

## Coronavirus Pandemic

# Factors associated with the use of personal protective equipment among Brazilian physicians during the COVID-19 pandemic

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### Abstract

**Introduction:** The objective was to analyze the factors associated with use of Personal Protective Equipment (PPE) among Brazilian physicians during the COVID-19 pandemic.

**Methodology:** An analytical cross-sectional study was conducted from October to December 2020 with 1298 Brazilian physicians. The respondent driven sampling technique was used by sharing the survey through social media.

**Results:** Factors associated with the use of PPE while caring for COVID-19 patients were: being female (AOR = 1.57; 95% CI: 1.24-1.98;  $p \leq 0.001$ ); working in Intensive Care Unit (ICU) (AOR = 2.78; 95% CI: 2.06-3.75;  $p \leq 0.001$ ); training (AOR = 1.62; 95% CI: 1.25-2.09;  $p \leq 0.001$ ); access to sufficient PPE (AOR = 2.22; 95% CI: 1.27-3.90;  $p = 0.0050$ ), and PPE of good quality (AOR = 1.84; 95% CI: 1.16-2.92;  $p = 0.009$ ). The following factors were associated with the use of recommended PPE during procedures that generate aerosols in the context of COVID-19: working in the ICU (ORA=2.73; 95% CI: 2.06-3.62;  $p < 0.01$ ); working in a field hospital (AOR = 1.37; 95% CI: 1.06-1.79;  $p = 0.018$ ); training (AOR = 1.72 95% CI: 1.32-2.24;  $p < 0.01$ ); access to sufficient PPE (AOR = 1.63; 95% CI: 0.91-2.92;  $p < 0.01$ ), PPE of good quality (AOR = 2.07; 95% CI: 1.28-3.35;  $p = 0.003$ ).

**Conclusions:** The factors associated with the use of necessary PPE with COVID-19 patients and for procedures that generate aerosols were identified. Educational interventions for professionals and managers must be implemented to direct them towards protecting themselves and others.

**Key words:** coronavirus; pandemic; personal protective equipment; physicians.

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### Introduction

In late 2019, a new respiratory infection called Coronavirus Disease 2019 (COVID-19), caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) was detected in China [1]. In January 2020 the World Health Organization (WHO) announced that the new epidemic was a Global Health Emergency [2]. After the global emergency was declared, successive guidelines on infection prevention methods were issued by the WHO [3].

Following the WHO notification, several countries such as Brazil and the United States implemented guidelines on the correct use of Personal Protective Equipment (PPE) for disease prevention [4,5], keeping in mind their contextual and epidemiological

peculiarities. These guidelines were aimed at the general population and health professionals. Such recommendations were extremely effective in reducing cases of infection, especially because non-symptomatic carriers can transmit the virus [6].

The most popular recommended preventive measure was the use of masks, both by the general population and by health professionals. Masks were used in various environments: home, public places, and in health services [7]. In fact, there is evidence that the correct use of face masks provides protection against respiratory diseases [8].

The COVID-19 pandemic highlighted issues surrounding the management and availability of resources and sufficient supplies for health care

workers, especially when the ways in which the virus was transmitted became publicized through mass media and scientific publications. Initial guidelines focused on respiratory protection through the use of masks and the prevention of contact through the use of gloves [9].

The demand for PPE has increased exponentially around the world due to the need for protection to contain the spread of the virus. As a result, there has been a global shortage of PPE and the need for international cooperation to overcome gaps in the production chain of such necessary supplies [10].

In addition to the logistics of production and distribution of PPE at global levels, issues surrounding adequate supply and the correct use of these materials by healthcare institutions need to be considered. Insufficient supplies can put the health professionals at risk of infection by COVID-19 [11]. The WHO has recommended the use of PPE based on the risk of transmission, risk of exposure, and the dynamics of transmission of the pathogen [12]. In Brazil alone, 810 physicians died from complications of COVID-19 since the beginning of the pandemic until May 25, 2021 [13].

