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Incidence of pressure injuries in critically ill patients with and without covid-19: study of Cohort

Incidência de lesão por pressão em pacientes críticos com e sem covid-19: estudo de Coorte

Incidencia de lesiones por presión en pacientes críticos con y sin covid-19: estudio de cohorte

Marina Raffin Buffon[a]
Isis Marques Severo[b]
Karina de Oliveira Azzolin[c]
Amália de Fátima Lucena[c]

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ABSTRACT

Objective: To compare the incidence, characteristics, and risk factors of pressure injuries among critically ill patients with and without Covid-19 in an intensive care unit.

Method: Retrospective cohort study in an intensive care unit by collecting data from electronic medical records of patients admitted in 2021**.** Sample of 302 patients, 151 with Covid-19 and 151 without Covid-19. Poisson's regression with robust variance and p <0.05 as a significant value was used to analyze the data.

Results: The incidence of pressure injuries in patients with Covid-19 was 60.3% and in those without Covid-19 were 35.8%. Stage 2 and the sacral region were predominant in both groups and patients with Covid-19 developed lesions earlier compared to those without Covid-19. An increase in pressure injuries was observed in patients with chronic diseases, on mechanical ventilation and in the prone position The clinical variables associated were "obesity,""Braden ≤ 12," and "sedation time."

Conclusion: The incidence of pressure injuries was higher in patients with Covid-19.The variables "obesity," "Braden ≤ 12," and "sedation time" were associated with pressure injuries, regardless of whether the patient had Covid-19 or not, corroborating risk factors for pressure injuries.

Descriptors: Coronavirus Infections. Pressure Ulcer. Intensive Care Units. Incidence. Risk Factors.

RESUMO

Objetivo: comparar a incidência e características de lesão por pressão entre pacientes críticos com e sem covid-19 em unidade de terapia intensiva, além de fatores de risco demográficos, clínicos e a carga de trabalho de enfermagem.

Método: Estudo de coorte retrospectivo em unidade de terapia intensiva. Foram coletados dados em prontuários eletrônicos de 302 pacientes internados em 2021, com (n=151) e sem covid-19 (n=151). Análise com Regressão de Poisson com variância robusta e $p < 0,05$ como valor significativo.

Resultados: A incidência de lesão por pressão em pacientes com covid-19 foi 60,3% e os sem covid-19 35,8%, *p-valor < 0,001*. O estágio 2 e região sacra foram predominantes em ambos os grupos e pacientes com covid-19 desenvolveram lesão mais cedo em comparação aos sem covid-19. Observou-se aumento de lesão por pressão em pacientes com doenças crônicas, em ventilação mecânica e posição prona. As variáveis clínicas associadas foram "Obesidade", "Braden ≤ 12" e "Tempo de sedação".

Conclusão: A incidência de lesão por pressão foi superior nos pacientes com covid-19. As variáveis "Obesidade", "Braden ≤ 12" e "Tempo de sedação" foram associadas à lesão por pressão, independentemente de o paciente ter ou não covid-19, corroborando fatores de risco para lesão por pressão.

Descritores: Infecções por coronavírus. Úlcera por pressão. Unidades de Terapia Intensiva. Incidência. Fatores de risco.

RESUMEN

Objetivo: Comparar la incidencia, las características y los factores de riesgo de las lesiones por presión entre pacientes críticos con y sin covid-19 en unidad de cuidados intensivos.

Método: Estudio de cohorte retrospectivo en una unidad de cuidados intensivos mediante la recopilación de datos de historias clínicas electrónicas de pacientes ingresados en 2021. Participaron 302 pacientes, de los cuales 151 estaban en el grupo covid-19 y 151 en el grupo sin covid-19. Se utilizaron la regresión de Poisson para analizar, con varianza robusta, y $p < 0,05$ como valor de significancia.

Resultados: La incidencia de lesiones por presión en pacientes con Covid-19 fue del 60,3% y en los que no tenían Covid-19 del 35,8%. La etapa 2 y la región sacra predominaron en ambos grupos y los pacientes con Covid-19 desarrollaron lesiones antes en comparación con aquellos sin Covid-19.

Conclusión: Se observó un aumento de las lesiones por presión en pacientes con enfermedades crónicas, con ventilación mecánica y en decúbito prono. Las variables clínicas asociadas a la presencia de las LP fueron "obesidad", "Braden ≤ 12" y "tiempo de sedación".

Descriptores: Infecciones por coronavírus. Úlcera por Presión. Unidades de Cuidados Intensivos. Incidencia. Factores de Riesgo.

[a] Universidade Federal do Rio Grande do Sul, Programa de Pós-Graduação em Enfermagem. Porto Alegre, RS, Brasil.

[b] Hospital de Clínicas de Porto Alegre, Porto Alegre, RS, Brasil

[c] Universidade Federal do Rio Grande do Sul, Escola de Enfermagem. Porto Alegre, RS, Brasil.

