

RESEARCH ARTICLE (ORIGINAL) 

COVID-19 protective measures from the perspective of health professionals: Cross-sectional and analytical study

Medidas de proteção contra COVID-19 sob ótica dos profissionais de saúde: Estudo transversal e analítico
Medidas de protección contra el COVID-19 desde la perspectiva de los profesionales sanitarios: Un estudio transversal y analítico

Bianca Fontana Aguiar ¹ <https://orcid.org/0000-0001-9054-8245>Leila Maria Mansano Sarquis ¹ <https://orcid.org/0000-0002-0542-5062>Silviamar Camponogara ² <https://orcid.org/0000-0001-9342-3683>Maria de Fátima Mantovani ¹ <https://orcid.org/0000-0001-7961-8273>Fernanda Moura D'Almeida Miranda ¹ <https://orcid.org/0000-0001-7140-9557>¹ Federal University of Paraná, Curitiba, PR, Brazil² Federal University of Santa Maria, Santa Maria, RS, Brazil**Abstract****Background:** The use of protective measures by health professionals may be associated with COVID-19 prevention.**Objective:** To analyze how health professionals use COVID-19 protective measures in a hospital complex in a Brazilian capital city.**Methodology:** Descriptive, analytical, cross-sectional study with a quantitative approach. The sample consisted of health professionals working in the fight against COVID-19. Data were collected through an online interview, with a structured questionnaire on their socio-occupational profile and use of COVID-19 protective measures. Data were analyzed through descriptive statistics, Chi-square and Fisher's exact tests, and odds ratio.**Results:** Of the 104 participants, 57.7% were nurses, 66.7% had training in COVID-19 prevention at the workplace and tested negative for COVID-19 ($p = 0.006$), 59.2% reported availability and use of personal protective equipment ($p = 0.05$) and were not infected; 37.5% of professionals who used protective measures in aerosol-generating procedures tested negative for COVID-19.**Conclusion:** Protective measures reduced health professionals' exposure to the risks of COVID-19 infection.**Keywords:** pandemic; COVID-19; professional practice; health behavior; occupational health; health personnel**Resumo****Enquadramento:** A utilização de medidas de proteção por profissionais de saúde pode estar associada à prevenção do risco de contaminação pela COVID-19.**Objetivo:** Analisar o uso de medidas de proteção por profissionais de saúde contra COVID-19 num complexo hospitalar numa capital brasileira.**Metodologia:** Estudo transversal, descritivo, quantitativo e analítico, realizado com profissionais de saúde que trabalharam na luta contra COVID-19. A recolha de dados ocorreu através de entrevista online, com questionário estruturado sobre perfil sócio-ocupacional e medidas de proteção contra COVID-19. A análise foi com estatística descritiva, testes Qui Quadrado, exato de Fisher e odds ratio.**Resultados:** Dos 104 participantes, 57,7% eram enfermeiros, 66,7% participaram de capacitações de prevenção no trabalho e foram negativos para COVID-19 ($p = 0,006$), 59,2% reportaram disponibilidade e uso de equipamentos de proteção individual ($p = 0,05$) e não foram infectados; 37,5% dos profissionais que utilizaram medidas de proteção em procedimentos com aerossóis, testaram negativo para COVID-19.**Conclusão:** As medidas de proteção reduziram a exposição dos profissionais de saúde aos riscos de contaminação por COVID-19.**Palavras-chave:** pandemia; COVID-19; prática profissional; comportamentos relacionados com a saúde; saúde do trabalhador; pessoal da saúde**Resumen****Marco contextual:** El uso de medidas de protección por parte del personal sanitario puede estar asociado a la prevención del riesgo de contaminación por COVID-19.**Objetivo:** Analizar el uso de medidas de protección por parte de los profesionales sanitarios frente al COVID-19 en un complejo hospitalario de una capital brasileña.**Metodología:** Estudio transversal, descriptivo, cuantitativo y analítico, realizado con profesionales sanitarios que trabajaban en la lucha contra el COVID-19. La recogida de datos se realizó mediante entrevista en línea, con cuestionario estructurado sobre perfil sociolaboral y medidas de protección frente al COVID-19. El análisis se llevó a cabo con estadística descriptiva, pruebas chi cuadrado, exacta de Fisher y odds ratio.**Resultados:** De los 104 participantes, el 57,7% eran enfermeros, el 66,7% participaron en formación preventiva en el puesto de trabajo y dieron negativo en COVID-19 ($p = 0,006$), el 59,2% indicaron la disponibilidad y el uso de equipos de protección individual ($p = 0,05$) y no estaban infectados; el 37,5% de los profesionales que utilizaron medidas de protección en procedimientos con aerosoles dieron negativo en COVID-19.**Conclusión:** Las medidas de protección han reducido la exposición del personal sanitario a los riesgos de contaminación por COVID-19.**Palabras clave:** pandemia; COVID-19; práctica profesional; conductas relacionadas con la salud; salud laboral; personal de salud**Corresponding author**

