

AVAILABILITY OF PERSONAL PROTECTIVE EQUIPMENT IN THE
CONTEXT OF COVID-19 IN MINAS GERAIS - BRAZIL

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Highlights: 1. Proper use of PPE protects against exposure to infection in the workplace. 2. Most participants reported the availability of gloves, masks and goggles. 3. The unavailability of PPE can increase the risk of occupational exposure.

PRE-PROOF

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ABSTRACT

Objective: to verify the availability of personal protective equipment (PPE) among health professionals working in the context of the Covid-19 pandemic in Minas Gerais/Brazil.

Method: cross-sectional study conducted with health professionals regardless of the level of care in Minas Gerais. It includes a questionnaire prepared by the authors containing the categorization of professionals and availability of PPE. Data were collected through an online form hosted on the Kobotoolbox software. The associations between the variables were verified using the chi-square test and the prevalence ratio was evaluated. **Results:** 397 health professionals participated in the study, of which 193 were physiotherapists (48.6%), 121 nurses (30.5%), 60 technicians/nursing assistants (15.1%) and 23 physicians (5.8%). PPE was available "always as recommended" for gloves, 323 (81.4%); surgical masks, 321 (80.9%); N95 masks, 267 (67.3%), and protective glasses, 248 (62.5%). Physiotherapists had a higher prevalence of unavailability of gloves (PR=1.268; $p<0.001$), masks (PR=1.106; $p=0.027$) and goggles (PR=1.187; $p=0.018$) when compared to other professionals. Gloves were reported as more available by nurses (PR= 0.861; $p = 0.002$) and nursing technicians (PR= 0.831; $p = 0.001$) when compared to other professionals. Nursing technicians reported greater availability of glasses (PR = 0.803; $p = 0.019$) and N95 masks (PR = 0.833; $p = 0.031$) when compared to other workers. **Conclusion:** The unavailability of PPE, even if reported by a small portion of the participants, may increase the risk of exposure of professionals during direct patient care.

Keywords: Personal Protective Equipment, Health Personnel, Covid-19

INTRODUCTION

In December 2019, the world was faced with cases of a respiratory disease that would become known as Covid-19¹⁻³. In March 2020, Covid-19 was characterized as a pandemic by the World Health Organization (WHO)¹⁻³. Regarding global data, as of February 19, 2023, 757 million confirmed cases of Covid-19 had been recorded, including 6,850,594 deaths reported to WHO⁴. In the same period, regarding data from Brazil, more than 36 million cases were confirmed and 698,056 deaths were confirmed⁴. In the state of Minas Gerais, until February 2023, more than 4 million confirmed cases and around 65 thousand deaths were reported⁵, which highlights the relevance of the state in the national context.

The SARS-CoV-2 virus, which is responsible for Covid-19 in humans, is mainly transmitted through contact with respiratory droplets from infected people⁶. Controlling the spread included measures such as social isolation, hand hygiene and the adequate use of personal protective equipment (PPE), especially among healthcare workers to increase protection against exposure to the virus in the workplace^{7,8}. The increase in the number of people infected by Covid-19 required efforts to ensure that health teams were supplied with the necessary materials to fight the virus pandemic⁷.

As for health professionals, according to the WHO, 6,643 deaths of health professionals affected by Covid-19 were reported, but there may be underreporting of this data⁹. In Brazil, deaths were reported of 622 physicians and 872 nursing professionals^{10,11}. In Minas Gerais, until April 2021, 26,742 infected professionals were reported and 1,804 health professionals died in the state in the same period¹².

Due to the increased demand for PPE to assist people infected by Covid-19, the risk of shortages was a global concern¹³⁻¹⁴, culminating in specific use recommendations for contingency situations¹⁵. Therefore, it was necessary to evaluate the availability of PPE in the context of Covid-19 in Minas Gerais, as it is the Brazilian state with the largest number of cities, with a population of more than 21 million inhabitants and with a significant epidemiological contribution to the national scenario, in terms of the number of cases and deaths.

Therefore, ensuring access to recommended PPE for workers in adequate quantity and quality is the responsibility of the health institution, whether public or private. These institutions also have an obligation to provide training, supervision of the appropriate use and necessary replacement of these PPE^{3,8}. Despite the epidemiological context of international interest and the imminent risk of shortages experienced, few studies have focused on evaluating the availability of PPE. Thus, the present study aimed to verify the availability of personal protective equipment (PPE) among health professionals in the context of Covid-19 in Minas Gerais, Brazil.