INTRODUCTION

It is known that in the intensive care unit (ICU), patients are more vulnerable to the incidence of pressure injury (PI) due to risk factors such as advanced age, use of invasive mechanical ventilation (IMV), use of vasoactive and/or sedative drugs, and immobility in bed[1].

The Covid-19 pandemic has caused a sudden and rapid increase in ICU hospitalizations of critically ill patients with complications such as acute respiratory distress syndrome (ARDS), vasculopathy, shock, and multiple organ failure that required complex interventions and technologies to support treatment, in addition to management and fast adaptations of health services and teams[2]. There was also an increase in the incidence of PI with changes in the characteristics of the injuries, their location and severity[3]. This may be related to the exposure of the patients to multiple risk factors such as potentially impaired nutrition in this patient profile and factors that were previously non-existent or very infrequent, such as those resulting from support therapies, such as the prone position maneuver[4].

International data suggest that up to 57% of patients in the prone position develop some pressure-related skin damage[5]. Furthermore, the physiological effects of Covid-19 include a cytokine storm, endothelial dysfunction, and ischemia, perpetuating other processes that are also associated with an increased probability of pressure injuries[6]. Patients are also affected by ischemia-reperfusion injury and acroischemia. Abnormal coagulation, one of the indicators of poor prognosis in critically ill patients with Covid-19, may also indicate soft tissue vulnerability, which affects the integrity of the skin, increasing pressure-related damage, with the potential masking of the underlying skin and the development of deep tissue PI[7]. Faced with this adverse scenario, the National Pressure Injury Advisory Panel (NPIAP) published a guide on the skin manifestations of Covid-19. The guide describes that microvascular occlusions caused by Covid-19 in tissue exposed to pressure and/or shear stress can increase the magnitude and severity of the non-modifiable risk to a level that cannot be overcome even with reasonable efforts to prevent PI, that is, changes in position and use of adequate support surfaces[8].

International studies reported an increase in the incidence of PI associated to the pandemic[3,9-10]. A study carried out in China, in a sample of 109 severe patients with covid-19 in the ICU, found that 46 (42.2%) of them developed PI and 16 (34.8%) had ischemic lesions[9]. Increase in stage 3 and 4 pressure injuries and deep tissue injuries were observed in a teaching hospital in the United Kingdom, in the early period of the pandemic compared with the period before the pandemic, with a reported 77% increase in this type of injury[3]. In the United States, another study with retrospective analysis compared the incidence of PIs during the first months of the pandemic with the pre-COVID-19 period, reporting a 14.9% increase in PIs and their higher severity[10].

Although recent international research[3,9-10] has described an increase in the number of PI cases and some studies have reported the severity of these injuries during the pandemic, it is still not sufficiently clear to what extent this is associated with the different risk factors to which critically ill patients with Covid-19 are subject, also considering external factors such as the workload of the nursing team.

In Brazil, the pandemic compromised and disrupted many health services, reducing the quality of care and leading to an increase in the incidence of PIs. Therefore, studies on the incidence and characteristics of these injuries in patients with Covid-19 compared to patients not affected by Covid-19, due to the change in the complexity profile of these patients, have become necessary. In the context of the pandemic, these studies would gain insight into the impact of these variables on the emergence of PIs, to plan interventions capable of improving care for patients with Covid-19 admitted to the ICU.

Therefore, the present study formulated the hypothesis that patients with Covid-19 admitted to the ICU are subject to different risk factors specific to this population, which increase the incidence of PI in a shorter period and with higher severity compared to patients admitted to the general ICU. The study therefore aimed to compare the incidence and characteristics of PI among critically ill patients with and without Covid-19 in the ICU, in addition to demographic and clinical risk factors and nursing workload.

METHOD

Type of study

A retrospective cohort study, with a quantitative approach, is based on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline[11].

Study site

The study was carried out in the adult intensive care unit (ICU) of a public teaching hospital in Rio Grande do Sul (RS), which is a reference in the care of highly complex patients, including patients with Covid-19.

Data collection

Data collection was performed by the researchers in 2022 and, through electronic medical records, data were collected from patients admitted between March and July 2021. This period was chosen because it was the peak of the second wave of the pandemic in Brazil, with an increase in the number of cases in ICUs and a change in the profile of affected patients[12]. In March 2021, the ICU of the hospital where the study was conducted had 105 beds for Covid-19 patients, divided into clusters.

Eligibility criteria

Monitoring began upon patient admission and development of stage 2 PI and verification of changes in PI stage until patient discharge or death, with no maximum follow-up period considered. The inclusion criteria were: patients aged 18 years or over, of both genders, hospitalized for at least 24 hours at the Covid-19 ICU, with SARS-CoV-2 infection confirmed by the RT-PCR test; and patients without Covid-19 admitted to general ICU, for at least 24 hours. Patients with PI at the time of admission and patients with stage 1 PI were not included in the sample. PI stage 1 was not included due to the similarity with dermatitis, which could result in inaccurate data. Three patients without Covid-19 who had hospital PI at the time of admission and seven patients who did not authorize the use of their data for research purposes were excluded from the study. These patients were excluded before the sample of 302 patients was totaled.

