (80.7%) considered it satisfactory, and 15.2% reported having doubts about using PPE (Table 3).

**Table 3.** Use of PPE and access to training among SAMU professionals according to status of SARS-CoV-2 infection (N = 197)

Characteristics	Positive N = 109 (55.33%)	Negative N = 88 (44.67%)	Total N = 197 (100%)
<b>Prior contact with a COVID-19-positive case</b>			
No	11 (26.2%)	31 (73.8%)	42 (21.3%)
Yes	82 (64.6%)	45 (35.4%)	127 (64.5%)
Missing	–	–	28 (14.2%)
<b>Use individual protection equipment</b>			
I wore all the necessary PPE to work	62 (52.5%)	56 (47.5%)	118 (59.9%)
I didn't use PPE sometimes	47 (59.5%)	32 (40.5%)	79 (40.1%)
<b>PPE reuse</b>			
No	11 (68.7%)	5 (31.3%)	16 (8.1%)
Yes, for the shortest part of the period	32 (58.2%)	23 (41.8%)	55 (27.9%)
Yes, most of the time	27 (56.3%)	21 (43.7%)	48 (24.4%)
Yes, for the entire period	15 (55.6%)	12 (44.4%)	27 (13.7%)
Missing	–	–	51 (25.9%)
<b>Received training in the use of PPE</b>			
No	15 (65.2%)	8 (34.8%)	23 (11.7%)
Yes	92 (53.8%)	79 (46.2%)	171 (86.8%)
Missing	–	–	3 (1.5%)

*Continues on next page*

Characteristics	Positive N = 109 (55.33%)	Negative N = 88 (44.67%)	Total N = 197 (100%)
<b>How many training</b>			
3 or more training	18 (36.7%)	31 (63.3%)	49 (24.9%)
1 – 2 training	63 (62.4%)	38 (37.6%)	101 (51.3%)
Did not receive training	13 (68.4%)	6 (31.6%)	19 (9.6%)
Missing	–	–	28 (14.2%)

PPE: personal protective equipment

Multivariate analysis showed that history of contact with infected individuals ( $p < 0.01$ , adjusted OR 6.8; 2.74 to 16.89) and having received none ( $p = 0.03$ , 95% CI: 1.11-18.01) or one or two training sessions ( $p = 0.02$ , 95% CI: 1.17-6.37) for PPE were associated with SARS-CoV-2 infection (**Table 4**).

**Table 4.** Analysis of risk factors associated with SARS-CoV-2 infection among SAMU professionals in MS State, Brazil (N = 197)

Characteristics	Total n/N #	<i>p</i> -value	Odds ratio (95% CI)	<i>p</i> -value	Adjusted Odds ratio (95% CI)
<b>Sex</b>					
Male	58/113	–	1	–	–
Female	51/84	0.19	1.46 (0.82-2.59)	0.46	1.42 (0.55-3.66)
<b>Age (years)</b>					
20 to 42 years	65/106	–	1	–	–
43 years or older	44/91	0.07	0.59 (0.33-1.04)	0.14	0.54 (0.24-1.22)
<b>Education</b>					
Postgraduate	48/75	–	1	–	–
Graduate	33/68	0.06	0.53 (0.27-1.03)	0.07	2.20 (0.29-16.41)
Technical-level and undergraduate	28/54	0.16	0.60 (0.29-1.23)	1.04	3.14 (0.36-27.37)
<b>Professional category</b>					
Rescue driver	28/57	–	1	–	–
Health Assistant	31/61	0.85	1.07 (0.52-2.20)	0.82	0.88 (0.29-2.62)
Doctor	21/31	0.09	2.17 (0.87-5.42)	0.21	4.46 (0.42-46.45)
Nurse	29/48	0.24	1.58 (0.72-3.43)	0.21	4.00 (0.44-36.23)
<b>Prior contact with a COVID-19-positive case</b>					
No	11/42	–	1	–	–
Yes	82/67	0.00	5.13 (2.35-11.18)	< 0.01	6.8 (2.74-16.89)
Missing	28	–	–	–	–