In Bangladesh, a multicenter study with physicians identified that the use of face shields/goggles, regular decontamination of the environment around the patient, and the use of N95 masks helped protect against COVID-19. Those physicians who reused gowns were twice as likely to test positive for COVID-19 [14]. We investigated the factors associated with the use of PPE among Brazilian physicians in the context of the COVID-19 pandemic.

## Methodology

An analytical cross-sectional study was conducted using an online survey applied throughout the Brazilian territory. A total of 12,086 health professionals who worked in direct patient care at different levels of health services were surveyed. This study followed the recommendations of Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) and was guided by the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).

For this study, 1,298 physicians who provided care to patients with a suspected or confirmed diagnosis of COVID-19 in public and/or private health services, at least in the last six months prior to the start of data collection, were eligible.

Data was collected from October to December 2020. Professionals were recruited using a modified respondent driven sampling (RDS) method designed for virtual data collection. In this method, the participant is

responsible for recruiting other individuals of the same category as their own, through social networks.

Researchers from all regions of Brazil were invited to operationalize the data collection. They were trained on how to conduct an online survey using the RDS technique adapted to the reality imposed by the COVID-19 pandemic period. Each researcher identified health professionals who met the study's inclusion criteria and, from the first eligible professionals, other professionals were identified until a significant sample was obtained.

Health professionals received a link that directed them to the Survey Monkey platform, which allowed them to participate in the study after reading the Informed Consent Form (FICF) available electronically. After providing consent, they were directed to the online data collection form that was constructed and validated in terms of form and content by specialists in the field of infectiology.

The instrument included multiple-choice questions, some of which were mandatory to proceed. The survey was divided into: sociodemographic information, professional category and type of care provided, variables related to the availability of PPE, access to PPE, and the recommended uses thereof in the care of patients suspected of or having COVID-19, as well as on the recommended use of PPE during procedures that generate aerosols in the context of COVID-19.

In this study, the use of PPE recommended for service to patients with suspected or diagnosed COVID-19 was defined based on the guidelines defined by the Centers for Disease Control and Prevention (CDC) and the National Health Surveillance Agency (ANVISA) for direct patient service, which included: hat; gloves; surgical masks or N-95 masks; waterproof apron or fabric apron or coveralls, and face protector/face shield or goggles. In the case of procedures that generate aerosols in the care of patients suspected or diagnosed with COVID-19, the following PPE were considered: head cover; gloves; N-95 masks; waterproof apron or coveralls, and face shield or goggles. Therefore, professionals who marked all the PPE described above by CDC and ANVISA were classified as following the recommended use of PPE in both outcomes.

Data were analyzed using the R statistical software, version 4.0.4. For descriptive analysis, frequency and percentages were used. The Chi-square test was used. A multivariate model was developed with variables previously associated with the outcomes (during bivariate analysis): "PPE recommended in care of patients with COVID-19" and "PPE required in

procedures that generate aerosols in the context of COVID-19". From the results of the adjustment of this model, all variables were identified whose *p* values associated with the estimates of the coefficients were equal to or less than 0.20.

The stepwise method was then applied to the model with the identified variables. Bivariate and multivariate logistic regression generated crude and adjusted odds ratios (OR) with explanatory variables and respective 95% confidence intervals (95%CI) indicating the chances of "use of PPE recommended for care of patients with COVID-19" and "PPE required in procedures that generate aerosols in the context of COVID-19", categorized as: yes or no.

The study followed the guidelines of the Declaration of Helsinki, and was approved by the Research Ethics Committee (CEP), opinion number 4,258,366. All participants gave consent by signing the Informed Consent Form (FICF) by selecting the option "agree", attached to the online questionnaire.

## Results

A total of 1298 physicians from all regions of Brazil participated in the study, 737 (56.8%) used the PPE recommended for the care of patients suspected or diagnosed with COVID-19; 601 (43.3%) physicians used PPE recommended for procedures that generate aerosols in the context of COVID-19 (Table 1).