Population and sample

To calculate the study's sample size, the authors based themselves on the findings in the literature on the incidence of PI in ICUs[1]. The sample size was calculated to detect differences between the incidence proportions of PI among patients with and without Covid-19, using the PSS Health tool, online version. A power of 80%, a significance level of 5% and an incidence proportion of 35% of PI in patients with Covid-19 and 20% of PI in patients without COVID-19 were considered, as well as 20% of losses. A total sample of 302 patients was obtained *i.e.* 151 in each study group.

Research variables

The study variables were retrospectively collected from the patients' electronic medical records by the researcher in charge and two research assistants. The assistants were scientific initiation scholarship holders from Universidade Federal do Rio Grande do Sul, which is associated to the institution of this study. The scholarship holders were previously trained in data collection and application in the database by the responsible researcher, an ICU and research specialist. The clinical variables selected for this study are based on already known risk factors for PI, added to important variables related to patients with Covid-19.

The variables were stored and organized directly in a database created by the researchers, in Excel® software (Microsoft Office 2013), and the following sociodemographic and clinical variables related to each patient were tabulated: Sociodemographic variables: age, gender, education, and origin; Clinical variables subdivided into:

Support interventions – Prone maneuver, in cases of severe ARDS with PaO2:FiO2 (P/F) ratio ≤ 150 (if positive, number of times the patient was in the prone position; time spent in the prone position); use of IMV (if positive, the total number of days), hemodialysis and Extracorporeal Membrane Oxygenation (ECMO).

Medications – Sedation (if yes, total number of days), neuromuscular blocker (if yes, total number of days). Vasopressor, norepinephrine (if positive, the maximum dose during hospitalization). Dose classification was carried out in order to optimize data analysis: dose between 0.1 mcg/kg/minute to 0.4 mcg/kg/minute; 0.5 mcg/kg/minute to 0.9 mcg/kg/minute and dose ≥ 1.0 mcg/kg/minute, considered as a high vasopressor dose.

Hospitalization – Length of stay in the ICU (days), outcome (discharge or death). Reason for admission to the general ICU (clinical or surgical).

Comorbidities – Presence of comorbidities (yes or no – if yes, which comorbidities) and thinness or obesity, considering the Body Mass Index (BMI), categorized according to recommendations made by the World Health Organization[13]

Pressure injury – Amount, location and stage of PI; time taken to develop the first PI and change to a more severe stage. The first record of PI in the medical records, from stage 2 onwards, was considered as the first PI; from then on, this injury was monitored for the assessment of the time taken until the most severe stage was reached, that is, from stage 2 to 3 or 2 to 4.

Assessment instruments – Lowest Braden Scale score[14] recorded during hospitalization: low risk (scores between 15 and 18); moderate risk (scores between 13 and 14); high risk (scores between 10 and 12); very high risk (scores of 9 or lower) and the Nursing Activities Score (NAS) instrument(15)[15], which reflects the workload of the nursing team in the ICU, classified into categories, according to the institution's routine[16]: NAS ≤ 50% = mild; NAS between 50.1% and 100%

= moderate/high; and NAS ≥ 100% = very high. The highest NAS during hospitalization was considered.

The main outcome was the incidence of PI in patients with and without Covid-19 and the demographic, clinical, and nursing workload risk factors for its occurrence. The secondary outcomes were the severity of PIs and the time taken by these injuries to develop during ICU admission. The data were checked and entered into the Microsoft Excel® software by two different researchers (main researcher and research assistant), and the documents generated were subsequently compared to avoid errors and biases.

Data analysis

The data were analyzed with the Statistical Package for the Social Sciences (SPSS), version 22. Initially, descriptive analysis was performed. Continuous variables with normal distribution were expressed as mean and standard deviation; and asymmetric variables were expressed as median and interquartile range. Data normality was tested using the Kolmogorov-Smirnov test and histograms.

The comparison of qualitative variables between the groups with and without COVID-19 was made using Pearson's chi-square test and for continuous variables, with Student's t-test and Mann-Whitney (according to the normality of the variable). The significance level was set at 5% ($p < 0.05$). In addition, to compare the variables between the two groups with the presence of PI, Wald test and Interaction Effect Analysis with Covid-19 were used to assess whether the effect of this disease on the development of PI was dependent or independent of other variables. If the p-value is not significant, it is concluded that, for these variables, their effect on PI is the same in both groups, that is, the presence of these variables in the development of PI is independent of whether or not the individual is affected by Covid-19. The incidence was described by frequency and percentage and in cases where there was a significant association, the degree of association was assessed by calculating the relative risk (RR). The incidence was calculated by dividing the number of PIs during follow-up by the sum of the period of time that each patient was exposed to the risk of developing PI in the ICU. The result of this ratio was multiplied by 100 and the incidence rate was then presented per 100 patient-days.