Bianca Fontana Aguiar

E-mail: biancafoguiar@hotmail.com

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Introduction

In late 2019, the city of Wuhan, China, confirmed the first cases of pneumonia from a new strain of coronavirus, known as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), responsible for the coronavirus disease (COVID-19; Costa et al., 2022).

Given that the number of COVID-19 cases was increasing rapidly in several countries, including Brazil, the World Health Organization (WHO) declared the situation a global pandemic in March 2020 (WHO, 2020). Until April 2022, a total of 25,620,209 cases and 628,067 deaths due to COVID-19 had been reported in Brazil (Ministério da Saúde, 2022).

Moreover, until April 2022, around 61,127 nursing professionals had tested positive for COVID-19, and around 872 had died (Conselho Federal de Enfermagem, 2022). A study conducted in the northern region of Brazil in 2021 found a mortality rate of 0.6% among health professionals infected with COVID-19 (Campos & Leitão, 2021). It should be noted that Brazil had one of the highest mortality rates due to COVID-19 among health professionals, and nursing was the most affected area.

Given the high number of cases, COVID-19 had a direct impact on health services, affecting frontline professionals in the fight against the pandemic (Souza & Souza, 2020), most of whom were nurses who provided direct care to patients and were more exposed to the risk of COVID-19 infection.

Several health professionals became infected with COVID-19, demonstrating the importance of using protective measures to reduce and prevent new infections and creating a safe workplace for health professionals (Castro et al., 2021). Therefore, health professionals' adherence to appropriate protective measures reduces the risk of exposure to SARS-CoV-2 and minimizes the risk of infection (Ashinyo et al., 2020). In Brazil, during the critical period of the pandemic, there was a lack of resources and personal protective equipment (PPE) in health services, which increased health professionals' risk of infection.

Thus, this study aimed to analyze how health professionals use COVID-19 protective measures in a hospital complex in a Brazilian capital city.

Background

According to Hartmann et al. (2021), during the COVID-19 pandemic, health professionals were not only at risk of infection but also of transmitting the infection to patients, co-workers, family members, and the general population. This possibility decreased with the use of protective measures aimed at ensuring quality of life at work and the quality of care.

Protective measures include all measures to protect workers' health and safety, which health services must make available (Agência Nacional de Vigilância Sanitária, 2020a). They include PPE (gloves, goggles, face shields, face masks, head covers, shoe covers, and gowns) that

must be used during activities involving direct contact with suspected COVID-19 patients. Professionals must wash their hands before and after using this equipment and, if possible, use collective protective equipment such as negative pressure systems (Agência Nacional de Vigilância Sanitária, 2020b).

In an international study, Ashinyo et al. (2020) investigated the level of exposure and risk of COVID-19 virus infection among 408 healthcare workers, revealing that 80.4% had been exposed to the COVID-19 virus. However, despite the high exposure to the virus, only 14% were at high risk of infection, which meant that other healthcare workers adhered to appropriate protective measures.

These data reveal the importance of intensifying the use of protective measures in health services to reduce health professionals' risk of infection (Oliveira et al., 2021).