Continues on next page

Characteristics	Total n/N #	<i>p</i> -value	Odds ratio (95% CI)	<i>p</i> -value	Adjusted Odds ratio (95% CI)
<b>How many training</b>					
3 or more training	18/49	–	1	–	–
1 – 2 training	63/101	< 0.01	2.85 (1.40-5.78)	0.02	2.73 (1.17-6.37)
Did not receive training	13/19	0.02	3.73 (1.20-11.53)	0.03	4.47 (1.11-18.01)
Missing	10	–	–	–	–

CI: confidence interval; # Observed values

The status of vaccination against SARS-CoV-2 infection was also studied. Only one participant reported not receiving any COVID-19 vaccine; that is, 99.5% of participants were vaccinated with at least 1 dose. The second dose was received by 98% of participants, 93.0% reported having received the third dose, and 65.0% completed the four-dose schedule recommended by the Brazilian Ministry of Health.

## DISCUSSION

To the best of our knowledge, this is one of the first studies in Brazil focusing on prehospital emergency professionals. An innovative approach was adopted to understand the prevalence of SARS-CoV-2 in the Brazilian public health system. By exploring the activities and challenges that health professionals face outside hospital facilities, this study highlights the often-overlooked facets of the healthcare system.

We identified a considerably high prevalence (55.3%, 95% CI: 48.30-68.20) of SARS-CoV-2 infection among SAMU healthcare workers. This finding corroborates research showing that healthcare workers, particularly those directly involved in the care of infected patients, are at a substantially higher risk of being infected than the general population<sup>4,11,12</sup>. Cross-sectional studies on healthcare workers in various countries found SARS-CoV-2 infection prevalence rates of 5.4% to 51.4%<sup>12-14</sup>. In Brazil, studies conducted across healthcare settings with varying levels of complexity found positivity rates for SARS-CoV-2 infection ranging from 14.90% to 42.37%<sup>15-18</sup>. These results cannot be directly compared with those of the present study because we interviewed healthcare workers after the pandemic period. Furthermore, the results are based on self-reported infection. Prevalence rates vary according to geographic region, health conditions, and testing methods. Nevertheless, most studies showed an increased risk of exposure and infection in the workplace among healthcare workers. Only a few studies assessed the prevalence of infection exclusively among healthcare workers in prehospital settings<sup>4,13,17,18</sup>.

The current study found that contact with infected individuals in the past 14 days was associated with a 6.8-fold higher risk of SARS-CoV-2 infection ( $p < 0.01$ , adjusted OR = 6.80, 95% CI: 2.74-16.89). This result is unsurprising, given that such an association has been reported in earlier studies with similar OR (odds ratio) values<sup>15,19,20</sup>. One factor that could explain this prevalence is the occurrence of aerosol-generating procedures in small environments (e.g., inside an ambulance) with inefficient ventilation and exhaust systems. A systematic review of six studies found that the OR of aerosol-generating procedures causing infection among healthcare workers using PPE was 1.85 (95% CI: 1.33-2.57). The OR increased to

1.89 (95% CI: 1.38-2.59) in the non-PPE group, suggesting that non-use of PPE during aerosol-generating procedures can increase the risk of infection among healthcare workers<sup>21</sup>.

Our research found a relationship between access to PPE use training and the risk of infection: professionals without access had a 4.47-fold higher risk (95% CI: 1.11-18.01). Those who attended only one or two training sessions had a 2.73-fold higher risk of infection (95% CI: 1.17-6.37). These results demonstrate that continuing education in biosafety techniques can play a protective role in preventing infectious diseases among healthcare workers. Healthcare teams are globally recognized for their commitment to training and adherence to protocols. Despite this, surprisingly, 36.6% of the workers reported not having used PPE at some point. The factors most associated with this decision were thermal discomfort, excessive heat, and inefficient air conditioning (45.1%), which could potentially reinforce the transmission chain of oligo-symptomatic cases.

