

# Pressure injury related to the use of N95 mask in COVID-19 pandemic

**RESUMO** | Objetivo: avaliar o desenvolvimento de lesão por pressão em profissionais de saúde desencadeadas pelas máscaras de proteção individual N95, assim como avaliar o uso de barreiras de proteção usadas como interface para prevenção desse tipo de lesão. Método: Trata-se de um estudo transversal desenvolvido de julho de 2020 a julho de 2021. Para a coleta de dados, foi aplicado questionário para avaliar as particularidades da pele, desenvolvimento de lesão, classificação e os fatores de risco para seu desenvolvimento. Para análise estatística foi considerada a significância de  $p < 0,1$  e regressão logística múltipla. Resultados: Foram avaliados 85 profissionais, sendo que 91,8% destes apresentaram algum tipo de lesão. Conclusão: Conclui-se que a lesão por pressão relacionada ao uso de máscaras de proteção individual N95 apresentou alta ocorrência nessa população. E embora importantes, barreiras protetoras foram pouco utilizadas devido a questões financeiras da instituição.

**Descritores:** COVID-19; Lesão por pressão; Equipamento de Proteção Individual

**ABSTRACT** | Objective: to evaluate the development of pressure injuries triggered by N95 personal protective masks in health professionals, as well as to evaluate the use of protective barriers used as an interface to prevent this type of injury. Method: This is a cross-sectional study developed from July 2020 to July 2021. For data collection, a questionnaire was applied to assess the particularities of the skin, lesion development, classification and risk factors for its development. For statistical analysis, significance of  $p < 0.1$  and multiple logistic regression were considered. Results: Eighty-five professionals were evaluated, and 91.8% of them developed some type of injury. Conclusion: Pressure injuries related to the use of N95 personal protective masks were highly prevalent in this population. And although important, protective barriers were under-used due to financial issues in the institution.

**Keywords:** COVID-19; Pressure Injury; Personal Protective Equipment

**RESUMEN** | Objetivo: evaluar el desarrollo de lesiones por presión en profesionales de la salud desencadenadas por máscaras de protección personal N95, así como evaluar el uso de barreras protectoras utilizadas como interfaz para prevenir este tipo de lesiones. Método: Se trata de un estudio transversal desarrollado de julio de 2020 a julio de 2021. Para la recolección de datos se aplicó un cuestionario para evaluar las particularidades de la piel, desarrollo de la lesión, clasificación y factores de riesgo para su desarrollo. Para el análisis estadístico se consideró la significación de  $p < 0,1$  y la regresión logística múltiple. Resultados: Se evaluaron 85 profesionales, de los cuales el 91,8% presentaba algún tipo de lesión. Conclusión: Se concluye que las lesiones por presión relacionadas con el uso de máscaras de protección personal N95 fueron altamente prevalentes en esta población. Y aunque importantes, las barreras de protección fueron poco utilizadas por cuestiones financieras de la institución.

**Palabras claves:** COVID-19; lesión por presión; Equipo de protección individual

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**INTRODUCTION**

The first cases of COVID-19 (CoronaVirus Disease) were recorded in Wuhan, China. In December 2019, the World Health Organization (WHO) became aware of the outbreak of pneumonia in the city of Wuhan at a seafood and live animal market, identifying that the pneumonias were caused by a new type of coronavirus, called SARS Cov-2. (1-2)

In Brazil, the first confirmed case occurred on February 24 and the first death the following month, with an increase in community contamination of the disease, doubling the number of cases every three days, in addition to 4.6% of cases being lethal. (3) Due to the high infectivity rate of the virus and mode of transmission (4), the health team becomes susceptible to acquiring the disease if they do not correctly use personal protective equipment (PPE), which include a hat, visor, goggles, apron, gloves and respiratory protection and particulate respirator masks (type N95, N99, N100, PFF2 or PFF3). (5)