Health professionals should be aware of the importance of protective measures and use them adequately. To this end, health services should provide in-service training to minimize barriers that may influence the adherence to protective measures and the safety of health professionals fighting against COVID-19 (Carvalho et al., 2019) and other infectious agents.

Research question

What is the association between the COVID-19 protective measures used by health professionals and the occurrence of COVID-19?

Methodology

This descriptive, analytical, cross-sectional study with a quantitative approach was conducted at a university hospital complex in a capital city in southern Brazil.

The participants consisted of frontline health professionals fighting against the COVID-19 pandemic, namely assistant nurses or nurse technicians, nurses, physiotherapists, and physicians. The inclusion criteria were being assistant nurses or nurse technicians, nurses, physiotherapists, or physicians for at least 3 months, aged over 18 years, and working or having worked in a unit providing direct care to suspected or confirmed COVID-19 patients. Health professionals absent during data collection due to medical, parental, or vacation were excluded.

Based on information from the university hospital complex, 806 professionals worked in wards allocated to COVID-19 patients. The number suggested by sample calculation was 250 health professionals. Due to the critical conditions imposed by the COVID-19 pandemic in the capital city where the study was conducted, a nonprobability convenience snowball sampling technique was used, resulting in a total of 104 health professionals. Data were collected online between May and August 2021. Health professionals had their first contact with the research through internal news published in the institution's online newspaper or sent by email by the

institution's Teaching and Research Management Unit. The Informed Consent Form (ICF) was made available through Google Forms. Data were collected through a structured interview. The interview was recorded at a time and using a technological medium agreed upon by the researcher and the participant. In this phase, the researchers used the survey "Assessment of protective measures among health professionals in the fight against COVID-19" (*Avaliação de medidas de proteção entre profissionais de saúde no combate ao COVID-19*), which was based on WHO's *Risk assessment and management of exposure of health care workers in the context of COVID-19*. Adaptations consisted of new questions about participants' socio-occupational profile and occupational history. Given the urgency of research on this topic, the researchers decided to use the WHO instrument translated into Brazilian Portuguese, since the translation and validation of instruments require time and could compromise the results.

The survey consists of 41 questions divided into 10 items related to the socio-occupational profile, 19 questions related to the occupational history, and 12 questions on COVID-19 measures. The response options were rated on a Likert-type scale with different degrees of frequency (*always, as recommended; most of the time; occasionally; rarely; or never*).

After this step, data were organized and analyzed in Microsoft Excel® 2016 and then exported to the R environment (R Core Team, 2021). The variables of the socio-occupational profile were used to characterize the population. As for the variables corresponding to occupational history, occupational exposure, COVID-19 disease, and COVID-19 protective measures, an association was found between the occurrence of COVID-19 and the use of

protective measures.

Data were analyzed using descriptive statistics through the distribution of simple and absolute frequencies and using Chi-square and Fisher's Exact tests. Odds ratio (*OR*) was used as a measure of association, with a confidence interval of 95% ($p < 0.05$). They were presented in tables, with the collaboration of a professional statistician.

This research complied with the ethical principles, including the right to anonymity. The Research Ethics Committee of the University Hospital Complex approved the study (Opinion number 4.685.713 and CAAE: 37962720.5.0000.0096).

Results

Of the 104 health professionals who participated in this study, 57.7% ($n = 60$) were nurses, 84.6% ($n = 88$) were women, 58.7% ($n = 61$) were Caucasian, 77.9% ($n = 81$) had completed higher education, 75% ($n = 78$) commuted to work using their own transport, and 83.7% ($n = 87$) had no comorbidities. Their mean age was 35.8 years, and 42.3% ($n = 44$) were aged 30 to 39 years.

To characterize participants' socio-occupational profile related to COVID-19, a comparison was made between those who tested positive for COVID-19 (38.5%; $n = 40$) and those who tested negative (61.5%; $n = 64$). The age groups 30 to 39 years (31.8%; $n = 14$) and 40 to 49 years (46.7%; $n = 14$), with a mean age of 36.2 years, were those where more health professionals had COVID-19. With regard to occupation, 38.3% ($n = 23$) of nurses tested positive for COVID-19, and no physician tested positive (Table 1).