The log-rank test was used to evaluate the time taken by the patient to develop the first LP and the change in stage. The RR of the patient having PI was estimated using the Poisson regression model with robust variance. A multivariate model was adjusted using the following method: all variables with $p < 0.10$ in the univariate analysis were included in the initial multivariate model and subsequently eliminated in stages until a combination was reached in which all had $p \leq 0.05$ in the Wald test.

Ethical aspects

The study was approved by the institution's Research Ethics Committee under Consolidated Protocol No. 5,334,786 and CAAE: 57129622.7.0000.5327. The Free and Informed Consent Form was waived because data collection occurred exclusively in electronic medical records in a retrospective manner, making it impossible to contact all potential participants due to outdated registration information, deaths and possible risks and discomforts resulting from the contact itself to obtain consent.

RESULTS

Among the main sociodemographic characteristics, the prevalence of males was identified in both groups 83 (54.5%); 88 (58.3%) and mean age of 55 (±18.3) and 55 (±14.2) years, respectively, in the group with covid-19 and without covid-19. Other characteristics of the sample are described in Table 1.

Table 2 presents a comparison of clinical factors found in patients with and without Covid-19 and their associations.

Regarding the prone position, 68 (44.7%) of the 151 patients hospitalized with COVID-19 required it as supportive therapy, with 22 (32.3%) being proned only once and 46 (67.6%) being proned two or more times. Of the prone patients, 40 (58.8%) remained in this position for more than 16 hours. The occurrence of PI in prone Covid-19 patients was 50 (73.5%) cases, with a statistically significant difference when compared to non-prone patients ($p < 0.00$). Furthermore, PI was developed by 22 (32.3%) of the patients who were prone for up to 16 hours and 28 (41.1%) of those who were prone for more than 16 hours. Although the incidence of PI increased in patients who were prone for longer periods, there was no significant difference between patients who were prone for up to 16 hours and more than 16 hours.

The characteristics of PIs in patients with and without Covid-19 and their associations are described in Table 3.

Table 4 presents the interaction effect of Covid-19 with the presence of PI..

Most variables did not show an interaction effect with Covid-19 for the development of PI. Therefore, for these factors, their effect on PI is independent of whether the patient has Covid-19 or not, unlike length of hospital stay, IMV time, and sedation time, in which an interaction effect with Covid-19 was detected.

Table 1 – Sociodemographic characteristics of patients with (n=151) and without Covid-19 (n=151) admitted to the ICU. Porto Alegre, RS, Brazil, 2022

Characteristics	WITH Covid-19 (n = 151)	WITHOUT Covid-19 (n = 151)
	n (%)	n (%)
Age (years)		
18-40	36 (23.8)	43 (28.5)
41-60	63 (41.7)	31 (20.5)
> 60	52 (34.4)	77 (51.7)
Education		
Incomplete primary education	27 (17.9)	47 (31.1)
Primary education	31 (20.5)	43 (28.5)
Secondary education	75 (49.7)	50 (33.1)
Complete higher education	18 (11.9)	11 (7.3)
Origin		
Porto Alegre	76 (50.3)	95 (62.9)
Metropolitan Region	37 (24.5)	28 (18.5)
Countryside of the state	32 (21.2)	22 (14.6)
Coastal cities of RS*	6,0 (4.0)	6,0 (4.0)

Source: Research data, 2022.
* Rio Grande do Sul

Table 2 – Clinical factors associated with the incidence of PI in patients with (n=151) and without Covid-19 (n=151) admitted to the ICU. Porto Alegre, RS, Brazil, 2022

Clinical factors	WITH Covid-19		WITHOUT Covid-19		*P*-value*
	Total (n=151) N (%)	PI N (%)	Total (n=151) N (%)	PI N (%)	
Invasive mechanical ventilation	127 (84.1)	89 (70.6)	106 (70.2)	50 (47.2)	0.582
Continuous hemodialysis	41 (27.2)	37 (90.2)	30 (19.9)	14 (46.7)	0.307
Sedation	126 (83.4)	89 (70.6)	102 (67.5)	49 (48.0)	0.437
Vasopressor 0.1 mcg/kg/min.	45 (29.8)	28 (62.2)	45 (29.8)	19 (42.2)	0.448
Vasopressor 0.5 mcg/kg/min.	27 (17.9)	19 (70.4)	21 (13.9)	11 (52.4)	0,345
Vasopressor ≥ 1.0 mcg/kg/min.	22 (14.6)	20 (90.9)	30 (19.9)	12 (40.0)	0.193
Braden ≤ 12	129 (85.4	90 (69.8)	102 (67.5)	47 (46.1)	0.135
Death	52 (34.4)	42 (80.8)	61 (40.4)	30 (49.2)	0.624

Table 2 – Cont.

