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Pressure injuries in critical patients: Incidence, patient-associated factors, and nursing workload

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Abstract

Aim: To estimate the incidence of pressure injury and its predictors including nursing workload in critical patients.

Background: There is controversy about the influence of the nursing workload on the occurrence of pressure injury in intensive care units.

Methods: A retrospective cohort of 766 patients in nine intensive care units of two university hospitals was studied. The nursing workload was measured using the Nursing Activities Score. The predictors were identified by logistic regression.

Results: The pressure injury incidence was 18.7%. The odds ratio of the development of pressure injury, increased 3.5 times in mechanical ventilation ($p < 0.001$), 7.8 times in palliative care ($p = 0.004$), 2.3 times in the 60–84 years old group ($p = 0.005$); it also increased 10% for each day of hospitalization ($p < 0.001$), and 1.5% for each registered point of the Nursing Activities Score ($p = 0.016$).

Conclusion: Existing risks for the development of pressure injury have been confirmed and nursing workload identified as a new predictor. Much still needs to be done in the area of prevention, especially in groups at risk.

Implications for Nursing Management: Increasing nursing resources in the intensive care unit may assist in reducing the pressure injury rate.

KEYWORDS
incidence, intensive care units, nursing, pressure ulcer, workload

1 | INTRODUCTION

Pressure injury (PI) is one of the most prevalent adverse events in the intensive care unit (ICU), with international incidence rates ranging from 8% to 40% (Apostolopoulou et al., 2014; Becker et al., 2017; Campanili, de Santos, Strazzieri-Pulido, Thomaz, & Nogueira, 2015; González, Lima, Martín, Alonso, & Lima, 2018; Tayyib, Coyer, & Lewis, 2016).

Pressure injury is a particular health problem as it results in an increased length of stay, greater patient suffering, higher mortality rates and an undue economic burden to the health system (Roque, Tonini, & Melo, 2016) with costs ranging from 20,900 to 151,700 $USD per injury (Agency for Healthcare Research Quality, 2014). Moreover, the pressure injury rate is considered an essential quality of care indicator as a large percentage of cases are preventable (Jackson et al., 2016).

The main reported risk factors for the development of pressure injury include clinical characteristics of the patient relating to mobility/activity, perfusion and skin status (Coleman et al., 2013); as well as extrinsic factors including treatment and its duration. In the past decade, it has been suggested that health care management, including nursing workload, may contribute to the incidence of pressure injury (Aiken et al., 2014; Al-Kandari & Thomas, 2009; Cho et al., 2015; McGahan, Kucharski, & Coyer, 2012), but the number of studies on this topic is still limited. Thus, the objective of this study was to determine the association between the nursing workload among other risk factors and the incidence of pressure injury in an intensive care setting.

Pressure injury is defined as localized damage to the skin and underlying soft tissue usually over a bony prominence, as a result of intense and/or prolonged pressure alone or in combination with shear. The most frequent locations of pressure injury are the cranial, sacral, gluteal, pedal and auricular regions. The current pressure injury classification system denotes stages using Arabic numerals 1–4 and also includes four additional categories: Unstageable full-thickness; Deep tissue; Medical device-related and Mucosa Membrane (Edsberg et al., 2016; González et al., 2018).

A number of factors contribute the occurrence of pressure injury in an ICU setting, where patients experience long periods confined to bed due to life-saving interventions, such as mechanical ventilation and treatments with vasoactive drugs that can last from 1 to ≥90 days (González et al., 2018; Novaretti, Santos, Quitério, & Daud-Gallotti, 2014; Tayyib et al., 2016). It is also known that the use of sedating medications, with analgesic and relaxing effects, used in the ICU, may limit reaction to pain and discomfort caused by prolonged pressure in the tissues and contribute to pressure injury. In addition, haemodynamic instability, and some degree of compromised nutritional status, whether due to increased trauma, sepsis, post-surgery status or prolonged fasting (Tayyib, Coyer, & Lewis, 2013), can lead to a decrease in tissue tolerance and, consequently, an increase in the risk for pressure injury in ICU.