A study conducted with emergency medical services in the United States examined the change in knowledge and PPE training during the COVID-19 pandemic. The study found that the sample had high levels of knowledge about the use of N95 respirators (91.0%), however, only 86.6% reported having received PPE training for biological threats 12 months before the survey. The study also found that workers in prehospital services had lower PPE training and awareness, highlighting essential gaps in knowledge and training among emergency medical care professionals<sup>22</sup>. In a study by Martin-Delgado et al, who investigated healthcare workers in Brazil, Colombia, and Ecuador, 51.4% of participants did not receive PPE training<sup>23</sup>. Here, only 11.7% of the sample did not receive training. Our results corroborate previous findings showing that PPE scarcity, reuse, and lack of adequate training may contribute to the high infection rate among healthcare workers worldwide<sup>15,22,23</sup>. Differences in results between this study and research conducted in other states, countries, and continents are likely due to regional variability in health system organizations and pandemic responses. The economic and social conditions and the healthcare system of the state of Mato Grosso do Sul, Brazil, can explain some of the findings. Such factors include lack of access to different types of PPE, diagnostic methods available during different periods of the pandemic, and access to platforms and training resources.

Some limitations must be highlighted. Although some individuals refused to participate, the cohort included approximately 60% of SAMU workers across all municipalities in Mato Grosso do Sul where there is SAMU. It would not be possible to include such a sample by using a face-to-face format. The cross-sectional nature of the study does not allow us to monitor the evolution, limitations, and challenges of frontline health workers over time, nor to identify the infection's casualties. Another limitation that might have affected sample size was that participants were asked to complete electronic forms. Self-reported infection may result in over reporting.

An additional point to consider is the challenge of collecting self-reported data in the post-pandemic period. As data collection occurred after the most critical phases of the COVID-19 pandemic, participants may have had difficulty accurately recalling events such as infection history, diagnostic testing, symptoms, and details related to PPE use and training. Furthermore, the intense workload and emotional strain experienced by emergency medical service professionals during the pandemic may have influenced both participation and recall accuracy. These factors should be considered when interpreting the study findings.

The strengths of our research lie in the study's territorial reach and the few errors in data transcription attributed to the use of electronic tools. Additionally, our study opens new perspectives for a group of workers who are often overlooked in large prevalence studies. The data generated can aid decision-makers in preparing for future epidemics.

## Contributions to the service

The results provide valuable insights for implementing more effective biosafety strategies and protocol planning, directly benefiting frontline professionals. Furthermore, it underscores the importance of continuing education for healthcare professionals as an essential tool to enhance the application of these strategies, ensuring they stay up to date on the latest infection prevention and control best practices. Additionally, the data generated can guide future research and political decisions to improve working conditions and reduce the risk of infection in prehospital environments. Investing in ongoing training strengthens collective safety and contributes to a more resilient, prepared healthcare system to face emerging challenges.

## CONCLUSION

The prevalence of SARS-CoV-2 infection among SAMU healthcare workers in Mato Grosso do Sul, Brazil, was higher than that reported in other national and international studies. This finding highlights the importance of implementing measures to safeguard healthcare workers in prehospital settings, including preventive measures and biosafety protocols, ensuring an adequate supply of PPE, and promoting training and awareness for its proper use. It is urgent to ensure the safety of prehospital care professionals, mitigate infection risks, and promote a safe working environment during public health emergencies, pandemics, and other high-stress events.

---

## CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

## FUNDING

The authors did not declare.

## AUTHOR'S CONTRIBUTIONS

Conceptualization: Marcela Aparecida Bertoldi de Melo, and Ana Rita Coimbra Motta-Castro. Methodology: Marcela Aparecida Bertoldi de Melo, and Ana Rita Coimbra Motta-Castro. Analyzed the data: Marcela Aparecida Bertoldi de Melo, Larissa Melo Bandeira, Carolina Amianti, and Ana Rita Coimbra Motta-Castro. Contributed reagents/materials/analysis tools: Marcela Aparecida Bertoldi de Melo, Viviane Torqueti Felisberto Souza, Sandra Maria do Vale Leone de Oliveira, Larissa Melo Bandeira, Carolina Amianti, and Ana Rita Coimbra Motta-Castro. Writing (original draft preparation, review, and editing): Marcela Aparecida Bertoldi de Melo, Viviane Torqueti Felisberto Souza, Sandra Maria do Vale Leone de Oliveira, Larissa Melo Bandeira, Carolina Amianti, and Ana Rita Coimbra Motta-Castro. Supervision: Ana Rita Coimbra Motta-Castro. All the authors have read and agreed to the published version of the manuscript.