Recommended PPE for the care of patients suspected or diagnosed with COVID-19 was identified by most professionals. However, it is important to emphasize that 561 (43.2%) physicians did not use the recommended PPE when caring for patients suspected or diagnosed with COVID-19. Of the professionals working in the Intensive Care Unit (ICU), 230 (75.6%) reported that they used the recommended PPE during care for patients suspected or diagnosed with COVID-19. Among the physicians who received a training course on COVID-19, 567 (61.4%) used the necessary PPE.

**Table 1.** Sociodemographic and occupational data of physicians who care for patients with COVID-19, and their use of the recommended PPE in Brazil, 2020.

Variables	Uses PPE recommended for care of patients with COVID-19 [n (%)]		<i>p</i> value <sup>1</sup>
	Yes	No	
<b>Gender</b>			
Male	298 (52.1)	274 (47.9)	
Female	439 (60.5)	287 (39.5)	<b>0.003</b>
<b>Marital status</b>			
Single/Divorced	332 (56.8)	252 (43.2)	
Married/Stable Relationship	397 (56.6)	305 (43.4)	0.781
Widower	8 (66.7)	4 (33.3)	
<b>Region</b>			
North	99 (60.0)	66 (40.0)	
North East	190 (56.5)	146 (43.5%)	
Midwest	148 (56.9)	112 (43.1)	0.920
Southeast	232 (55.6)	185 (44.4)	
South	68 (56.7)	52 (43.3)	
<b>Works in ICU care</b>			
No	507 (51.0)	487 (49.0)	
Yes	230 (75.6)	74 (24.3)	<b>&lt; 0.01</b>
<b>Field Hospital</b>			
Yes	227 (59.4)	155 (40.6)	
No	510 (55.7)	406 (44.3)	0.214
<b>Diagnosis of COVID-19</b>			
No	535 (57.2)	400 (42.8)	
Yes	202 (55.6)	161 (44.4)	0.608
<b>Received Training</b>			
Yes	567 (61.4)	356 (38.6)	
No	170 (45.3)	205 (54.7)	<b>&lt; 0.01</b>
<b>The workplace provides sufficient PPE</b>			
Yes	565 (62.8%)	334 (37.2)	
No	28 (31.5)	61 (68.5)	<b>&lt; 0.01</b>
Somewhat	144 (46.5)	166 (53.5)	
<b>The workplace provides good quality PPE</b>			
Yes	443 (62.4)	267 (37.6)	
No	49 (33.8)	96 (66.2)	<b>&lt; 0.01</b>
Somewhat	245 (5.3)	198 (4.7)	

<sup>1</sup> *p* values referring to the Chi-square test for association. (n = 1298).

**Table 2.** Adjusted model of factors associated with the use of necessary PPE and sociodemographic and occupational characteristics of physicians caring for patients with COVID-19 in Brazil, 2020.

Variables	No	Yes	Crude Odds Ratio (CI 95%)	p value	Adjusted Odds Ratio (CI 95%)	p value
	n (%)	n (%)				
<b>Gender</b>						
Male	274 (47.9)	298 (52.1)	1		1	
Feminine	287 (39.5)	439 (60.5)	1.41 (1.13-1.76)	0.003	1.57 (1.24-1.98)	≤ 0.001
<b>Works in ICU care</b>						
No	487 (49.0)	507 (51.0)	1		1	
Yes	74 (24.3)	230 (75.6)	2.98 (2.23-3.99)	< 0.001	2.78 (2.06-3.75)	≤ 0.001
<b>Received training</b>						
Yes	449 (48.6)	567 (61.4)	1.84 (1.46-2.32)	< 0.001	1.62 (1.25-2.09)	≤ 0.001
No	248 (66.1)	170 (45.3)	1		1	
<b>The workplace provides sufficient PPE for use</b>						
Yes	334 (37.2)	565 (62.8)	3.68 (2.31-5.81)	< 0.001	2.22 (1.27-3.90)	0.005
No	61 (68.5)	28 (31.5)	1		1	
Somewhat	166 (53.5)	144 (46.5)	1.89 (1.15-3.12)	0.012	1.28 (0.72-2.28)	0.384
<b>The workplace provides good quality PPE</b>						
Yes	267 (37.6)	443 (62.4)	3.25 (2.23-4.73)	< 0.001	1.84 (1.16-2.92)	0.009
No	96 (66.2)	49 (33.8)	1		1	
Somewhat	198 (44.7)	245 (55.3)	2.42 (1.64-3.59)	< 0.001	1.91 (1.22-3.01)	0.005