Respiratory protection masks type N95, as they are better known, should be used by healthcare professionals when performing procedures that may generate aerosols (dispersion of particles <5µm in the environment), such as: intubation, non-invasive ventilation (CPAP type, venturi mask), airway suction, cardiopulmonary resuscitation. (5) In addition, the Society of Intensive Medicine recommends the use of this

type of mask constantly in intensive care environments, making this discomfort even greater due to long periods of using PPE in the care of critically ill patients with COVID-19. (6)

Therefore, N95 masks can cause pressure injuries (PI) "related to medical device use", a relatively recent classification published by the NPIAP in 2016. (7) The PI caused by PPE comes from continuous pressure on specific bone prominences, such as the back of the nose and zygomatic bone, however, with the pandemic and the continuous use of N95 masks, PI by PPE have become more frequent and are still poorly known and studied. (8)

In this context, the guiding question of the study was formulated: "What are the factors related to the development of pressure injuries in health professionals due to the use of an N95 mask?".

**METHOD**

This is a cross-sectional study carried out at the Specialized Intensive Care Service (SICS) at Hospital das Clínicas linked to the Botucatu School of Medicine (HCFMB - Hospital das Clínicas vinculado à Faculdade de Medicina de Botucatu). The population coverage of this hospital is approximately 2 million people from 68 municipalities in its region in the interior of São Paulo and is a reference to the care of the COVID-19 pandemic.

After approval by the Research Ethics Committee of the Faculty of Medicine of Botucatu in June 2020 (CAAE: 33530520.3.0000.5411), data collection began in July 2020 and ended in July 2021.

The sample consisted of health professionals working in the ICU directly with suspected/confirmed patients (doctors, nurses, nursing technicians and physiotherapists), based on the inclusion and exclusion criteria. Inclusion: health professionals who used the N95 mask in their work shift; Exclu-

sion: professionals who did not remain fixed in the sector.

Data collection took place through a questionnaire developed by the authors containing the dependent or independent variables described below.

- Gender: female and male;
- Age: in years;
- Skin color (self-reference): white, yellow, brown, black;
- Skin appearance (according to the professional's report): dry, normal, oily or mixed;
- Pre-existing dermatoses (self-referred): acne, rosacea, contact dermatitis, and others;
- Use of sunscreen and which factor;
- Use of facial moisturizer, peeling/acid and facial soap;
- Work shift (day, night or mixed);
- Hours of permanence with the mask (maximum time) in the work shift;
- Hours of stay without the mask (maximum time) in the work shift;
- Use of protective barriers (polyurethane film, hydrocolloid, microporous tape, tape);
- Time of use of the chosen barriers;
- Skin changes in the researchers' assessment: reactive hyperemia, stage 1, stage 2 pressure injury (intact or ruptured blister), deep tissue injury, contact dermatitis, pruritus;
- Regions affected by PI: root of the nose, dorsum of the nose, wings of the nose, right or left zygomatic region, maxillary, mental, ears and cervical.

Each professional answered the questionnaire only once, always at the end of the shift. After completing the questionnaire, a skin assessment was performed by a nurse from the institution's dressing committee, where the professional was asked to remove the N95 mask, in a safe environment, to assess pressure points and the development of PI. In case of presence of PI, it was characterized as to the stage and region affected.

All professionals read and signed the Free and Informed Consent Form.

For statistical analysis, the collected data were entered into Excel spreadsheets and evaluated by a statistician from the University's Technical Support Section for Teaching, Research and Extension (STAEPE).

For analysis, data were grouped into white and yellow, black or brown skin tones, mixed or normal, oily or dry, age under 30 years and over 30 years. The same data were evaluated individually.

Descriptive statistics of the data were performed, and logistic regression was performed to verify the incidence of PI due to the use of N95 and its associations.

For correlations, statistical significance was considered if  $p < 0.1$ .

## RESULTS

The final sample comprised almost the entire team of professionals working in the ICU, totaling 85 individuals, including nurses, doctors, physiotherapists and nursing technicians.

Table 1 presents the profile of the professionals evaluated, being 76.5% female; 43.5% aged between 31 and 40 years; 46.4% work during the day and 52.9% are nursing technicians.

