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Use of recommended personal protective equipment among Brazilian health professionals during the COVID-19 pandemic

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Abstract.
BACKGROUND: The COVID-19 pandemic is one of the biggest health crises in the world and the use of personal protective equipment (PPE) is significant measures to prevent the transmission of SARS-CoV-2. However, PPE needs to be used properly by healthcare professionals.
OBJECTIVE: To analyze the use of PPE among Brazilian health professionals and associated factors during a period of the COVID-19 pandemic.
METHODS: An analytical cross-sectional study was carried out from October to December 2020. For data collection, the respondent-driven sampling technique was used, adapted for social media, with a link to an online survey form.
RESULTS: The study considered 12,086 Brazilian health professionals. Most (69%) used PPE recommended for the care of patients with suspected or diagnosed COVID-19. Factors associated with the use of PPE were: working in an Intensive Care Unit (ICU) or in a field hospital, receiving training, being provided with sufficient, high-quality PPE by the workplace and being an odontologist compared to nursing professionals. For procedures that generate aerosols in the context of COVID-19, 54.1% of them used the recommended PPE, the associated factors were: being married or in a stable relationship compared to a single/divorced professional, working in an ICU, being offered training, providing sufficient, high-quality PPE, and being an odontologist compared to nursing professionals.
CONCLUSIONS: For the care of patients with COVID-19, 69% of health professionals used PPE properly, and several factors interfered with the use of this equipment.

Keywords: Coronavirus infection, occupational safety and health, personal protective equipment, COVID-19, healthcare professionals

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1. Introduction

The 2019 coronavirus disease pandemic (COVID-19) caused by the Severe Acute Respiratory Syndrome Coronavirus 2 virus (SARS-CoV-2) is a worldwide public health emergency [1]. Due to the high transmissibility and easy dissemination of SARS-CoV-2, there has been a sharp curve of cases, leading to overloaded health services, which can collapse a health care system [2].

In addition to this context, frequent and continuous exposure to SARS-CoV-2 in the healthcare environment has led to a significant number of infected professionals who need time away from work [3]. Pre-symptomatic or asymptomatic healthcare workers with COVID-19 may also contribute to transmissions within healthcare institutions [4]. Therefore, protecting health professionals is a significant factor in controlling the COVID-19 pandemic.

As there is no proven effective treatment and vaccines still affect a low percentage of the world population, the use of personal protective equipment (PPE) and hand hygiene are significant measures to prevent the transmission of SARS-CoV-2. Therefore, it is necessary to ensure sufficient, high-quality PPE [5]. However, the scarcity and unavailability of PPE are reported worldwide [6]. Furthermore, it is noteworthy that the use of PPE by health professionals can significantly reduce the risk of infection associated with patient care in health care services [7].

However, this has not been the reality in the context of the pandemic. In the US, National Nurses United conducted a survey of more than 6,000 nurses in all 50 states, plus Washington DC and four US territories. Preliminary results show that 87% of nurses reported having to reuse disposable single-use masks or N95 type face breathing masks, 27% of nurses reported being exposed to patients with confirmed COVID-19 without the use of adequate PPE, and 72% reported having had skin or clothing exposure when caring for suspected or confirmed COVID-19 patients [8].

In Brazil, the lack of PPE has also been documented. The Brazilian Medical Association registered 3,926 anonymous complaints from health professionals about the lack of various PPE across the country until September 2020 [9]. The Federal Nursing Council recorded 61,835 cases of COVID-19 in health professionals and 872 deaths until mid-February of 2022 [10].

PPE refers to safety apparel and equipment used to protect healthcare professionals, including disposable gowns, aprons, gloves, face shields, goggles, shoe covers, head covers, surgical masks, and respirators with filter masks. This was also demonstrated in the 2003 severe acute respiratory syndrome (SARS) virus outbreak, where inappropriate or inconsistent use of PPE was significantly associated with SARS infection among HCWs [11–13].