Table 1*Participants' socio-occupational profile related to COVID-19*

Socio-occupational profile	COVID-19 positive <i>n</i> = 40 <i>n</i> (%)*	COVID-19 negative <i>n</i> = 64 <i>n</i> (%)*	<i>p</i> -value	OR [95% CI]
Age group (years)				
18 - 29	7 (31.8)	15 (68.2)	-	Ref.
30 - 39	14 (31.8)	30 (68.2)	1	1 [0.33-3]
40 - 49	14 (46.7)	16 (53.3)	0.281	1.87 [0.59-5.91]
50 - 59	5 (62.5)	3 (37.5)	0.129	3.57 [0.66-19.34]
Gender				
Male	9 (56.2)	7 (43.8)	-	Ref.
Female	31 (35.2)	57 (64.8)	0.112	0.42 [0.14-1.25]
Race/Skin color				
White	23 (37.7)	38 (62.3)	-	Ref.
Black	5 (45.5)	6 (54.5)	0.627	1.38 [0.38-5.03]
Brown (<i>pardo</i>)	12 (37.5)	20 (62.5)	0.985	0.99 [0.41-2.4]
Education level				
Secondary education	10 (43.5)	13 (56.5)	-	Ref.
Higher education	30 (37)	51 (63)	0.575	0.76 [0.3-1.96]
Number of household members				
0				
1	8 (36.4)	14 (63.6)	-	Ref.
2	8 (27.6)	21 (72.4)	0.503	0.67 [0.2-2.19]
3 or more	8 (28.6)	20 (71.4)	0.558	0.7 [0.21-2.31]
	16 (64)	9 (36)	0.059	3.11 [0.94-10.25]
Ways to commute to work				
Ridesharing	3 (42.9)	4 (57.1)	-	Ref.
Public transport	5 (55.6)	4 (44.4)	0.614	1.67 [0.23-12.22]
Walking	2 (20)	8 (80)	0.309	0.33 [0.04-2.87]
Own transport	30 (38.5)	48 (61.5)	0.819	0.83 [0.17-3.99]
Comorbidities				
No	31 (35.6)	56 (64.4)	-	Ref.
Yes	9 (52.9)	8 (47.1)	0.18	2.03 [0.71-5.8]
Profession				
Nurse	23 (38.3)	37 (61.7)	-	Ref.
Assistant nurses or nurse technicians	16 (50)	16 (50)	0.281	1.61 [0.68-3.83]
Physiotherapist	1 (33.30)	2 (66.7)	0.862	0.8 [0.07-9.38]
Physician	(0.0)	9 (100)	0.023	-

Note. OR = Odds Ratio; CI = Confidence interval; Ref. = Reference; *n* and % = Absolute and relative frequencies.

* % of risk factor, sum of 100% in relation to the total of horizontal lines.

Concerning occupational history and COVID-19 infection by sector of activity, 72.2% (*n* = 26; *p* = 0.032) of health professionals who worked in other settings (e.g., operating room, obstetric center, skin care, imaging, maternity, neurology, pediatrics, and chemotherapy)

tested negative for COVID-19.

With regard to their exposure to confirmed COVID-19 patients, 62.5% (*n* = 5) of those who reported being partially safe in their workplace regarding the pandemic scenario became infected and were at increased risk for

COVID-19 (*OR* = 2.08 [0.3-14.55]). Moreover, 36.7% (*n* = 33) of health professionals who performed aerosol-generating procedures tested positive for COVID-19. Regarding the protective measures taken by the health facility during the COVID-19 pandemic, 66.7% (*n* = 60; *p* = 0.006) of the health professionals who tested negative

for COVID-19 reported that they had participated in pandemic-related training sessions at their workplace and had a lower risk of infection (*OR*: 0.2 [0.06-0.69]). Regarding the availability of PPE, 59.2% (*n* = 58) of health professionals who tested negative reported the availability and use of PPE at their workplace (*p* = 0.05; Table 2).