## PRESENTATION NOTE

The results of this article are part of the master's dissertation by Marcela Aparecida Bertoldi de Melo, entitled "SARS-CoV-2 Infection in Professionals of the Mobile Emergency Care Service in Mato Grosso do Sul", and defended in 2024 in the Graduate Program in Infectious and Parasitic Diseases at the Federal University of Mato Grosso do Sul.

---

## REFERENCES

1. World Health Organization – WHO. Guideline Clinical management of COVID-19: living guideline. 6th ed. Geneva: World Health Organization; 2023 [cited 2023 May 18]. 181 p. Available from: <https://iris.who.int/items/f09974e2-6561-475d-bb2e-b38765fa93c1>
2. McEllistrem MC, Clancy CJ, Buehrle DJ, Singh N, Lucas A, Sirianni V et al. SARS-CoV-2 is associated with high viral loads in asymptomatic and recently symptomatic healthcare workers. *PLoS One*. 2021;16(3):e0248347. <https://doi.org/10.1371/journal.pone.0248347>
3. Dal Pai D, Gemelli MP, Boufleuer E, Finckler PVPR, Miorin JD, Tavares JP et al. Repercussions of the COVID-19 pandemic on the emergency pre-hospital care service and worker's health. *Esc Anna Nery*. 2021;25(spe):e20210014. <https://doi.org/10.1590/2177-9465-EAN-2021-0014>
4. Dzinamarira T, Murewanhema G, Mhango M, Iradukunda PG, Chitungo I, Mashora M et al. COVID-19 prevalence among healthcare workers. A systematic review and meta-analysis. *Int J Environ Res Public Health*. 2021;19(1):146. <https://doi.org/10.3390/ijerph19010146>
5. Leite SN, Finkler M, Martini JG, Heidemann I, Verdi M, Hellmann F et al. Management of the health workforce in facing COVID-19: disinformation and absences in Brazil's public policies. *Ciêns Saúde Colet*. 2021;26(5):1873-84. <https://doi.org/10.1590/1413-81232021265.01252021>
6. Ministério da Saúde (BR). Gabinete do Ministro. Portaria n° 2.048, de 05 de novembro de 2002. Aprova, na forma do Anexo desta Portaria, o regulamento técnico dos sistemas estaduais de urgência e emergência. *Diário Oficial da União*. Brasília, DF, 12 nov 2002. Seção 1(219):32-54.
7. Brasil. Ministério da Saúde. Manual de regulação médica das urgências. Brasília; 2006; 126p. Disponível em: [https://www.gov.br/saude/pt-br/composicao/saes/samu-192/publicacoes/regulacao\\_medica\\_urgencias.pdf/view](https://www.gov.br/saude/pt-br/composicao/saes/samu-192/publicacoes/regulacao_medica_urgencias.pdf/view)
8. Lai CC, Shih TP, Ko WC, Tang HJ, Hsueh PR. Severe acute respiratory syndrome SARS-CoV-2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): the epidemic and the challenges. *Int J Antimicrob Agents*. 2020;55(3):105924. <https://doi.org/10.1016/j.ijantimicag.2020.105924>
9. Rodrigues KF, Carpes MM, Raffagnato CG. Preparação e resposta a desastres do Brasil na pandemia da COVID-19. *Rev Adm Pública*. 2020;54(4):614-34. <https://doi.org/10.1590/0034-761220200291>