In Brazil there is a shortage of studies on the use of PPE in the pandemic. Ensuring that workers have access to PPE is an essential condition to prevent cases of COVID-19 among health professionals, and to achieve this objective it is essential, among other actions, to coordinate the supply chain of these inputs, optimize their availability and ensure the proper use of these protective equipment [14]. Therefore, the objective of this study was to analyze the use of PPE among Brazilian health professionals and associated factors during a period of the COVID-19 pandemic.

2. Materials and methods

An analytical cross-sectional study, was conducted throughout Brazil using an online survey. Health professionals who worked in direct patient care at different levels of health care, at least in the last six months prior to the start of data collection, participated in the study. 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).

Data collection took place from October to December 2020. Professionals were recruited using an the respondent driven sampling (RDS) method which was adapted for the social media context. In this method, each participant is responsible for recruiting subsequent individuals of the same category as their own, through social networks.

For this study, researchers from all regions of Brazil were invited to operationalize the data collection. These, in turn, were trained on how to conduct an online survey using the RDS technique adapted to take into account the realities imposed by the COVID-19 pandemic period. Each researcher identified health professionals who met the inclusion criteria and, from the first eligible professionals, other professionals were identified.

Health professionals received a link that directed them to the *Survey Monkey platform*, which allowed them to read and accept the Informed Consent Form (FICF), to participate in the survey, available electronically. Afterward, they had access to

the online form for data collection, which was constructed and validated by seven specialists in the field of infectology in terms of form and content. The experts completed an instrument that contained general assessment items (adequacy and applicability), items that assessed the coherence and adequacy of the instrument to the research objectives, items to assess scientific accuracy and instrument content, and language assessment items (adequacy, clarity, objectivity).

For the sample calculation, the information on the number of professionals per region of Brazil was considered as a reference, according to data from the professional councils provided by the Ministry of Health, base year 2010 [15]. A confidence interval of 95% was adopted, with a margin of error equal to 1% plus or minus, obtaining a minimum sample of 5,079 individuals. Following online data collection, 12,086 participants participated in the study. The sample size calculation formula, is as follows [16]:

$$n = 1/\left(\frac{1}{no} + \frac{1}{N}\right)$$

on what,
$no = z^2S^2/d^2$
In the formula presented, we have that:

- z is the value related to the confidence level established for the survey (to 95% confidence);
- N is the size of the population;
- S is the standard deviation;
- d is the margin of error (pre-established according to the average score to be calculated).

The instrument includes multiple-choice questions, some of which are mandatory to proceed, divided into sociodemographic information, professional performance, and type of care provided, variables related to availability, access and recommended use of PPE in the care of patients with suspicion and diagnosis of COVID-19, as well as on the recommended use of PPE during procedures that generate aerosols in the context of COVID-19.

In the present study, the use of PPE recommended for assistance to patients with suspected or diagnosed COVID-19 was considered, the guidelines defined by the Centers for Disease Control and Prevention (CDC) and the National Health Surveillance Agency (ANVISA) for direct assistance: cap; gloves; surgical masks or N-95 masks; waterproof apron or fabric apron or coveralls and face shield/face shield or goggles. Regarding the performance of procedures that generate aerosols in the care of patients with suspected or diagnosed COVID-19, the following were considered: cap; gloves; N-95 masks; waterproof apron or coveralls and face shield/face shield or goggles. Thus, professionals who marked all the PPE described above by CDC and ANVISA were classified as recommended use of PPE in both outcomes.

Data were analyzed using R statistical software, version 4.0.4. For descriptive analysis, frequency and percentages were used. The Chi-square test was used. Then, a multivariate model was developed with variables previously (bivariate analysis) associated with the outcomes: 'PPE recommended in patient care with COVID-19' and 'PPE needed in procedures that generate aerosols in the context of COVID-19'. From the results of the adjustment of this model, a screening was performed to identify and select all variables whose *p*-values associated with the estimates of the coefficients of these variables were equal to or less than 0.20.