Chi-square test. *p* value < 0.05 (n = 1298).**Table 3.** Association between the use of necessary PPE in procedures that generate aerosols and demographic and occupational variables of physicians in COVID-19 patient care. (n = 1,298) in Brazil, 2020.

Variables	Use of necessary PPE in procedures that generate aerosols in the context of COVID-19		p value**
	No n (%)	Yes n (%)	
<b>Gender</b>			
Male	317 (55.4%)	255 (44.6%)	
Feminine	380 (52.3%)	346 (47.7%)	0.270
<b>Marital Status</b>			
Single/Divorced	321 (55.0%)	263 (45.0%)	
Married/Stable Relationship	369 (52.6%)	333 (47.4%)	0.656
Widower	7 (58.3%)	5 (41.7%)	
<b>Region</b>			
North	87 (52.7%)	78 (47.3%)	
North East	185 (55.1%)	151 (44.9%)	
Midwest	136 (52.3%)	124 (47.7%)	0.665
Southeast	231 (55.4%)	186 (44.6%)	
South	58 (48.3%)	62 (51.7%)	
<b>Works in the ICU</b>			
No	595 (59.8%)	399 (40.1%)	
Yes	102 (33.6%)	202 (66.4%)	< 0.01
<b>Field Hospital</b>			
Yes	176 (46.1%)	206 (53.9%)	
No	521 (56.9)	395 (43.1)	< 0.01
<b>Diagnosis of COVID-19</b>			
No	511 (54.7)	424 (45.3)	
Yes	186 (51.2)	177 (48.8)	0.268
<b>Received Training</b>			
Yes	449 (48.6)	474 (51.4)	
No	248 (66.1)	127 (33.9)	< 0.01
<b>Has the institution you work for provided enough PPE?</b>			
Yes	436 (48.5)	463 (51.5)	
No	65 (73.0)	24 (27.0)	< 0.01
Somewhat	196 (63.2)	114 (36.8)	
<b>Did the institution you work with provide good quality PPE?</b>			
Yes	338 (47.6)	372 (52.4)	
No	105 (72.4)	40 (27.6)	< 0.01
Somewhat	254 (57.3)	189 (42.7)	

Chi-square test. *p* value < 0.05.

Regarding the sufficient supply of quality PPE by the workplace, the majority stated that they received PPE in sufficient quantity 565 (62.8%) and of good quality 443 (62.4%), and used the recommended PPE. A higher number of female physicians who worked in the ICU and had training on service to COVID-19 patients reported that there was provision of sufficient and good quality PPE by the workplace (Table 1).

Based on multivariate analysis, female physicians (Adjusted Odds Ratio AOR = 1.570; 95% CI 1.242-1.986;  $p \leq 0.001$ ) are 1.570 times more likely to use recommended PPE during care for patients with COVID-19 when compared to males. While working in the ICU (AOR = 2.785; 95% CI: 2.067-3.751;  $p \leq 0.001$ ), the physician is 2.785 times more likely to use PPE recommended during the care of patients with COVID-19 compared to those who do not work in the ICU.