Table 2

Protective measures taken by the health facility during the COVID-19 pandemic

Protective measures	COVID-19 positive <i>n</i> = 40 <i>n</i> (%)*	COVID-19 negative <i>n</i> = 64 <i>n</i> (%)*	<i>p</i> -value	<i>OR</i> [95% CI]
Training				
No	10 (71.4)	4 (28.6)	-	Ref.
Yes	30 (33.3)	60 (66.7)	0.006	0.2 [0.06-0.69]
Promoted patient distancing				
No				Ref.
Yes	15 (42.9)	20 (57.1)	-	0.76 [0.33-1.74]
	25 (36.2)	44 (63.8)	0.512	
Promoted staff distancing				
No	15 (46.9)	17 (53.1)	-	Ref.
Yes	25 (34.7)	47 (65.3)	0.24	0.6 [0.26-1.41]
Ensured hand hygiene				
No	1 (25)	3 (75)	-	Ref.
Yes	39 (39)	61 (61)	0.573	1.92 [0.19-19.1]
Promoted the use of hand sanitizer				
No	0 (0)	1 (100)	-	Ref.
Yes	40 (38.8)	63 (61.2)	0.427	-
Provided PPE				
No	0 (0)	6 (100)	-	Ref.
Yes	40 (40.8)	58 (59.2)	0.05	-

Note. *OR* = Odds Ratio; CI = confidence interval; Ref. = Reference; PPE = Personal Protective Equipment; *n* and % = Absolute and relative frequencies.

* % of risk factor, sum of 100% in relation to the total of horizontal lines.

Regarding the use of protective measures to prevent COVID-19 infection, 100% (*n* = 7) of professionals reported occasional use of face shields or goggles/protective glasses compared to those who use always, as recommended (100%; *n* = 7), with significant differences (*p* = 0.038), as evidenced in Table 3. Regarding the use of PPE when performing aerosol-generating procedures, 37.5% (*n* = 36) of the professionals who perform it always as recommended had lower risk and tested negative for COVID-19 (*OR*: 1.67 [0.39-7.08]). As for the five moments for hand hygiene, 83.3% (*n* = 10) of those who reported performing it most of the time rather than always as recommended tested positive for COVID-19 (*p* < 0.001; *OR*: 10.89 [2.24-53.03]; Table 3).

nerating procedures, 37.5% (*n* = 36) of the professionals who perform it always as recommended had lower risk and tested negative for COVID-19 (*OR*: 1.67 [0.39-7.08]). As for the five moments for hand hygiene, 83.3% (*n* = 10) of those who reported performing it most of the time rather than always as recommended tested positive for COVID-19 (*p* < 0.001; *OR*: 10.89 [2.24-53.03]; Table 3).