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

The project was approved by the Research Ethics Committee (CEP), opinion number 4,258,366. All participants signed the Free and Informed Consent Form. In addition, they had the right not to answer any question, without the need for justification, and they could withdraw from the research at any time. The tool used for data collection respects the privacy, secrecy and confidentiality policy of the research participants' information.

3. Results

12,086 health professionals from all regions of the country participated in the study. The use of recommended PPE for the care of patients with suspected or diagnosed COVID-19 was identified in the majority of study participants, 8,340 (69%). When analyzing the frequency of use of recommended PPE by region, it appears that the region with the highest rate of use of recommended PPE was the Southeast region, 2,454 (70.3%), followed by the Midwest region, 1,494 (70,2%).

Table 1
Association between the use of PPE recommended to care for patients diagnosed with COVID-19 and demographic variables, sector of activity and access to equipment (N = 12,086). Brazil, 2020

Variables	Use of recommended PPE for care of COVID-19 patients (n = 12,086)		
	No (n = 3,746)	Yes (n = 8,340)	
	n (%)	n (%)	p^*
Sex			
Male	781 (32.7)	1,610 (67.3)	
Feminine	2,965 (30.6)	6,730 (69.4)	**0.051**
Marital status			
Single/Divorced	1,794 (31.2)	3,960 (68.8)	
Married/Stable marriage	1,930 (30.8)	4,330 (69.2)	0.92
Widower	22 (30.6)	50 (69.4)	
Region			
North	578 (32.5)	1,200 (67.5)	
North East	1,118 (30.7)	2,520 (69.3)	
Midwest	634 (29.8)	1,494 (70.2)	**0.001**
Southeast	1,039 (29.7)	2,454 (70.3)	
South	377 (35.9)	672 (64.1)	
Intensive Care Unit			
No	3,232 (35.3)	5,918 (64.7)	
Yes	514 (17.5)	2,422 (82.5)	**<0.01**
Field Hospital			
Yes	891 (24.9)	2,683 (75.1)	**<0.01**
No	2,855 (33.5)	5,657 (66.5)	
Professional category			
Physician	561 (43.2)	737 (56.8)	
Nursing professional	2,391 (26.5)	6,648 (73.5)	
Physiotherapist	195 (29.1)	475 (70.9)	
Psychologist	137 (73.3)	50 (26.7)	
Speech therapist	31 (52.5)	28 (47.5)	**<0.01**
Occupational therapist	26 (66.7)	13 (33.3)	
Odontologist	55 (22.9)	185 (77.1)	
Other	350 (63.2)	204 (36.8)	
Diagnosis of COVID-19			
No	2,604 (31.7)	5,618 (68.3)	**0.019**
Yes	1,142 (29.6)	2,722 (70.4)	
Received training			
Yes	2,299 (27.0)	6,205 (73.0)	
No	1,447 (40.4)	2,135 (59.6)	**<0.01**
Has the institution you work for provided enough PPE?			
Yes	2,265 (26.0)	6,446 (74.0)	
No	391 (58.7)	275 (41.3)	**<0.01**
Somewhat	1,090 (40.2)	1,619 (59.8)	
Did the institution you work for provide good quality PPE?			
Yes	1,684 (25.7)	4,861 (74.3)	
No	642 (49.4)	657 (50.6)	**<0.01**
Somewhat	1,420 (33.5)	2,822 (66.5)	

*p obtained from the results of the chi-square tests.

As for the analysis of the frequency of use of the recommended PPE by professional category, dentists were the ones who most used the recommended PPE and psychologists the least. Of the professionals who received training for COVID-19, 6,205 (73.0%) reported the use of the recommended PPE. Regarding the sufficient supply and quality of PPE by labor institutions, the majority 74.3% claimed to have received sufficient and quality PPE used the recommended PPE. Furthermore, evidence of an association was identified between the use of PPE recommended by health professionals in the care of patients diagnosed with COVID-19 and the variables related to region, ICU work, work in a field hospital, professional category, COVID-19 diagnosis, training, provision of sufficient and quality PPE by the work institution, as shown in Table 1.