Physicians who received training on COVID-19 (AOR = 1.620; 95% CI: 1.254-2.092;  $p \leq 0.001$ ) are 1.620 times more likely to use the necessary PPE to care for patients with COVID-19 compared to professionals who did not receive training. Regarding the provision of sufficient quantity PPE (AOR = 2.229; 95% CI:1.272-3.906;  $p = 0.005$ ), physicians are 2.299 times more likely to use the PPE needed to care for COVID-19 patients compared to professionals who did not receive them in sufficient quantities for use. Those who received PPE suitable for use (AOR = 1.849; 95% CI:1.168-2.928;  $p = 0.009$ ) are 1.849 times more likely to use the PPE needed to care for COVID-19 patients compared to those who did not receive PPE suitable for use (Table 2). Observations on the use of recommended PPE during procedures that generate aerosols were similar to those regarding the use of necessary PPE during care for patients with suspicion or diagnosis for COVID-19. 565 (62.8%) of the participants said they had received sufficient PPE at their workplace and 443 (62.4%) reported that the PPE was of good quality.

Furthermore, there was an association between the use of PPE needed by physicians in the care of patients diagnosed with COVID-19 and variables related to gender, ICU work, training in the context of care for COVID-19, provision of sufficient PPE by the workplace and provision of quality PPE by the workplace (Table 3).

Among the physicians who received training for COVID-19, 474 (36.5%) reported that they used the necessary PPE. Most physicians who claimed to have received sufficient and quality PPE used the necessary PPE, 463 (35.7%) and 372 (28.7%) respectively.

Furthermore, evidence of an association was identified between the use of PPE needed by physicians in the care of patients diagnosed with COVID-19 and the variables related to: providing care in the ICU, working in a field hospital for COVID-19, training in the context of service to COVID-19 patients, provision of sufficient PPE by the workplace, and provision of quality PPE by the workplace (Table 3).

After adjusting the logistic regression model, it was verified that the medical professionals who worked in the ICU (OR = 2.73; 95% CI: 2.06-3.62;  $p < 0.01$ ) were 2.7 times more likely to use the necessary PPE in procedures that generate aerosols in the context of COVID-19 when compared to a medical professional who did not work in the ICU. Regarding working in a field hospital, a doctor who provided care in a field hospital (OR = 1.37; 95% CI:(1.06-1.79);  $p = 0.018$ ) was 1.37 times more likely to use the PPE required in procedures that generate aerosols in the context of COVID-19 when compared with a medical professional who did not work in a field hospital.

Physicians whose workplace provided good quality PPE (OR = 2.07; CI: 1.28-3.35;  $p = 0.003$ ) were 2.07 times more likely to correctly use PPE in procedures that generate aerosols in the context of COVID-19 when compared to a medical professional whose workplace did not provide good quality PPE.

Interestingly, a physician whose workplace provided sufficient PPE for use had the same chances of correctly using PPE in procedures that generate aerosols in the context of COVID-19 when compared to a medical professional whose workplace did not provide enough PPE for use. The chances of using the necessary PPE were the same in both genders, and when the work institution provides sufficient PPE (Table 4).

## Discussion

In the present study, just over half of the physicians used the necessary PPE while interacting with patients suspected or diagnosed with COVID-19 and almost 50% of them used the necessary PPE for procedures that generate aerosols in the context of COVID-19. These results indicate that a significant number of professionals were at risk of infection by COVID-19 due to low adherence to the use of protective equipment. It is noteworthy that adequate protection is essential for health professionals involved in the direct care of patients suspected or diagnosed with COVID-19. However, in addition to the rates of usage, there are other factors surrounding the use of the recommended PPE. It was observed that the factors associated with the use of PPE recommended during care for patients with

COVID-19 and the use of PPE recommended in the performance of procedures that generate aerosols in the context of COVID-19 are similar.

Previous studies have reported that in Ghana, a country in West Africa, 90.6% of health professionals involved in infection prevention and control at COVID-19 treatment centers adhered to the use of PPE [15]. However, in that study, only 7.9% of the participants were physicians and most belonged to professional nursing categories (nurses and technicians), which may indicate that nurses have greater adherence to the use of PPE in providing care to patients with suspected or diagnosed COVID-19. In the present study, all participants were physicians.