Table 2 presents the skin aspects of these professionals, with 68.2% being white, 50.6% oily skin and 63.5% having no pre-existing dermatitis. In addition, 71.8% use skin care products, 58.8% use sunscreen and 45.9% facial moisturizer.

Table 3 shows the time of use of N95 masks by professionals, with 50.6% of them using the N95 mask between 1 and 2 hours without performing pressure point relief, and 64.7% were only from 1 to 2 hours. 2 hours without wearing the mask on your work shift. Regarding the use of protective barriers, 72.9% did not use them, especially the employees who were evaluated in 2021.

**Table 1. Profile of health professionals working in the COVID-19 ICU (n=85). Botucatu, 2021.**

Variables	n	(%)
<b>Gender</b>		
Female	65	76,5
Male	20	23,5
<b>Age</b>		
20-30	31	36,5
31-40	37	43,5
41-52	17	20,0
<b>Function</b>		
Nurse	25	29,4
Physician	3	3,5
Nursing Technician	45	52,9
Physiotherapist	12	14,1
<b>Shift</b>		
Night	27	31,8
Day	42	49,4
Mixed	16	18,8

Source: Prepared by the authors, 2021.

**Table 2. Skin characterization of SICS health professionals (n=85). Botucatu, 2021**

Variables	n	(%)
<b>Color</b>		
White/White	58	68,2
Black/Brown	27	31,8
<b>Skin Aspect</b>		
Normal	25	29,4
Mixed	2	2,4
Oily	43	50,6
Dry	15	17,6
<b>Pre-existing Dermatitis</b>		
Yes	31	36,5
No	54	63,5
<b>Use of skin products</b>		
Yes	61	71,8
No	24	28,2
<b>Use of moisturizer</b>		
Yes	39	45,9
No	46	54,1
<b>Use of sunscreen</b>		
Yes	50	58,8

Regarding the skin assessment after the work shift (Table 4), 91.8% of the professionals had some type of injury due to the use of the device, evidencing reactive hyperemia in 83.5% of the cases, where the most affected site was the nasal region (74.1%).

**DISCUSSION**

After analyzing the data, it was evident that professionals from the nursing team such as nursing technicians (52.9%) and nurses (29.4%) made up the majority of the sample, a percentage similar to that of a study carried out in hospitals in Ceará.<sup>(9)</sup> Among the professionals evaluated, 50.6% and 17.6% considered themselves to have oily and dry skin, respectively, and these types of skin were more likely to have a lesion in the jaw region, with a p of 0.07.

Part of the health team (71.8%) used skin care products, with 45.9% using moisturizers, 58.8% sunscreen and 2.4% facial soap. In this sense, a study reported that the use of these skin products could be a prevention factor for PI due to the use of medical devices, but with the data collected there was no significance after multiple regression.<sup>(10)</sup>

In the current survey, 91.8% of professionals had some type of injury related to the use of devices, similar to the multicenter study carried out in China, in this research, 83.5% had reactive hyperemia, 2.4% had stage 1 and stage 2 LP and 1.2% had deep tissue damage, differing from this same study, where stage 1 lesions prevail, followed by reactive hyperemia. The most affected places in both studies are the nose 74.1%, followed by the zygomatic, places where N95 masks exert more pressure.<sup>(11)</sup>

There were also reports of injuries in the jaw, ear and neck, and after the statistical analysis it was observed that people with black/brown color and night workers are more predisposed to be

No	35	41,2
<b>Use of facial soap</b>		
Yes	2	2,4
No	83	97,6
<b>Peeling</b>		
Yes	6	5,1
No	79	94,9

Source: Prepared by the authors, 2021.

Table 3. Use of N95 masks and protective barrier. Botucatu, 2021.		
Variables	n	(%)
<b>Time with the N95 mask</b>		
<1 hour	7	8,2
1 – 2 hours	43	50,6
3 – 6 hours	22	25,9
7 – 9 hours	2	2,4
>10 hours	11	12,9
<b>Time without the mask</b>		
>6 hours	8	9,4
3 – 5 hours	11	12,9
1 – 2 hours	55	64,7
< 1 hour	10	11,8
<b>Use of protective barrier</b>		
Yes	23	27,1
No	62	72,9
<b>Use of protective barrier</b>		
Hydrocolloid	21	24,7
Polyurethane film	1	1,2
Microporous tape	1	1,2
Did not use	62	72,9

Source: Prepared by the authors, 2021.