Clinical factors	WITH Covid-19		WITHOUT Covid-19		*P*-value*
	Total (n=151) N (%)	PI N (%)	Total (n=151) N (%)	PI N (%)	
Neuromuscular blocker	93 (61.6)	61 (65.5)	–	–	–
Length of hospital stay	21.7 ± 19.5	–	10 ± 10.0	–	*< 0.001*
Mechanical ventilation time	20 ± 17.5	–	12 ± 10.0	–	*< 0.001*
Sedation time	14.7 ± 13.0	–	8.0 ±7.0	–	*< 0.001*
Number of Comorbidities					
Thinness	3 (2.0)	3 (100.0)	28 (18.5)	11 (39.3)	0.141
Obesity	62 (41.1)	44 (71.0)	28 (18.5)	14 (50.0)	0.609
SAH†	90 (59.6)	55 (61.1)	74 (49.0)	28 (37.8)	0.759
DM2‡	64 (42.4)	44 (68.8)	47 (31.1)	16 (34.0)	0.254
Cardiopathies	25 (16.6)	18 (72.0)	31 (20.5)	9 (29.0)	0.161
Respiratory illness	29 (19.2)	18 (62.1)	18 (11.9)	6 (33.3)	0.765
Liver disease	13 (8.6)	7 (53.8)	8 (5.3)	–	0.553
Kidney disease	12 (7.9)	7 (58.3)	26 (17.2)	8 (30.8)	0.723
Cerebrovascular accident	6 (4.0)	3 (50.0)	10 (6.6)	4 (40.0)	0.587
Immunological disease	8 (5.3)	5 (62.5)	15 (9.9)	5 (33.3)	0.807
Cancer	7 (4.6)	5 (71.4)	25 (16.6)	9 (36.0)	0.656
Smoking					
Non-smoker	122 (80.7)	71 (58.2)	101(66.9)	36 (35.6)	
Former smoker	24 (15.9)	15 (62.5)	32 (21.2)	9 (28.1)	0.621
Smoker	5 (3.3)	5 (100)	9 (50.0)	9 (100)	
Presence of Comorbidities					
None	32 (21.2)	19 (59.4)	17 (11.3)	6 (35.3)	
1 or 2	73 (48.3)	40 (54.8)	80 (53.0)	30 (37.5)	0.446
3+	46 (30.5)	32 (69.6)	54 (35.8)	18 (33.3)	

Source: Research data, 2022.
*Chi-square test; (-) numeric data equal to zero, not resulting from rounding;
†SAH=Systolic arterial hypertension; ‡DM2=Type 2 Diabetes Mellitus.

Table 3 – Incidence and characteristics of LPs in patients with Covid-19 (n=151) and without Covid-19 (n=151) admitted to the ICU. Porto Alegre, RS, Brazil, 2022

	WITH Covid-19 (n = 151)	WITHOUT Covid-19 (n = 151)	P-value
	n (%)	n (%)	
Pressure injury (incidence)	91 (60.3)	54 (35.8)	*< 0.001*†
PI* stage 2	51 (56.0)	48 (88.8)	0.345†
Occipital	2 (2.1)	–	
Trochanter	1 (1.0)	1 (1.8)	
Dorsum	3 (3.2)	1 (1.8)	
Sacrum	15 (16.4)	20 (37)	
Gluteal	16 (17.5)	23 (42.5)	
Calcaneus	3 (3.2)	3 (5.5)	
Tibial region	9 (98)	–	
PI stage 3	21 (23.0)	9 (16.6)	*< 0.001*†
Sacrum	18 (19.5)	7 (13)	
Gluteal	3 (3.2)	1 (1.8)	
Calcaneus	–	1 (1.8)	
PI stage 4	8 (8.6)	–	*< 0.001*†
Sacrum	8 (8.6)	–	
Deep tissue PI	29 (31.8)	5 (9.2)	*< 0.001*†
Sacrum	15 (16.3)	2 (3.7)	
Gluteal	12 (13)	1 (1.8)	
Calcaneus	2 (2.1)	2 (3.7)	
Not classifiable PI	4 (4.3)	1(1.8)	0.135†
Sacrum	1 (1.0)	1 (1.8)	
Gluteal	2 (2.1)	–	
Calcaneus	1 (1.0)	–	
PI related to prone position±	50 (73.5) ±	–	
PI stage 2			
Face	18 (36)		
Chest	33 (66)		
Abdomen	29 (58)		

Table 3 – Cont.

	WITH Covid-19 (n = 151)	WITHOUT Covid-19 (n = 151)	P-value
	n (%)	n (%)	
Deep tissue PI			
Face	4 (8)		
Number of PIs per patient			
Up to one PI	29 (31.5)	41 (76)	0.322†
Two PIs	29 (31.5)	11 (20.3)	*< 0.001*†
≥ Three PIs	34 (37)	2 (3.7)	*< 0.001*†
Time taken to develop the first PI (days)	8±6	13±8	*< 0.001*‡
Time taken for change to more severe stage (days)	7 ±11.5	11 ±16	0.523‡

Source: Research data, 2022.
*PI=Pressure injury; †Chi-square test and ‡Log-rank test
50 (73.5%) of patients with Covid-19 developed PI related to the prone position and the same patient may have developed more than one PI and in different anatomical regions.