Table 3

Adherence to protective measures

Protective measures	COVID-19 positive <i>n</i> = 40 <i>n</i> (%)*	COVID-19 negative <i>n</i> = 64 <i>n</i> (%)*	<i>p</i> -value	OR [95% CI]
Use of single-use gloves during interaction with a COVID-19 patient				
Always, as recommended	28 (41.8)	39 (58.2)	-	Ref.
Most of the time	9 (31)	20 (69)	0.32	0.63 [0.25-1.58]
Occasionally	2 (33.3)	4 (66.7)	0.687	0.7 [0.12-4.07]
Rarely	1 (50)	1 (50)	0.817	1.39 [0.08-23.23]
Use of face shields or googles/protective glasses during interaction with a COVID-19 patient				
Always, as recommended	26 (39.4)	40 (60.6)	-	Ref.
Most of the time	13 (48.1)	14 (51.9)	0.437	1.43 [0.58-3.52]
Occasionally	0 (0)	7 (100)	0.038	-
Rarely	1 (25)	3 (75)	0.566	0.51 [0.05-5.2]
Use of disposable gowns during interaction with a COVID-19 patient				
Always, as recommended	31 (42.5)	42 (57.5)	-	Ref.
Most of the time	6 (37.5)	10 (62.5)	0.715	0.81 [0.27-2.48]
Occasionally	2 (15.4)	11 (84.6)	0.064	0.25 [0.05-1.19]
Rarely	1 (50)	1 (50)	0.832	1.35 [0.08-22.51]
Remove and replace the PPE				
Always, as recommended	36 (36.7)	62 (63.3)	-	Ref.
Most of the time	4 (66.7)	2 (33.3)	0.143	3.44 [0.6-19.75]
Difficulty in wearing PPE				
Always, as recommended	12 (38.7)	19 (61.3)	-	Ref.
Most of the time	15 (33.3)	30 (66.7)	0.63	0.79 [0.31-2.05]
Occasionally	6 (50)	6 (50)	0.5	1.58 [0.41-6.06]
Rarely	5 (38.5)	8 (61.5)	0.988	0.99 [0.26-3.74]
Never	2 (66.7)	1 (33.3)	0.347	3.17 [0.26-38.84]
Perform the five moments for hand hygiene during interaction with a COVID-19 patient				
Always, as recommended				Ref.
Most of the time	28 (31.5)	61 (68.5)	-	10.89 [2.24-53.03]
Occasionally	10 (83.3)	2 (16.7)	< 0.001	4.36 [0.38-50.08]
	2 (66.7)	1 (33.3)	0.2	
Use of PPE when performing aerosol-generating procedures on a COVID-19 patient				
Always, as recommended				Ref.
Most of the time	36 (37.5)	60 (62.5)	-	1.67 [0.39-7.08]
	4 (50)	4 (50)	0.485	

Note. OR = Odds Ratio; CI = Confidence interval; Ref. = Reference; PPE = Personal Protective Equipment; *n* and % = Absolute and relative frequencies.

** % of risk factor, sum of 100% in relation to the total of horizontal lines.

Discussion

Most of the 104 health professionals who participated in this study were nurses, the largest professional group in Brazil. Nurses were among the most affected professionals during the pandemic because they provided direct care to infected patients during their hospitalization. However, other health professionals also tested positive. This study highlighted the importance of implementing measures to protect the safety of health professionals. In a cross-sectional study with 408 healthcare workers, the

majority of professionals infected with COVID-19 were registered nurses (39.5%), followed by medical doctors (6.9%; Ashinyo et al., 2020). Health professionals were exposed to poor working conditions due to the lack of human and material resources, increasing the risk of infection.

In this sample, 84.6% were women, corroborating the findings of a Brazilian study in which 80.5% of health professionals working during the pandemic were women (Oliveira et al., 2021). The presence of the female gender in fighting the pandemic is evidenced in a review by Mor-



gan et al. (2022). Moreover, women are also predominant in health professions.

The analysis of the association between the socio-occupational profile and COVID-19 infection showed that the mean age among health professionals who tested positive was 36.2 years. Similarly, a study conducted in Europe found that the mean age of health professionals infected with COVID-19 was 43 years (Piapan et al., 2022). These results show that most health professionals working during the pandemic were young. It should be noted that, in Brazil, health professionals with chronic non-communicable diseases, such as hypertension, diabetes mellitus, obesity, and asthma, and over 65 years old were not involved in face-to-face work activities.

These data confirm that frontline health professionals fighting against the pandemic are young adults, suggesting they are at the beginning of their careers. In Brazil, professionals have been encouraged to complete medical and nursing degrees with reduced workloads in the last years of training (Mata et al., 2021) to increase the workforce of young people in the fight against the pandemic. Another finding was that health professionals lived with at least one person. This factor increased their insecurity, stress, and anxiety due to the possible contamination of their families (Paes et al., 2021). Therefore, health professionals' mental health has become a major concern. In this study, 38.5% of health professionals had or had had COVID-19, suggesting that protective measures may not have been used correctly, either due to work overload or lack of human or material resources, resulting in contamination.