Table 4. SICS health professionals' skin assessment (n=85). Botucatu, 2021		
Variables	n	(%)
<b>Incidence of injuries in professionals</b>		
No	07	8,2
Yes	78	91,8
<b>PI location</b>		
Nose	63	74,1
Zygomatic	39	45,9
Jaw	17	20,0

affected with injuries in the ear with p 0.073 and 0.116 respectively. It was not possible to relate these data to the literature due to the scarcity of articles on this topic.

Due to the pandemic and the scarcity of financial resources to purchase protective barriers, these measures were poorly adhered to, with only 27.1% used, where only 24.7% used hydrocolloid. The use of protective barriers, in particular, the hydrocolloid, has been reported by professionals who used it as relief of discomfort mainly in the nose, with greater ease of keeping the mask on for longer, without the need for relief. Studies with protective barrier guidelines indicate foams and hydrocolloids as interfaces for N95 masks to reduce pressure on bony prominences, mainly nose and zygomatic bone. (12-13)

Some correlations regarding the use of devices and their exposure could not be identified due to the limited number of individuals, which is a limitation of the study, as well as the performance of data collection in a single institution.

The literature lacks more information about pressure injuries in health professionals, with a lack of other studies for comparison.

The coronavirus pandemic exposed many aspects related to the work of nursing and the health team, especially for those who worked on the front line. Pressure injuries are one of the issues to be evaluated in this context, where the exposure of the team was one of the components of wear of these professionals.

**CONCLUSION**

Pressure injuries related to the use of N95 masks had a high occurrence in this population (91.8%), evidencing reactive hyperemia in 83.5% of the cases, where the most affected site was the nasal region (74.1%).

The profile of the professionals

Ears	19	22,4
Cervical	04	4,7
<b>Skin Assessment</b>		
Absence	07	8,2
Reactive hyperemia	71	83,5
Itching	02	2,4
PI stage 1	02	2,4
PI stage 2	01	1,2
Deep tissue injury	01	1,2
Contact dermatitis	01	1,2

Source: Prepared by the authors, 2021.

**Table 5. Multiple logistic regression to explain the occurrence of pressure injuries adjusted to the most strongly associated variables. Botucatu, 2021.**

Variable	RR*	CI 95%	p
Male gender	0,871	0,439 - 1,729	0,692
Age > 30 y/o	1,071	0,633 - 1,815	0,798
Black or brown skin	0,982	0,586 - 1,644	0,945
Oily or dry skin	1,125	0,672 - 1,883	0,654
Absence of pre-existing dermatitis			0,920
Contact dermatitis	0,836	0,313 - 2,229	0,720
Other dermatitis	1,034	0,607 - 1,763	0,902
Physicians or physical therapists	0,930	0,424 - 2,041	0,856
Day shift			0,885
Night shift	1,123	0,643 - 1,964	0,683
Mixed shift	1,152	0,578 - 2,296	0,687
>6 hours with the n95 mask	0,845	0,423 - 1,687	0,632
>3 hours without the mask	1,016	0,552 - 1,869	0,959
Use of protective barrier	1,129	0,345 - 3,693	0,841
>6h with protective barrier	0,980	0,278 - 3,448	0,974

\*RR: Relative Risk

Source: Prepared by the authors, 2021.

evaluated was female; age between 31 and 40 years; nursing technicians and working during the day. Regarding the characterization of the skin, 68.2% self-reported as being white, 50.6% oily skin and 63.5% did not have pre-existing dermatitis.

According to the time of mask use, 50.6% used the N95 mask between 1 and 2 hours without relief of pressure

points. Regarding the use of protective barriers, such as hydrocolloid, 72.9% did not use them due to the institution's lack of financial resources.

Therefore, the results of this study support the awareness of professionals and institutions about the risks and preventive measures, in fact, the first step towards the prevention of these occupational injuries.