Our results indicated that female participants who worked in the ICU and received training in the context of COVID-19 were more likely to use the necessary PPE in the care of patients with COVID-19. In fact, one of the central issues in the care of patients with COVID-19 seems to involve the provision of training, especially

at the beginning of the pandemic, when little was known about the forms of transmission and clinical manifestations of the disease. In this sense, technological and educational efforts have been developed by researchers to instruct health professionals on methods of proper use, removal, and disposal of PPE in the context of COVID-19 in order to improve these techniques and prevent virus transmission [16].

However, doctors, nurses and other health professionals working in public institutions in Latin American countries reported that they felt less prepared and received less training compared to their colleagues working in private institutions [17]. These issues should be better investigated, especially in Brazil, due to its unique geographical characteristics, political context, and public health system, in order to better understand the needs of physicians regarding continuing education related to the use of PPE and safe care to patients with COVID-19. Furthermore, there is a need for the country

**Table 4.** Adjusted model of factors associated with the correct use of PPE in procedures that generate aerosols and sociodemographic and occupational data of physicians who care for patients with COVID-19. (n = 1,298) in Brazil, 2020.

Variables	No n (%)	Yes n (%)	Crude Odds (CI 95%)	p value**	Adjusted Odds (CI 95%)	p value**
<b>Gender</b>						
Male	317 (55.4%)	255 (44.6%)	1		1	
Feminine	380 (52.3%)	346 (47.7%)	1.13 (0.91-1.41)	0.270	1.25 (0.98-1.58)	0.068
<b>Marital status</b>						
Single/Divorced	321 (55.0%)	263 (45.0%)	1		1	
Married/Stable Marriage	369 (52.6%)	333 (47.4%)	1.10 (0.88- 1.37)	0.391	0.79 (0.62-1.00)	0.052
Widower	7 (58.3%)	5 (41.7%)	0.87 (0.27-2.78)	0.831	0.72 (0.22-2.39)	0.590
<b>Region</b>						
North	87 (52.7%)	78 (47.3%)	1.09 (0.76-1.60)	0.623	1.06 (0.71-1.58)	0.786
North East	185 (55.1%)	151 (44.9%)	1			
Midwest	136 (52.3%)	124 (47.7%)	1.12 (0.81-1.54)	0.505	0.93 (0.66-1.32)	0.690
Southeast	231 (55.4%)	186 (44.6%)	0.99 (0.74-1.32)	0.926	0.77 (0.56-1.05)	0.098
South	58 (48.3%)	62 (51.7%)	1.31 (0.86-1.99)	0.208	0.96 (0.62-1.51)	0.874
<b>Works in the ICU</b>						
No	595 (59.8%)	399 (40.1%)	1		1	
Yes	102 (33.6%)	202 (66.4%)	2.95 (2.25-3.87)	< 0.01	2.73 (2.06-3.62)	< 0.01
<b>Field Hospital</b>						
Yes	176 (46.1%)	206 (53.9%)	1.54 (1.21-1.96)	< 0.01	1.37 (1.06-1.79)	0.018
No	521 (56.9)	395 (43.1)	1		1	
<b>Diagnosis of COVID-19</b>						
No	511 (54.7)	424 (45.3)	1		1	
Yes	186 (51.2)	177 (48.8)	1.15 (0.90-1.46)	0.269	1.02 (0.78-1.32)	0.900
<b>Received Training</b>						
Yes	449 (48.6)	474 (51.4)	2.06 (1.61-2.65)	< 0.01	1.72 (1.32-2.24)	< 0.01
No	248 (66.1)	127 (33.9)	1		1	
<b>Has your workplace provided enough PPE?</b>						
Yes	436 (48.5)	463 (51.5)	2.88 (1.77- 4.68)	<0.01	1.63 (0.91-2.92)	< 0.01
No	65 (73.0)	24 (27.0)	1		1	
Somewhat	196 (63.2)	114 (36.8)	1.58 (0.93-2.65)	0.086	1.14 (0.63-2.08)	0.659
<b>Did your workplace provide good quality PPE?</b>						
Yes	338 (47.6)	372 (52.4)	2.88 (1.95-4.28)	0.01	2.07 (1.28-3.35)	0.003
No	105 (72.4)	40 (27.6)	1		1	
Somewhat	254 (57.3)	189 (42.7)	1.95 (1.30-2.94)	0.01	1.74 (1.08-2.79)	0.022

to prepare for possible future outbreaks, with adequate logistics, especially for the protection of health professionals involved in direct care.