Apart from patient characteristics or treatment factors contributing to pressure injury, organisational elements of the ICU, such as workload and the availability of human resources for nursing, are also risk factors for adverse events (Aiken et al., 2012). For example, Weissman et al. (2007) demonstrated that a 0.1% increase in the patient-to-nurse ratio led to a 28% increase in the adverse event rate. This evidence demonstrates the need for including the nurse–patient ratio and nursing workload management as part of the pressure injury prevention bundle, improving, even more, the quality of care and decreasing the cost of health care.

However, there is still controversy as to the extent to which the nursing workload impacts the risk of pressure injury. Some authors (Aiken et al., 2014; Cho et al., 2015; Novaretti et al., 2014) state that the excess of this burden may interfere negatively in the quality of care provided, thus contributing to the occurrence of adverse events such as pressure injury.

Others (Cremasco, Wenzel, Zanei, & Whitaker, 2013; McGahan et al., 2012) do not corroborate these assertions and have even described the workload as a protective factor against pressure injury because of a higher number of care activities that favour prevention. Therefore, to clarify this controversy, this study aimed to determine the relationship between the incidence of pressure injury and the nursing workload in the ICU.

2 | DESIGN AND SETTING

This was a retrospective cohort study conducted in two university hospitals in the city of São Paulo. In both institutions, the medical and nursing care records were systematized. At the time of data collection, one of the institutions had 70 active ICU beds distributed among eight medical specialties. Due to the recently initiated process of change, this institution did not have a fully implemented specific protocol for the prevention of pressure injury, and only the Braden scale had been established for the detection of patients at risk. The other institution had 20 active beds, distributed between a general ICU and a semi-intensive unit. Since 2005, the service had a pressure injury prevention protocol to guide nursing actions in patients with a Braden score less than or equal to 16. The ethics committee of both university hospitals approved the project.

2.1 | Participants

During the study period all adult patients without pressure injury were included who had been hospitalized at the participating units for more than 24 hr in order to exclude pressure injury developed in units other than the ICU (e.g., emergency room, surgical centre) (n = 1,196). It was decided to exclude patients with skin lesions disseminated by the body, either by burns or dermatoses, which could make the diagnosis of pressure injury difficult (430 patients).

2.2 | Data collection

Medical records of hospitalized patients were audited from 3 May to 31 July 2012 in one institution, and from 3 September to 1 December 2012 in the other, making a total sample of 766 included patients after exclusions.

A demographic and clinical data tool was developed based on literature considering the variables of interest for the development of pressure injury in ICU. For the demographic data, the assessed variables were age and sex. The clinical variables were related to the type of hospitalization (clinical or surgical), the medical admission diagnosis and its duration (days), palliative care status, and the ICU discharge result (survivor or not).

For treatment, the use of mechanical ventilation and its duration in days, surgeries, the use of vasoactive drugs, and the type of mattress used by the patient during ICU hospitalization were studied. To characterize the pressure injury, information about the presence, location and severity of pressure injury (World Health Organization, 2009), the time of appearance and classification was collected (NPUAP, EPUAP & PPPIA, 2014).

To characterize the clinical condition of the ICU patients the Charlson comorbidity index (CCI) was used to calculate the burden of patient morbidity. The simplified acute physiologic II (SAPS II) index, which calculates the probability of mortality resulting from a pathological condition, and the logistic organ dysfunction system (LODS), which is based on organ failure, evaluated the severity.

The nursing workload was assessed by the Nursing Activities Score (NAS), and the risk of pressure injury was by the Braden scale, both instruments having been previously translated and validated in Brazilian Portuguese (Paranhos & Santos, 1999; Queijo & Padilha, 2009). Regarding the application of NAS, an inter-rater reliability test was performed between ICU nurses of the included hospitals and researchers, in a sample of 116 patients from different ICU units. The results showed an acceptable correlation between them (0.669; $p < 0.001$).