From the results obtained by the adjustment of the logistic regression model, it was verified that professionals from the South region have 35% less chances of using the PPE recommended for assistance to patients with suspicion or diagnosis of COVID-19 when compared to patients from the Northeast region. Working in the ICU and providing care in a field hospital increase the chances of using the PPE recommended to care for patients with suspected or diagnosed COVID-19 when compared to professionals who did not work in the ICU and who did not work in field hospitals. The professional who received training was 1.48 (95% CI [1.35–1.62]) times more likely to use the PPE recommended for care of patients with COVID-19 compared to a professional who did not receive training. Regarding the provision of PPE in sufficient quantity and suitable for use, the chances of using the recommended PPE increased by 2.5 (95% CI [2.04–3.05]) times and 1.7 (95% CI [1.49–2.03]) times, respectively.

As for the professional category, the dentist was 1.5 (95% CI [1.12–2.11]) times more likely to use the PPE recommended in the care of patients with COVID-19 when compared to a nursing professional. However, the other professional categories had lower chances of using the recommended PPE compared to nursing professionals (Table 2).

The use of PPE recommended for procedures that generate aerosols in the context of COVID-19 was identified in most professionals in the study, 6,537 (54.1%). When analyzing the frequency by region, it appears that the region with the highest rate of use was the South region, 582 (55.5%) followed by the Southeast region, 1,934 (55.4%).

Regarding the analysis of the frequency of use of the PPE recommended during procedures that generate aerosols by professional category, dentists were 1.37 (95% CI [1.05–1.80]) times more likely to use the PPE recommended in the care of patients with COVID-19 when compared to a nursing professional. However, in other professional categories, the chances of using the recommended PPE decrease.

It is noteworthy that the professionals who did not receive training for COVID-19, also used the recommended PPE, mostly. Regarding the provision of sufficient and quality PPE by the work institutions, most provided it, according to the study participants. Evidence of an association was also identified between the correct use of PPE in procedures that generate aerosols in the context of COVID-19 and the variables related to work in the ICU, work in a field hospital, professional category, training, provision of sufficient and quality PPE by work institution (Table 3).

From the results obtained by adjusting the logistic regression model, it was found that participants who were married or in a stable union had 1.10 (95% CI [1.02–1.19]) times more likely to use the recommended PPE in procedures that generate aerosols in the context of COVID-19 when compared to a single/divorced professional. The professional who provides assistance in the ICU is 1.80 (95% CI [1.64–1.98]) times more likely to use the recommended PPE in procedures that generate aerosols in the context of COVID-19 compared to a professional who does not work in this unit.

The professional who received training in the context of COVID-19 had 1.47 (95% CI [1.35–1.60]) times more likely to use the recommended PPE in procedures that generate aerosols in the context of COVID-19 when compared to a professional who did not receive training. Regarding the provision of PPE in sufficient quantity and quality, the chances increased by 1.57 (95% CI [1.29–1.92]) times and 1.82 (95% CI [1.56–2.11]) times, respectively, in relation to the use of Recommended PPE in procedures that generate aerosols in the context of COVID-19 (Table 4).

4. Discussion

In the present study, almost 70% of health professionals used the necessary PPE during care provided to patients suspected or diagnosed with COVID-19 and a little more than half of them used the necessary PPE for procedures that generate aerosols in the context of COVID-19. This result is lower than that observed in another study carried out in Ghana, which evaluated 328 health professionals from COVID-19 treatment centers and found that 90.6% of these professionals adhered to the use of PPE and during the execution of generating procedures of 97.5% aerosol [17]. An observational study conducted in Germany identified that in the COVID-19 wards there was a higher adherence of health professionals to the use of PPE (85%), compared to those working in non-COVID-19 wards (76%) [1].