Table 4 – Effect of interaction between clinical factors and Covid-19 for the development of PI. Porto Alegre, RS, Brazil,

Clinical factors	Covid-19	Factor	Interaction*
Invasive mechanical ventilation	0.938	0.002	0.582
Continuous hemodialysis	0.015	0.000	0.307
Sedation	0.761	0.001	0.437
Vasopressor 0.1 mcg/kg/minute	< 0.001	0.745	0.448
Vasopressor 0.5 mcg/kg/minute	< 0.001	0.189	0.345
Vasopressor ≥ 1.0 mcg/kg/minute	0.002	< 0.001	0.193
Braden ≤ 12	0.270	0.005	0.135
Nursing Activities Score ≥100	0.013	0.016	0.469
Length of hospital stay	**< 0.001**	**< 0.001**	**< 0.001**
Mechanical ventilation time	**< 0.001**	**< 0.001**	**< 0.001**
Sedation time	**0.001**	**< 0.001**	**< 0.001**
Death	0.002	< 0.001	0.624
Number of Comorbidities			
Thinness	< 0.001	< 0.001	0.141
Obesity	0.003	0.022	0.609

Table 4 – Cont.

Clinical factors	Covid-19	Factor	Interaction*
SAH†	0.004	0.797	0.759
DM2‡	0.016	0.064	0.254
Cardiopathies	0.002	0.137	0.161
Respiratory illness	< 0.001	0.822	0.765
Kidney disease	< 0.001	0.889	0.723
Cerebrovascular accident	< 0.001	0.640	0.587
Immunological disease	< 0.001	0.891	0.807
Cancer	< 0.001	0.472	0.656
Smoking	0.001	< 0.001	0.600
Presence of Comorbidities	0.148	0.243	0.446

Source: Research data, 2022.
*Wald test for interaction effect with Covid-19;

Table 5 shows the results of the univariate and multivariate analysis of clinical factors regarding the Relative Risk (RR) of developing PI, considering all patients admitted to the ICU, since according to the interaction effect test with Covid-19, these variables have the same risk for the development of PI in patients with Covid-19 and without Covid-19. The variables length of hospital stay and length of IMV lost their interaction effect with Covid-19 when multivariate analysis was applied, with only sedation time remaining, as shown in the Table 5:

The RR of patients who demand a high workload from the nursing team (NAS ≥ 100) in developing PI is 41% higher than that of those who demand less workload from the nursing team. The mean NAS obtained for patients with Covid-19 was 91.15 (SD±20.5) and for patients without Covid-19 it was 81.7 (SD±19.4), considered as a moderate/high workload for the nursing team. Furthermore, a NAS value ≥ 100 was found in 63 (41.7%) of patients with Covid-19 and in 36 (23.8%) of patients without Covid-19, a value classified as very high, with this difference being statistically significant (p < 0.001).

Of the patients with Covid-19 who demanded a very high nursing team workload (with a NAS score ≥ 100), 45 (71.4%) developed PI; and among the patients without Covid-19, also with this score, 14 (38.9%) developed PI. Although Covid-19 patients who demanded high workload had a higher prevalence of PI, this difference was not statistically significant (p = 0.469).

DISCUSSION

The incidence of pressure injury in patients with Covid-19 was 60.3% and in patients not affected by Covid-19, it was 35.8%. Furthermore, the RR of patients with Covid-19 having PI is estimated to be 1.69 (95% CI: 1.31-2.16) times the risk of patients without Covid-19 (p <0.001), that is, a 69% higher risk of developing PI when compared with critical patients without Covid-19. A similar result was obtained in a study in the United States, which found that patients with Covid-19 were 50% more likely to have PI[17]. Studies conducted in different countries such as Iran, the United Kingdom and China also found high incidence rates of around 46.74%[18], 75.8%[19] and 42.2%[9].

Regarding the characteristics of PIs, stage 2 was predominant in both groups analyzed, with the sacral and gluteal regions being the most affected areas. However, patients with Covid-19 had PIs in more severe stages, such as stages 3 and 4, and a higher incidence of deep tissue PI. This result, also found in other studies, suggests that increased severity of PI and high incidence of deep tissue PI in Covid-19 patients are some of the complications related to the pathophysiology of the disease, which may present hypercoagulability and intravascular thrombosis in the pathogenesis of Covid-19 infection[7]. Furthermore, Covid-19 patients had multiple injuries and developed the first PI on average eight days after

Table 5 – Risk factors for PI according to univariate and multivariate analysis in patients with and without Covid-19 admitted to the ICU (n = 302). Porto Alegre, RS, Brazil, 2022