METHODOLOGY

Design

Descriptive cross-sectional study. STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) and CHERRIES (Checklist for Reporting Results of Internet E-Surveys) checklists were used for the presentation of the results of this study.

Study location and period

Health professionals from the State of Minas Gerais participated in the study. Data was collected online between November 2020 and June 2021.

Population or sample

This is a convenience sample. Health professionals from the following occupations were considered potential participants for the study: Nurses, Nursing Technicians and Assistants, Physiotherapists and Physicians. As for the health professionals registered in the State of Minas Gerais, the numbers of professionals by occupation follow, in descending order: Nursing technicians and assistants come first with 167,176, followed by Physicians 48,606, Nurses 60,566 and, lastly, Physiotherapists, with 29,476 16–18^{16–18}. The final sample consisted of 397 participants.

Inclusion and exclusion criteria

The following inclusion criteria were considered: being a nursing technician or assistant, physician, nurse or physiotherapist; providing direct assistance to patients with suspected or confirmed Covid-19; and developing work activities in the state of Minas Gerais, at different levels of health care. Exclusion criteria were not adopted because: a) the data collection period was broad (between November 2020 and June 2021; and b) Online data collection did not make it possible to verify whether or not the worker was on leave at the time they answered the questionnaire. It should be noted that the fact that a professional was active in the health service or away when they answered the questionnaire did not prevent them from being able to share their experiences regarding the (un)availability of PPE in the context of care to individuals with Covid-19.

Study protocol

The results of this investigation are part of the study “Evaluation of the risk of exposure of healthcare professionals and the availability of personal protective equipment in the context of COVID-19”. This study is in the development phase and its main objective was to characterize the risk of exposure of healthcare professionals in the context of COVID-19 in the State of Minas Gerais. Due to the importance of PPE for preventing contamination among healthcare workers, it was necessary to know the availability of PPE in this context.

The variables were obtained through participants' responses to an online form developed by the researchers, including the categorization of professionals and the availability of PPE. In order to avoid possible sources of bias, the form was restricted to only one response per IP address to avoid duplication of responses from the same participant. Also, the selection protocol was carried out in a uniform manner, regardless of the participant's professional occupation or workplace.

The availability of PPE was assessed using a Likert scale containing the response options “always, as recommended”, “most of the time”, “occasionally” and “rarely” for the items: a) procedure gloves, b) surgical masks, c) protective glasses or face shield, d) N95/PPF2 face masks or similar. These PPE were listed in the study because they are items sought after by the general population, which could further impact the risk of shortages.

For online data collection, the Kobotoolbox software was used, which allows the construction of forms to be completed online, facilitating the data collection process and avoiding typing bias. The invitation to participate was made through advertising on the social networks Facebook (<https://www.facebook.com/riscocovid>) and Instagram (@riscocovid). The content of the publications on social networks was generated by two undergraduate students and one master's student and reviewed by the research coordinator. The periodicity of publications was defined as three times a week until the completion of data collection.

E-mails were sent to state and municipal health departments, professional councils, medical-hospital health institutions and scientific societies in the specialties of the professionals involved in the study to publicize the research. In response to this action, the Minas Gerais Regional Nursing Council - COREN-MG, through a publication, publicized the study, providing the access link on the aforementioned council's page. In turn, CREFITO-MG sent an

individual email to all registered participants. Another strategy used in the study was adapted from the Respondent Driven Sampling (RDS)¹⁹ method in which a participant recruits other individuals and receives a reward for doing so. The first participants identified by the researchers were invited to recruit new potential participants. This strategy was replicated by the subsequent participants, promoting an expansion in “waves” of people recruited. Those who recommended new contacts received a certificate of collaboration in data collection as a reward. To operationalize this strategy, health workers were approached via Whatsapp to share a standardized invitation text with the link to the research questionnaire²⁰.

In addition to the strategies described, the research website was created (<https://www.ufjf.br/riscocovid/>), which provides information about the study, as well as an invitation to participate and an access link for those who visit the page.

Analysis of results and statistics

The data were organized in the Excel for Windows software, processed and statistically analyzed with the aid of the Statistical Package for Social Sciences (SPSS), version 29. Absolute and percentage frequency of categorical data were evaluated and measures of central tendency were used to describe continuous data. To evaluate the association between dependent (PPE availability) and independent (professional occupation) variables, chi-square test was performed and $p \leq 0.05$ was adopted. The prevalence ratio and 95% confidence interval were verified.