10. Esperidião E, Saidel MGB, Rodrigues J. Saúde mental: foco nos profissionais de saúde. *Rev Bras Enferm*. 2020;73(Suppl 1):e73supl01.  
<https://doi.org/10.1590/0034-7167.202073supl01>
11. Saidel MGB, Lima MHM, Campos CJG, Loyola CMD, Espiridião E, Rodrigues J. Intervenções em saúde mental para profissionais de saúde frente à pandemia de coronavírus. *Rev Enferm UERJ*. 2020;28:e49923.  
<https://doi.org/10.12957/reuerj.2020.49923>
12. Tarabichi Y, Watts B, Collins T, Margolius D, Avery A, Gunzler D et al. SARS-CoV-2 Infection among serially tested emergency medical services workers. *Prehosp Emerg Care*. 2021;25(1):39-45.  
<https://doi.org/10.1080/10903127.2020.1831668>
13. Nguyen LH, Drew DA, Graham MS, Joshi AD, Guo CG, Ma W et al. Risk of COVID-19 among front-line health-care workers and the general community: a prospective cohort study. *Lancet Public Health*. 2020;5(9):e475-83.  
[https://doi.org/10.1016/S2468-2667\(20\)30164-X](https://doi.org/10.1016/S2468-2667(20)30164-X)
14. Ganz-Lord FA, Segal KR, Rinke ML. COVID-19 symptoms, duration, and prevalence among healthcare workers in the New York metropolitan area. *Infect Control Hosp Epidemiol*. 2021;42(8):917-23.  
<https://doi.org/10.1017/ice.2020.1334>
15. Antonio-Villa NE, Bello-Chavolla OY, Vargas-Vázquez A, Fermín-Martínez CA, Márquez-Salinas A, Pisanty-Alatorre J et al. Assessing the burden of coronavirus disease 2019 (COVID-19) among healthcare workers in Mexico City: a data-driven call to action. *Clin Infect Dis*. 2021;73(1):e191-8.  
<https://doi.org/10.1093/cid/ciaa1487>
16. Buonafine CP, Paiatto BNM, Leal FB, Matos SF, Morais CO, Guerra GG et al. High prevalence of SARS-CoV-2 infection among symptomatic healthcare workers in a large university tertiary hospital in São Paulo, Brazil. *BMC Infect Dis*. 2020;20:917.  
<https://doi.org/10.1186/s12879-020-05662-8>
17. Albuquerque MFPM, Souza WV, Montarroyos UR, Pereira CR, Braga C, Araújo TVB et al. Risk of SARS-CoV-2 infection among front-line healthcare workers in Northeast Brazil: a respondent-driven sampling approach. *BMJ Open*. 2022;12:e058369.  
<https://doi.org/10.1136/bmjopen-2021-058369>
18. Gasparoto ALDB. Infecção por SARS-CoV-2 em profissionais de saúde em hospitais terciários de Campo Grande – MS [dissertação de mestrado]. Campo Grande (MS): Universidade Federal de Mato Grosso do Sul; 2022. Available from:  
<https://repositorio.ufms.br/handle/123456789/5077>

19. Mostafa A, Kandil S, El-Sayed MH, Girgis S, Hafez H, Yosef M et al. Universal COVID-19 screening of 4040 health care workers in a resource-limited setting: an Egyptian pilot model in a university with 12 public hospitals and medical centers. *Int J Epidemiol*. 2021;50(1):50-61.  
<https://doi.org/10.1093/ije/dyaa173>
20. Shah ASV, Wood R, Gribben C, Caldwell D, Bishop J, Weir A et al. Risk of hospital admission with coronavirus disease 2019 in healthcare workers and their households: nationwide linkage cohort study. *BMJ*. 2020;371:m3582.  
<https://doi.org/10.1136/bmj.m3582>
21. Nafisah SAB, Mzahim BY, Aleid BS, Sheerah SA, Almatrafi DQ, Ciottone GR et al. The risk of coronavirus to healthcare providers during aerosol-generating procedures: a systematic review and meta-analysis. *Ann Thorac Med*. 2021;16(2):165-71.  
[https://doi.org/10.4103/atm.ATM\\_497\\_20](https://doi.org/10.4103/atm.ATM_497_20)
22. Cash RE, Rivard MK, Camargo Júnior, Powell JR, Panchal AR. Emergency medical services personnel awareness and training about personal protective equipment during the COVID-19 pandemic. *Prehosp Emerg Care*. 2021;25(6):777-84.  
<https://doi.org/10.1080/10903127.2020.1853858>
23. Martin-Delgado J, Viteri E, Mula A, Serpa P, Pacheco G, Prada D et al. Availability of personal protective equipment and diagnostic and treatment facilities for healthcare workers involved in COVID-19 care: a cross-sectional study in Brazil, Colombia, and Ecuador. *PLoS One*. 2020;15(11):e0242185.  
<https://doi.org/10.1371/journal.pone.0242185>