The data identified in our study are of great concern, considering that health professionals, by not using the recommended PPE, expose themselves to the risk of COVID-19. The Centers for Disease Control and Prevention (CDC), which aggregates American data, reported until June 12, 2021, 510,242

Table 2
Odds ratios for using the recommended PPE in the care of patients diagnosed with COVID-19 (N = 12,086). Brazil, 2020

Variables	Using the recommended PPE in the care of patients diagnosed with COVID-19 (N = 12,086). Brazil, 2020							
	No (n = 3,746)	Yes (n = 8,340)						
	n (%)	n (%)	Crude odds	95% CI	p*	Adjusted odds ratio	95% CI	p*
Region								
North East	1,118 (30.7)	2,520 (69.3)	1			1		
North	578 (32.5)	1,200 (67.5)	0.92	0.82–1.04	0.19	1.03	0.91–1.18	0.58
Midwest	634 (29.8)	1,494 (70.2)	1.04	0.93–1.17	0.45	1.00	0.88–1.13	0.94
Southeast	1,039 (29.7)	2,454 (70.3)	1.05	0.95–1.16	0.37	1.06	0.95–1.18	0.28
South	377 (35.9)	672 (64.1)	0.79	0.68–0.91	**<0.01**	0.65	0.56–0.76	**<0.01**
Intensive Care Unit								
No	3,232 (35.3)	5,918 (64.7)	1			1		
Yes	514 (17.5)	2,422 (82.5)	2.57	2.32–2.86	**<0.01**	2.45	2.19–2.75	**<0.01**
Field Hospital								
No	2,855 (33.5)	5,657 (66.5)	1			1		
Yes	891 (24.9)	2,683 (75.1)	1.52	1.39–1.66	**<0.01**	1.24	1.13–1.36	**<0.01**
Diagnosis of COVID-19								
No	2,604 (31.7)	5,618 (68.3)	1			1		
Yes	1,142 (29.6)	2,722 (70.4)	1.10	1.02–1.20	**0.02**	0.83	0.63–1.08	0.16
Professional category								
Nursing professional	2,391 (26.5)	6,648 (73.5)	1			1		
Physician	561 (43.2)	737 (56.8)	0.47	0.42–0.53	**<0.01**	0.45	0.39–0.51	**<0.01**
Physiotherapist	195 (29.1)	475 (70.9)	0.88	0.74–1.04	0.14	0.55	0.46–0.67	**<0.01**
Psychologist	137 (73.3)	50 (26.7)	0.13	0.09–0.18	**<0.01**	0.12	0.08–0.17	**<0.01**
Speech therapist	31 (52.5)	28 (47.5)	0.32	0.19–0.54	**<0.01**	0.25	0.14–0.43	**<0.01**
Occupational therapist	26 (66.7)	13 (33.3)	0.18	0.09–0.35	**<0.01**	0.17	0.08–0.35	**<0.01**
Odontology	55 (22.9)	185 (77.1)	1.21	0.89–1.64	0.22	1.54	1.12–2.11	**0.007**
Other	350 (63.2)	204 (36.8)	0.21	0.18–0.25	**<0.01**	0.2	0.17–0.25	**<0.01**
Received training								
No	1,447 (40.4)	2,135 (59.6)	1			1		
Yes	2,299 (27.0)	6,205 (73.0)	1.83	1.68–1.99	**<0.01**	1.48	1.35–1.62	**<0.01**
Has the institution you work for provided enough PPE?								
No	391 (58.7)	275 (41.3)	1			1		
Yes	2,265 (26.0)	6,446 (74.0)	4.05	3.44–4.76	**<0.01**	2.50	2.04–3.05	**<0.01**
Somewhat	1,090 (40.2)	1,619 (59.8)	2.11	1.78–2.51	**<0.01**	1.6	1.30–1.95	**<0.01**
Did the institution you work for provide good quality PPE?								
No	642 (49.4)	657 (50.6)	1			1		
Yes	1,684 (25.7)	4,861 (74.3)	2.82	2.50–3.19	**<0.01**	1.74	1.49–2.03	**<0.01**
Somewhat	1,420 (33.5)	2,822 (66.5)	1.94	1.71–2.20	**<0.01**	1.46	1.26–1.71	**<0.01**

Note: 95% CI: 95% confidence intervals. *Statistically significant $p < 0.05$.