Variable	Univariate analysis			Multivariate analysis		
	RR	CI 95%	P-value*	RR	CI 95%	P-value*
Covid-19	1.69	(1.31-2.16)	< 0.001			
Death	1.65	(1.31-2.07)	< 0.001			
Thinness	0.93	(0.62-1.40)	0.743			
Obesity	1.57	(1.26-1.96)	< 0.001	1.24	(1.03 1.49)	*0.025*
SAH	1.13	(0.89-1.43)	0.328			
DM2	1.21	(0.96-1.53)	0.103			
Cardiopathies	1.01	(0.74-1.36)	0.973			
Respiratory illness	1.08	(0.79-1.46)	0.641			
Liver disease	0.68	(0.37-1.26)	0.218			
Kidney disease	0.80	(0.53-1.21)	0.293			
Cerebrovascular accident	0.91	(0.51-1.60)	0.736			
Immunological disease	0.90	(0.56-1.45)	0.663			
Cancer	0.90	(0.60-1.36)	0.622			
Smoking						
Former smoker	0.89	(0.64-1.24)	0.505			
Smoker	1.27	(0.89-1.81)	0.189			
Number of comorbidities						
1 or 2	0.90	(0.65-1.24)	0.509			
3+	0.98	(0.70-1.37)	0.906			
Prone position	2.38	(1.97-2.88)	< 0.001			
VMI[±]	6.86	(3.17-14.84)	< 0.001			
Hemodialysis	1.77	(1.43-2.18)	< 0.001			
Sedation	6.40	(3.14-13.05)	< 0.001			
Noradrenaline 0.1 mcg/kg/minute	1.13	(0.88-1.44)	0.330			
Noradrenaline 0.5 mcg/kg/minute	1.38	(1.07-1.79)	0.014			
Noradrenaline > 1 mcg/kg/minute	1.36	(1.06-1.76)	0.018			
Braden ≤ 12	5.26	(2.72 10.20)	< 0.001	3.06	(1.55 -6.01)	*<0.001*
Length of hospital stay	1.05	(1.04-1.06)	< 0.001			
IMV time	1.07	(1.05-1.09)	< 0.001			
Sedation time	1.12	(1.09-1.15)	< 0.001	1.04	(1.02-1.06)	*<0.001*
NAS[†] ≥ 100	1.41	(1.12-1.77)	< 0.001			

Source: Research data, 2022.
* Poisson regression with robust variance
[†] NAS = Nursing Activities Score; [†]SAH=Systolic Arterial Hypertension; [‡]DM2=Diabetes Mellitus type 2; [±]IMV=Invasive mechanical ventilation

hospitalization, i.e. five days earlier than patients without Covid-19. These findings are largely consistent with those observed in the international literature, which also identified an increase in the incidence and severity of PIs during the covid-19 pandemic[9-10].

One of the most important factors for the higher incidence of PI in Covid-19 patients was the need for prone maneuver, since 68 (44.7%) required it as supportive therapy, 46 (67.6%) had to be proned two or more times and 40 (58.8%) remained in the prone position for more than 16 hours. Although the nursing team is trained to care for patients with Covid-19 and provide intensive care to prevent PI during the prone position, 50 (73.5%) developed PI after this therapy. Both national and international literature report this condition as one of the main and most common complications of the prone position[4-5,20].

It should be noted that, for comparison purposes, in this study no patient without Covid-19 was proned. However, in a study conducted in 2019 with patients not affected by Covid-19, in the same city where the present study was conducted, it was found that, on average, the patients remained in the prone position for 16.8 hours, and a new prone position session was necessary in 32.4% of cases. There was also an incidence of PI after the prone maneuver of 21.6%[4], that is, lower than that found in the present study in prone patients with covid-19 and also described in the literature[21]. This difference in the incidence of PI can be explained by the pathophysiology of Covid-19 itself, as already described, as well as by the fact that patients with Covid-19 need to remain in the prone position for longer and require a greater number of sessions than patients not affected by Covid-19.

Regarding the length of hospital stay, this study found that patients with Covid-19 spent an average of 21 days in the ICU, ten days longer than patients not affected by Covid-19, similar to the results found in China[22]. Moreover, patients with Covid-19 also required more time on IMV and a longer period of sedation than those without Covid-19, potentially important factors for the increased incidence of PI[23].

Although mobilizing patients in bed is an essential care performed by nursing staff, the literature shows that obese patients are more difficult to mobilize and require more human resources for this purpose. It is also necessary to consider that, often, due to the severity of the disease, there is a need to reduce position changes so as not to cause clinical instability[24]. Furthermore, in a pandemic context, such care may have been impaired in this patient profile, due to the high workload and exhaustion of the nursing team, which may have culminated in an increase in PI in patients.

Regarding sedation in the ICU, the time spent was also associated with the development of PI in the present study. In the context of intensive care, its use is recurrent, especially in patients on IMV. However, prolonged use is directly associated with increased IMV time, length of hospital stay, and higher incidence of muscle degeneration[25]. In a study in Brazil aimed to compare the use of sedation in Covid-19 ICU and conventional ICU patients, an increase in the use of sedatives in patients with Covid-19 compared to patients without Covid-19 was also found[25]. Therefore, the sensory deficit caused by sedation leads to immobility in bed, muscle weakness, and consequently, PI. A Brazilian retrospective study showed that PI was one of the most reported adverse events in patients using sedation[23].