Ethical aspects.

The participants were asked to read the free and informed consent form (ICF) and were told that their anonymity would be ensured during the dissemination of the study. As this was an online data collection, participants had access to the ICF through an access link for downloading the consent form, and expressed their agreement to participate in the study in an online form.

The requirements of Resolution No. 466/2012, of the National Health Council, on research with human subjects, were observed. The project was previously assessed by the Human Research Ethics Committee of Universidade Federal de Juiz de Fora and was approved under Protocol No. 4,031,046.

RESULTS

The present study involved 97 health professionals. Regarding their professional occupation, there was a prevalence of physiotherapists (48.6%). The professional occupation of the participants is shown in Table 1.

Table 1. Professional occupation of the participants (n=397). Minas Gerais, Brazil, 2021

Professional occupation	n	%
Physiotherapist	193	48.6
Nurse	121	30.5
Nursing Technician/Assistant	60	15.1
Physician	23	5.8

Regarding the availability of PPE, the predominant response pattern was “Always as Recommended”, with gloves being the most available PPE (81.4%). The availability of PPE reported by participants is described in Table 2.

Table 2- Availability of PPE for healthcare professionals (n=397). Minas Gerais, Brazil, 2021

PPE	Always, as Recommended	Mostly	Occasionally	Rarely
Gloves	323 (81.4%)	51 (12.8%)	9 (2.3%)	14 (3.5%)
Surgical Masks	321 (80.9%)	54 (13.6%)	11 (2.8%)	11 (2.8%)
N95 Mask	267 (67.3%)	73 (18.4%)	22 (5.5%)	32 (8.1%)
Protective Glasses	248 (62.5%)	79 (19.9%)	32 (8.1%)	38 (9.6%)

Legend: PPE = Personal protective equipment

Physiotherapists had a higher prevalence of unavailability of gloves ($p < 0.001$), masks ($p = 0.027$) and protective glasses ($p = 0.018$) compared to the other professionals. Gloves were reported to be more available to nurses ($p = 0.002$) and nursing technicians ($p = 0.001$) compared to other professionals. Nursing technicians reported greater availability of glasses ($p = 0.019$) and N95 masks ($p = 0.031$) compared to the other workers (Table 3).

Table 3- Association between professional occupation and availability of personal protective equipment (n=397). Minas Gerais, Brazil, 2021

Variable	Glove		Mask		Goggles		N95		
	no n (%)	yes n (%)	no n (%)	yes n (%)	no n (%)	yes n (%)	no n (%)	yes n (%)	
Physiotherapist	No	19 (9.3)	185 (90.7)	31 (15.2)	173 (84.8)	66 (32.4)	138 (67.6)	61 (29.9)	143 (70.1)
	Yes	55 (28.5)	138 (71.5)	45 (23.3)	148 (76.7)	83 (43.0)	110 (57.0)	69 (35.8)	124 (64.2)
	PR (CI 95%)	1.68 (1.148 – 1.401)		1.106 (1.004 – 1.219)		1.187 (1.016 – 1.386)		1.091 (0.950 – 1.253)	
	<i>p</i> -value	<0.001		0.027		0.018		0.128	
Nursing technician or assistant	No	71 (21.1)	266 (78.9)	67 (19.9)	270 (80.1)	134 (39.8)	203 (60.2)	117 (34.7)	220 (65.3)
	Yes	3 (5.0)	57 (95.0)	9 (15.0)	51 (85.0)	15 (25.0)	45 (75.0)	13 (21.7)	47 (78.3)
	PR (CI 95%)	0.831 (0.767 – 0.900)		0.943 (0.837 – 1.062)		0.803 (0.678 – 0.952)		0.833 (0.714 – 0.972)	
	<i>p</i> -value	0.001		0.244		0.019		0.031	
Nurse	No	62 (22.5)	214 (77.5)	59 (21.4)	217 (78.6)	108 (39.1)	168 (60.9)	92 (33.3)	184 (66.7)
	Yes	12 (9.9)	109 (90.1)	17 (14.0)	104 (86.0)	41 (33.9)	80 (66.1)	38 (31.4)	83 (68.6)
	PR (CI 95%)	0.861 (0.789 – 0.939)		0.915 (0.832 – 1.006)		0.921 (0.785 – 1.079)		0.972 (0.839 – 1.125)	
	<i>p</i> -value	0.002		0,056		0.189		0.399	
Physician	No	70 (18.7)	304 (81.3)	71 (19.0)	303 (81.0)	139 (37.2)	235 (62.8)	120 (32.1)	254 (67.9)
	Yes	4 (17.4)	19 (82.6)	5 (21.7)	18 (78.3)	10 (43.5)	13 (56.5)	10 (43.5)	13 (56.5)
	PR (CI 95%)	0.984 (0.811-1.194)		1.035 (0.830 – 1.291)		1.112 (0.770 – 1.604)		1.202 (0.834 – 1.731)	
	<i>p</i> -value	0.567		0.459		0.345		0.183	