Table 3
Association between the use of PPE recommended for procedures that generate aerosols in the context of COVID-19 and demographic variables, sector of activity and access to equipment (N = 12,086). Brazil, 2020

Variables	Correct use of PPE in procedures that generate aerosols in the context of COVID-19		
	No (n = 5,549)	Yes (n = 6,537)	
	n (%)	n (%)	p^*
Sex			
Male	1,112 (46.5)	1,279 (53.5)	0.521
Feminine	4,437 (45.8)	5,258 (54.2)	
Marital status			
Single/Divorced	2,698 (46.9)	3,056 (53.1)	
Married/Stable marriage	2,822 (45.1)	3,438 (54.9)	**0.086**
Widower	29 (40.3)	43 (59.7)	
Region			
North	891 (50.1)	887 (49.9)	
North East	1,654 (45.5)	1,984 (54.5)	
Midwest	978 (46.0)	1,150 (54.0)	**0.003**
Southeast	1,559 (44.6)	1,934 (55.4)	
South	467 (44.5)	582 (55.5)	
Intensive Care Unit			
No	4,551 (49.7)	4,599 (50.3)	**<0.01**
Yes	998 (34.0)	1,938 (66.0)	
Field Hospital			
Yes	1,448 (40.5)	2,126 (59.5)	**<0.01**
No	4,101 (48.2)	4,411 (51.8)	
Professional category			
Physican	697 (53.7)	601 (46.3)	
Nursing professional	3,799 (42.0)	5,240 (58.0)	
Physiotherapist	296 (44.2)	374 (55.8)	
Psychologist	169 (90.4)	18 (9.6)	
Speech therapist	37 (62.7)	22 (37.3)	**<0.01**
Occupational therapist	30 (76.9)	9 (23.1)	
Odontologist	93 (38.8)	147 (61.3)	
Other	428 (77.3)	126 (22.7)	
Diagnosis of COVID-19			
No	3,823 (46.5)	4,399 (53.5)	**0.06**
Yes	1,726 (44.7)	2,138 (55.3)	
Received training			
Yes	3,555 (41.8)	4,949 (58.2)	**<0.01**
No	1,994 (55.7)	1,588 (44.3)	
Has the institution you work for provided enough PPE?			
Yes	3,612 (41.5)	5,099 (58.5)	
No	442 (66.4)	224 (33.6)	**<0.01**
Somewhat	1,495 (55.2)	1,214 (44.8)	
Did the institution you work with provide good quality PPE?			
Yes	2,653 (40.5)	3,892 (59.5)	
No	821 (63.2)	478 (36.8)	**<0.01**
Somewhat	2,075 (48.9)	2,167 (51.1)	

*p obtained from the results of the chi-square tests.

cases among health professionals and 1,653 deaths [18].

In Brazil, until June 7, 2021, 396,140 cases of flu syndrome suspected of COVID-19 were reported in health professionals, 108,379 (27.4%) of which were confirmed. The health professions with the highest records were nursing technicians/auxiliaries (31,991; 29.5%), followed by nurses (18,250; 16.8%) and physicians (11,496; 10.6%). Of the 1,850 health professionals hospitalized with hospitalized severe acute respiratory syndrome, 498 (26.9%) died, the majority (479; 96.2%) due to COVID-19 [19].