## References

1. Rosa CJH, Posenato GL. Resposta imediata da Vigilância em Saúde à epidemia da COVID-19. *Epidemiol. Serv. Saúde* [Internet]. 2020;29(1):e2020002. <https://doi.org/10.5123/s1679-49742020000100021>
2. Guo Y, Huang YM, Huang J, Jin YZ, Jiang W, Liu PL, et al. COVID-19 pandemic: global epidemiological trends and China's subsequent preparedness and responses]. 2020 May 10;41(5):642-647. doi: 10.3760/cma.j.cn112338-20200301-00222.
3. Brasil. Ministério da Saúde. Boletim Epidemiológico 7 – COE Coronavírus – 06 de abril de 2020. Brasília: MS; 2020. Disponível em <https://portalarquivos.saude.gov.br/images/pdf/2020/Abril/06/2020-04-06-BE7-Boletim-Especial-do-COE-Atualizacao-da-Avaliacao-de-Risco.pdf>
4. Belasco AGS, Fonseca CD. Coronavírus 2020. *Rev Bras Enferm.* 2020;73(2):e2020n2. doi: <http://dx.doi.org/10.1590/0034-7167-2020730201>
5. Monteiro N, Aquino V, Pacheco S, Scheneiders L. Saúde anuncia orientações para evitar a disseminação do coronavírus. Brasil: Ministério da Saúde; 2020. Disponível em: <https://www.saude.gov.br/noticias/agencia-saude/46540-saude-anuncia-orientacoes-para-evitar-a-disseminacao-do-coronavirus>
6. World Health Organization (WHO). Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19): Interim guidance. Geneva: WHO; 2020. Disponível em: [https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPE\\_use-2020.1-eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPE_use-2020.1-eng.pdf)
7. National Pressure Ulcer Advisory Panel. National Pressure Ulcer Advisory Panel (NPUAP) announces a change in terminology from pressure ulcer to pressure injury and updates the stages of pressure injury. National Pressure Ulcer Advisory Panel Web. 2016.
8. Ramalho AO; Freitas PSS; Nogueira PC. Lesão por pressão relacionada a dispositivo médico nos profissionais de saúde em época de pandemia. *ESTIMA, Braz. J. Enterostomal Ther.*, 18: e0120; 2020. [https://doi.org/10.30886/estima.v18.867\\_PT](https://doi.org/10.30886/estima.v18.867_PT)
9. Carvalho REFL, Arruda LP, Nascimento NKP, Sampaio RL, Cavalcante MLSN, Costa ACP. Assessment of the culture of safety in public hospitals in Brazil. *Rev. Latino-Am. Enfermagem.* 2017;25:e2849. DOI: <http://dx.doi.org/10.1590/1518-8345.1600.2849>.
10. Moraes JT, Borges EL, Lisboa CR, Cordeiro DCO, Rosa EG, Rocha NA. Conceito e classificação de lesão por pressão: atualização do National Pressure Ulcer Advisory Panel. *Enferm. Cent. O. Min.* 2016 mai/ago; 6(2):2292-2306. <https://doi.org/10.19175/recom.v6i2.1423>
11. Lan J, Song Z, Miao X, Li H, Li Y, Dong L, et al. Skin damage among health care workers managing coronavirus disease-2019. *J Am Acad Dermatol.* 2020 May;82(5):1215-1216. doi: 10.1016/j.jaad.2020.03.014.
12. Ramalho, A. Lesões de pele relacionadas ao uso de equipamentos de proteção individual em profissionais de saúde: estratégias de prevenções frente a pandemia por covid 19, São Paulo, SOBEST, 2020.
13. Colodetti R, Garcia Romero Sipolatti W, de Oliveira Bringuento ME. Cobertura profilática para lesões por pressão na face dos profissionais de saúde durante a COVID-19. *Nursing* [Internet]. 17º de maio de 2021 [citado 8º de fevereiro de 2022];24(276):5700-13. <https://doi.org/10.36489/nursing.2021v24i276p5700-5713>