Legend: PR = prevalence ratio; CI = confidence interval

DISCUSSION

Availability of PPE must be ensured immediately for healthcare professionals^{3,8}. In the Covid-19 pandemic, this situation has become an aggravating factor due to the rapid spread of the virus, which may have contributed to the high number of infected professionals²¹ and deaths of workers caused by this new virus^{9,10}. One of the priorities of health services should be to ensure the supply of high-quality PPE to health professionals, as well as training care teams in the correct use of this equipment^{3,8}.

The use of PPE in healthcare in the pandemic context is an absolute measure. Misuse or scarcity of these items directly impacts the risk of contamination²². In a study carried out in Latin America, including Brazil, Colombia and Ecuador, approximately three quarters of the participants mentioned the unavailability of resources necessary to carry out their functions of adequately caring for patients with Covid-19²³. It should be noted that PPE such as masks, gloves, personal protective glasses, among others, are recommended internationally and must be suitable for each country and each epidemiological situation^{2,15}. The personal protective equipment to be made available to healthcare workers must be in adequate condition, and actions should be implemented to ensure the optimization of its correct use, in compliance with the most current guidelines developed based on epidemiological evolution⁸.

PPE, equipment that must be available to healthcare workers, cannot be missing during their care for patients³. Studies developed in the context of the pandemic, however, revealed a challenging scenario, confirming the shortage of PPE in that period^{13-14,23}. In Brazil, a high mortality rate was observed among healthcare professionals affected by Covid-19, characterizing a high-risk situation for healthcare professionals in this context^{10,24}.

In a cross-sectional survey carried out in Brazil, health professionals referred to the scarcity of some type of PPE in the institution (50.1%), especially N95/PPF2 (37.1%) or surgical masks (29.9%), and face shields /glasses (2.4%)²⁵. A multicenter study carried out in Latin America highlighted the shortage of PPE such as N95 masks (55.5%) and face shields (52.6%) reported by participants²³. The present study obtained results that reflect greater availability of PPE, gloves and surgical masks compared to the studies mentioned.

Regarding professional occupations, there was a difference in the reported availability of PPE, with better results among nursing technicians. It is believed that this finding is explained by the

specific characteristics of the tasks and duties performed by workers in this occupation, highlighting their direct and continuous contact with patients, intrinsic to their work²⁶. It should be noted that the data analyzed are a reflection of the perception of the study participants, and no objective data were obtained, which may be another explanation for the differences identified between the professional occupations.

In the context of Covid-19, patients who are less resistant to the disease require the healthcare team to carry out more invasive procedures. Physiotherapists play an important role in the management of airways, working to restore lung functions, in addition to being involved in preserving the muscular conditions of these patients, which requires direct contact with them²⁷. In this context, the use of PPE is essential for the safety of these professionals.

The limitations of this study are associated to its cross-sectional design, because it would be difficult to establish a cause-effect relationship of PPE shortage. Furthermore, data was collected during the Covid-19 pandemic, one of the most challenging periods in recent history, with its own characteristics, and which will not be repeated. Thus, replication of the study is not possible. Nevertheless, it is believed that the present study can offer insight to managers and institutions into the development of protocols for ensuring the safety of the workers, as well as a basis for critical reflection on the working conditions of health professionals in higher risk contexts.

FINAL CONSIDERATIONS/CONCLUSION

According to the study, PPE was not made available throughout the entire period of time health professionals worked during the Covid-19 pandemic. The unavailability of PPE, although mentioned by a small percentage of participants, may increase the risk of exposure of these professionals during direct patient care. Based on these findings, it is evident the need to implement strategies focused on material provision and forecasting measures, including in emergency conditions such as pandemic situations. Furthermore, it is essential to delve into the origin of gaps in the institutional implementation of professional protection measures and carry out interventions that provide a safe work environment.

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