We found that professionals who received training in the context of COVID-19 were more likely to use the necessary PPE to care for patients with COVID-19 and during procedures that generate aerosols. This

Table 4
Odds ratios for using the recommended PPE during procedures that generate aerosols in the care of patients diagnosed with COVID-19 (N = 12,086). Brazil, 2020

Variables	Use of recommended PPE in procedures that generate aerosols in the context of COVID-19							
	No ($n = 5,549$) *n* (%)	Yes ($n = 6,537$) *n* (%)	Crude odds	95% CI	p^*	Odds ratio	95% CI	p^*
Marital status								
Single/Divorced	2,698 (46.9)	3,056 (53.1)	1			1		
Married/Stable marriage	2,822 (45.1)	3,438 (54.9)	1.08	1.00–1.16	**0.04**	1.10	1.02–1.19	**0.008**
Widower	29 (40.3)	43 (59.7)	1.31	0.82–2.10	0.27	1.49	0.90–2.46	0.11
Region								
North East	1,654 (45.5)	1,984 (54.5)	1			1		
North	891 (50.1)	887 (49.9)	0.83	0.74–0.93	**<0.01**	0.90	0.80–1.01	0.08
Midwest	978 (46.0)	1,150 (54.0)	0.98	0.88–1.09	0.72	0.94	0.84–1.05	0.32
Southeast	1,559 (44.6)	1,934 (55.4)	1.03	0.94–1.13	0.48	1.04	0.94–1.15	0.38
South	467 (44.5)	582 (55.5)	1.04	0.90–1.19	0.59	0.92	0.79–1.06	0.26
Intensive Unit Care								
No	4,551 (49.7)	4,599 (50.3)	1			1		
Yes	998 (34.0)	1,938 (66.0)	1.92	1.76–2.10	**<0.01**	1.80	1.64–1.98	**<0.01**
Field Hospital								
No	4,101 (48.2)	4,411 (51.8)	1			1		
Yes	1,448 (40.5)	2,126 (59.5)	1.36	1.26–1.48	**<0.01**	1.17	1.08–1.28	**<0.01**
Professional category								
Nursing professional	3,799 (42.0)	5,240 (58.0)	**1**			1		
Physician	697 (53.7)	601 (46.3)	0.62	0.56–0.70	**<0.01**	0.60	0.54–0.68	**<0.01**
Physiotherapist	296 (44.2)	374 (55.8)	0.39	0.34–0.44	**<0.01**	0.65	0.55–0.77	**<0.01**
Psychologist	169 (90.4)	18 (9.6)	0.08	0.05–0.13	**<0.01**	0.07	0.04–0.12	**<0.01**
Speech therapist	37 (62.7)	22 (37.3)	0.43	0.25–073	**<0.01**	0.35	0.20–0.60	**<0.01**
Occupational therapist	30 (76.9)	9 (23.1)	0.22	0.10–046	**<0.01**	0.22	0.10–0.47	**<0.01**
Odontologist	93 (38.8)	147 (61.3)	1.14	0.88–1.49	0.31	1.37	1.05–1.80	**0.02**
Other	428 (77.3)	126 (22.7)	0.21	0.17–0.26	**<0.01**	0.21	0.17–0.26	**<0.01**
COVID-19 diagnosis								
No	3,823 (46.5)	4,399 (53.5)	1			1		
Yes	1,726 (44.7)	2,138 (55.3)	1.08	1.00–1.16	0.06	1.04	0.95–1.12	0.46
Received training								
No	1,994 (55.7)	1,588 (44.3)	1			1		
Yes	3,555 (41.8)	4,949 (58.2)	1.74	1.62–1.89	**<0.01**	1.47	1.35–1.60	**<0.01**
Has the institution you work for provided enough PPE?								
No	442 (66.4)	224 (33.6)	1			1		
Yes	3,612 (41.5)	5,099 (58.5)	2.78	2.36–3.29	**<0.01**	1.57	1.29–1.92	**<0.01**
Somewhat	1,495 (55.2)	1,214 (44.8)	1.60	1.34–1.91	**<0.01**	1.14	0.93–1.41	0.18
Did the institution you work with provide good quality PPE?								
No	821 (63.2)	478 (36.8)	1			1		
Yes	2,653 (40.5)	3,892 (59.5)	2.52	2.23–2.85	**<0.01**	1.82	1.56–2.11	**<0.01**
Somewhat	2,075 (48.9)	2,167 (51.1)	1.79	1.58–2.04	**<0.01**	1.51	1.30–1.76	**<0.01**