At the institution under study, the risk of patients developing PI is assessed daily based on the Braden Scale score. In the total sample of 302 patients (with and without Covid-19), 231 (76.4%) patients had a score ≤ 12, which represents a high risk of developing PI. This is a classic result found in research carried out with critically ill patients, due to their severity and the sum of numerous risk factors to which they are exposed. We also observed that the variables associated with the development of PI, both in univariate and multivariate analysis, are closely related to at least four factors assessed by the Braden Scale: sensory perception; activity; mobility; friction and shear. However, this scale does not assess other intrinsic factors of ICU patients, especially in patients with Covid-19, such as oxygenation and perfusion, which the literature has already revealed to be important risk factors for the development of PI[26].

There was an increase in the workload of the nursing team that cared for the group of patients with Covid-19, with a NAS value ≥ 100% (very high workload). Furthermore, univariate analysis demonstrated that patients who required a lot of time from the nursing team, with NAS ≥ 100, had a 41% higher risk of developing PI ($p < 0.001$). There are few studies that associate the development of PI with the workload of the nursing team, and the most recent research differs in the results regarding this association[27-28]. Although the high nursing workload associated with higher rates of pressure injuries was not significant, it should be emphasized that one of the most important factors in preventing PI is the human factor, as the nursing care provided by professionals overburdened by the high work demand may not be sufficiently adequate.

During the pandemic, the hospital where this study was carried out created new ICU beds in a short period of time, with the consequent hiring of new nursing professionals, because it was a reference hospital for the care of patients with Covid-19. Furthermore, the newly hired professionals did not have enough time for training and to gradually adapt to the institution's routines, due to the need for immediate

care imposed by the pandemic. This may have influenced the reduction of care for the prevention of PI, in addition to the prioritization of nursing care for critically ill patients admitted and for complications during care[29].

A limitation of this study is that it is retrospective and dependent on records from healthcare professionals in electronic medical records, which may lead to information biases. However, to minimize this limitation, the researchers sought to investigate only variables that could be collected entirely and reliably for all patients. Therefore, due to the lack of complete information in the electronic medical record, laboratory test variables, which would be important to assess the pathophysiology of Covid-19 with the presence of PI, could not be incorporated.

CONCLUSION

The incidence, severity and earlier development of PI were higher in the group of patients with Covid-19 than in patients without Covid-19, a fact that confirms the hypothesis of this study. Although patients with Covid-19 had a higher incidence and risk of developing PI than those without Covid-19, it cannot be stated that such disease is an independent risk factor for the emergence of PI.

The variables significantly associated as a risk factor for the onset of PI were "Obesity", "Sedation time" and "Braden Scale ≤ 12". Sedation time was the only variable that remained with an interaction effect with Covid-19 for the development of PI. Although the variables Obesity and Braden Scale ≤ 12 had the same strength in both groups, we found that they were significantly more frequent in patients with Covid-19. Therefore, we infer that these patients are more intensely subject to such risk factors than patients not affected by Covid-19, which increases the incidence of PI in the referred group.

The nursing team workload measured with the NAS instrument identified a NAS value ≥ 100% that was higher in patients with Covid-19 than in patients without Covid-19, which may also interfere with the increased risk and incidence of PI in this group.

Based on these results, it was found that Covid-19 changed the profile and complexity of ICU patients, influencing the high incidence of PI. Therefore, it is essential to highlight the importance of individualized assessment instruments for critically ill patients with Covid-19, to guide nursing interventions that seek to prevent and treat PI with care targeted to this patient's profile. Hence further research is needed to update and improve existing instruments, as well as promote organizational and care changes, in order to provide high-quality assistance and strengthen preventive measures that favor care for patients with Covid-19.

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Authors' contribution

Conceptualization: Marina Raffin Buffon e Amália de Fátima Lucena
Data curation: Marina Raffin Buffon
Formal analysis: Amália de Fátima Lucena e Isis Marques Severo
Methodology: Amália de Fátima Lucena
Project administration: Amália de Fátima Lucena e Marina Raffin Buffon
Supervision: Amália de Fátima Lucena
Validation: Amália de Fátima Lucena e Isis Marques Severo
Visualization: Amália de Fátima Lucena, Marina Raffin Buffon, Isis Marques Severo
Writing – original draft: Marina Raffin Buffon, Amália de Fátima Lucena, Isis Marques Severo, Karina de Oliveira Azzolin
Writing – review & editing: Marina Raffin Buffon, Amália de Fátima Lucena, Isis Marques Severo, Karina de Oliveira Azzolin

The authors declare that there is no conflict of interest.

Corresponding author:

Marina Raffin Buffon
E-mail: marinaraffinb@gmail.com

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