Another finding was that 36.7% of the health professionals who performed aerosol-generating procedures tested positive for COVID-19. It is known that aerosol-generating procedures contribute to the spread of SARS-CoV-2 and are a risk factor for health professionals working in intensive care units. The literature reports that healthcare workers who performed or were present during aerosol-generating procedures had a 23.8-fold increased risk of exposure to COVID-19 infection (Ashinyo et al., 2020). This information confirms the importance of protective measures and safe working conditions in the health professionals' workplace.

With regard to COVID-19 protective measures, health professionals who participated in training sessions about the pandemic in a hospital setting were less likely to become infected.

A study conducted in Wuhan (China) found reduced infection rates among healthcare workers who received training on protective measures and how to use them properly, among other relevant issues (Liu et al., 2020). Continuous training in healthcare services increases occupational health and safety and the quality of care.

With regard to the provision of PPE, 59.2% of the professionals who tested negative for COVID-19 reported that PPE were available at their workplace. However, some of these professionals also became infected, suggesting that they may have inadequately used some protective measures.

According to Morgan et al. (2022), some factors contributing to reducing the effective use of protective measures include difficulty finding PPE of the right size and the lack of information on the correct use of these materials, increasing the risk of infection.

A study conducted in Brazil showed that only 15.6% of health professionals considered themselves safe while using PPE during the pandemic, which increases the risk of infection (Oliveira et al., 2021). The risk of infection can also be influenced by poor working conditions and work overload that put health professionals in a situation of vulnerability.

With regard to the protective measures related to the use of PPE in aerosol-generating procedures, 37.5% of the health professionals who used them always as recommended tested negative, reinforcing the importance of using PPE. As for the five moments for hand hygiene, 83.3% of the professionals who reported performing them most of the time, rather than always as recommended, tested positive. Assefa et al. (2021) noted that 93.8% of the total sample of 96 health professionals were aware of the importance of hand hygiene, and 76% had good hygiene practices during patient care. Hand hygiene is necessary not only to prevent COVID-19 infection but also to minimize the risk of acquiring other infections and health issues. The limitations of this research include the unintentional and non-probability sampling technique and the sample size, which can be explained by the impossibility to reach the number suggested by sample calculation due to the pandemic.

Conclusion

This study analyzed the use of COVID-19 protective measures by health professionals, and its findings confirmed the association between adherence to protective measures and the occurrence of COVID-19.

It also found that health professionals showed higher adherence to the following protective measures against exposure to COVID-19 and other infections, including individual, collective, and organizational measures: health professionals' participation in the training provided by hospital services, the correct use and provision of PPE, mainly in aerosol-generating procedures, and the performance of hand hygiene.

Thus, implementing and adhering to protective measures can reduce health professionals' exposure to COVID-19, reducing the number of COVID-19 cases. However, although these measures have been known for decades, there is still resistance to using them. Therefore, investing in continuous in-service training is important to increase health professionals' adherence to protective measures. This research is relevant for health professionals and expected to contribute to improving professional practices, reinforcing the need to use protective measures in health services, and supporting the development of future research on adherence to measures for protecting workers' health.

Author contributions

Conceptualization: Aguiar, B. F., Miranda, F. M.
 Data curation: Aguiar, B. F., Miranda, F. M.
 Formal analysis: Aguiar, B. F., Sarquis, L. M., Camponogara, S., Mantovani, M. F., Miranda, F. M.
 Acquisition of funding: Miranda, F. M.
 Investigation: Aguiar, B. F., Miranda, F. M.
 Methodology: Aguiar, B. F., Sarquis, L. M., Camponogara, S., Mantovani, M. F., Miranda, F. M.
 Project administration: Aguiar, B. F., Miranda, F. M.
 Resources: Aguiar, B. F., Miranda, F. M.
 Software: Aguiar, B. F., Miranda, F. M.
 Supervision: Sarquis, L. M., Miranda, F. M.
 Validation: Aguiar, B. F., Sarquis, L. M., Camponogara, S., Mantovani, M. F., Miranda, F. M.
 Visualization: Aguiar, B. F., Sarquis, L. M., Camponogara, S., Mantovani, M. F., Miranda, F. M.
 Writing – original draft: Aguiar, B. F., Sarquis, L. M., Miranda, F. M.
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