Note: 95% CI: 95% confidence intervals. *Statistically significant $p < 0,05$.

evidence supports the statement that training in the proper technique for placing and removing PPE minimizes technical errors, a fact that implies a reduction in the risk of contamination for health professionals [17, 20]. The Intensive Care Society of Australia and New Zealand recommended that only personnel trained in the use of PPE should care for patients with COVID-19 [21].

The present results indicated that professionals working in the ICU were also more likely to use the necessary PPE in the two investigated contexts. A cross-sectional, multicenter, survey-type study identified that intensivists reported being in compliance with the World Health Organization's recommendations to limit the use of N95 type face masks only in aerosol-generating procedures in 38% of the ICUs (88/231), while 59% (136/231) used them routinely. Masks were not used in of the ICU (7/231) [22]. Another investigation conducted on the web with 2,711 ICU healthcare professionals noted that for routine care, the majority (1,557, 58%) reported the use of N95 or FFP2 type face breathing masks [6].

Also observed as factors associated with the use of the recommended PPE were the availability of these equipment in quantity and quality by the work institutions. These findings are corroborated by a survey carried out among Latin American countries that indicated that health professionals faced difficulties in accessing basic items for personal protection such as N95-type respiratory masks, face shields and waterproof long-sleeved gowns [23]. Another study with 2,711 health professionals showed that 1,402 (52%) reported that some type of PPE was not available at some point during care activities, and 817 (30%) reported reuse of single-use PPE. It is noteworthy that before evaluating the recommended PPE, it is necessary that health institutions provide equipment in adequate quantity and quality [24].

The study contributed to clinical practice as it documents the use of PPE by a large number of professionals from all regions of an important Latin American country, with Brazil being the third country in number of COVID cases and the second with the highest number of cases. deaths. In addition, idenfying factors associated with the use of PPE can facilitate the establishment of measures aimed at the group of professionals who do not use the recommended PPE.

The limitation of this study is related to online data collection, which can be difficult, as potential participants may have restrictions on internet access and use. Thus, there may have been an overrepresentation of qualified professionals in the use of computers and social networks. The cross-sectional methodological design of the present research, which does not allow the establishment of cause and effect relationships, is also a limitation.

5. Conclusion

Most Brazilian health professionals (69%) used PPE recommended for the care of patients suspected or diagnosed with COVID-19, the associated factors being providing care in the ICU or in a field hospital, receiving training, the institution provide sufficient and quality PPE and be a dentist compared to a nursing professional. In addition, professionals from the South region are 35% less likely to use the recommended PPE compared to patients from the Northeast region. Regarding the use of PPE recommended for procedures that generate aerosols in the context of COVID-19 54.1% of them did it, the associated factors being being married or in a stable relationship compared to a single/divorced professional, working in the ICU, receiving training, the institution to provide sufficient and quality EPI and to be a dentist compared to a nursing professional.

We conclude that the recommended PPE usage rates are low and that different factors interfere with PPE usage. There is still a need for an investment by government and health institutions in the supply of PPE in quantity and quality, as well as in the training of professionals, with a view to ensuring the safety of health professionals.

Ethical approval

The project was approved by the Research Ethics Committee by University of São Paulo, opinion number 4,258,366.

Informed consent

All participants signed the free and informed consent form prior to enrollment.

Conflict of interest

None to report.

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