A survey conducted in Nicaragua corroborated the present results related to being female and having a better chance to use PPE when compared to males; being a male health professional resulted in a higher risk of infection by COVID-19 [18]. Although Brazil and Nicaragua are countries in the Americas, their contextual, social and cultural realities are distinct. However, the behavior of female health professionals may be related to factors intrinsic to women, related to socially constructed gender patterns, such as having greater affection for taking care of themselves and others, which places men at greater risk of exposure. [19,20].

The present results also indicated that physicians who provided care in the ICU were more likely to use the necessary PPE to care for patients with COVID-19. In fact, working in the ICU requires greater diligence from health professionals due to the level of complexity of the procedures performed. For example, healthcare professionals who worked in the ICU in the initial phase of the pandemic in Italy received formal training in the use of PPE [21]. The level of complexity of health care provided in Intensive Care Units deserves greater attention from health professionals and managers with regard to qualification through continuing education. A multinational study (Australia, New Zealand, Singapore, Hong Kong, India and the Philippines) indicated that 97% of ICUs met or exceeded World Health Organization recommendations for the use of PPE [22].

Professionals who worked in the ICU, provided care in a field hospital, and whose workplace provided good quality PPE had more chances to correctly use PPE during procedures that generate aerosols in the context of COVID-19. Discussions about the role of physicians in combating the COVID-19 pandemic raise issues such as infection and mortality rates among these professionals. A study of deaths of physicians caused by COVID-19 indicated that physicians from all specialties are affected and may die [23]. In view of this, a broad prevention program that involves different ways to prevent infection is needed. Among them, the correct use of PPE during procedures involving patients with suspected or diagnosed coronavirus is highlighted in the present study. A review indicated that the occupational risk caused by the pandemic has increased mortality among physicians, requiring an adequate supply of personal protective equipment [24].

Although the associated factors indicate the presence of variables related to the correct use of PPE during procedures that generate aerosols in the context of COVID-19, the availability of PPE must also be discussed. For example, a study of the availability of PPE among US and Pakistani physicians in the COVID-19 pandemic indicated that overall Pakistani physicians had less access to PPE [25]. Corroborating this, a survey carried out among Latin American countries indicated that health professionals faced difficulties in accessing basic items for personal protection such as N95 masks, face shields, and gowns [17]. Before PPE can be used correctly it must be provided in the workplace in adequate quantity and quality. It is observed that in lower-income countries, access difficulties tend to be greater, as reported by studies that investigated the issue in Pakistan, Brazil, Colombia and Ecuador [17,25].

### **Limitations of the study**

As a limitation of the present study, it is emphasized that online data collection can present difficulties and even make it impossible for the participant when internet access is impaired or unsatisfactory. It is noteworthy, however, that this aspect did not interfere with the results, since all Brazilian regions and states were represented in the sample.

### **Conclusions**

This study concluded that 60% of physicians used PPE necessary for the care of patients suspected or diagnosed with COVID-19, and the factors associated with use were: being female, providing care in the ICU, receiving training, and the workplace providing PPE in sufficient supply and good quality. Almost 50% of the survey respondents used the PPE that is necessary for procedures that generate aerosols in the context of COVID-19; the associated factors in this case were working in the ICU and in a field hospital, receiving training, and the workplace providing sufficient PPE of good quality.

Further studies are recommended to investigate the reasons why some physicians did not use PPE necessary for the care of patients suspected or diagnosed with COVID-19. In addition, it is strongly recommended that health institutions prioritize the training of health teams in the proper use of PPE, in addition to providing them in adequate quantity and quality.

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