2.3 | Statistical analysis

Pearson's chi-square test was used to compare categorical risk factors between those who did and those who did not develop a pressure injury. To evaluate the association between the presence of pressure injury and the quantitative variables, the Mann-Whitney test was used. The identification of factors associated with pressure injury was performed through logistic regression, with PI as the nominal dependent nominal variable (yes/no) and the other variables as independent (categorical and quantitative). The model considered the variables with significant individual correlation with the occurrence of pressure injury and were included in the model using a simultaneous approach. The area under the ROC curve (AUC) was used to evaluate the model, indicating the probability of having a pressure injury when the associated variables were present.

For the entire study, tests that obtained a descriptive level of less than 5% ($p < 0.05$) were considered significant. Odds ratios and 95% confidence intervals were determined for the independent variables. Cases with a lack of information were excluded in order to manage the missing data. The calculations were performed using the software R (R Core Team, 2017).

This study follows the recommendations of the international consensus (NPUAP, EPUAP, & PPPIA, 2014) for measuring the incidence of pressure injury. This considers the incidence estimation as an expression of the number of new cases of a certain condition in a population (patients with PI), for a given period, over the number of persons exposed to the risk over the same period (all included patients), multiplied by 100.

Despite the relevance of the Braden scores in assessing the risk for the development of pressure injury and its importance in the PI prevention bundle as previously reported (Tayyib, Coyer, & Lewis, 2015), we chose to rule out the independent Braden score variable from the analyses since almost half of the patients (40.2%/n = 308) did not have a risk classification registered in their medical records.

3 | RESULTS

Of the 1,196 patients admitted to both institutions at the time of data collection, 430 (36%) patients did not meet the inclusion criteria, leaving a sample of 766 (64%) patients.

Regarding the demographic characteristics of the sample, the majority of the patients (58.2%/n = 446) were male, with a mean age of 56.7 years (SD = 17.7), and a median age of 58 years; with a predominance of those between 60 and 84 years of age (41.4%/n = 317), followed by 30.3% (n = 232) aged 45–59 years. Clinical admissions (n = 505/65.9%) predominated over surgical ones, with a mean duration of hospitalization of 7.8 days (SD = 10.3) range 2–160 days. Regarding the assessment of severity in the first 24 hr, the probability of death was, on average, 21.3% (SD = 21.3), according to SAPS II. While the probability of death over time was 0.23% (SD = 3.7) on average, according to the logistic organ dysfunction system (LODS). According to the NAS, the average nursing workload was 63.5% (SD = 17.5), a median of 71.6%, minimum of 26.9%, and a maximum of 173.1%.

Pressure injury was present in 143 patients totalling an incidence of 18.7% within 766 patients. On average, pressure injuries developed in 6.9 days (SD = 5.9), with a median of 4 days and a variation of 2–30 days. Pressure injuries were located mainly in the sacral region and were classified as stage I. The severity of the PI damage (according to WHO classification in 2014) was considered weak for 51.0% (n = 73) of the PIs, moderate for 42.7% (n = 61), and severe for 6.3% (n = 9). Table 1 presents the detailed distribution of pressure injuries according to its classification and anatomical location.

Comparing the mean length of hospitalization between the groups with and without pressure injury, a statistically significant

TABLE 1 Patients with pressure injuries according to classification and anatomical location (n = 143)

	Classification									
	I		II		III		UPI		Total	
Location	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Sacrum	61	42.6	45	31.5	1	0.7	7	4.9	114	79.7
Calcaneus	7	4.9	7	4.9	–	–	–	–	14	9.8
Gluteal	1	0.7	3	2.1	–	–	–	–	4	2.8
Trochanter	2	1.4	2	1.4	–	–	–	–	4	2.8
Ear	1	0.7	2	1.4	–	–	–	–	3	2.1
Elbow	–	–	1	0.7	–	–	–	–	1	0.7
Scapula	–	–	1	0.7	–	–	–	–	1	0.7
Occiput	–	–	–	–	–	–	1	0.7	1	0.7
Nose	–	–	1	0.7					1	0.7
Total	72	50.3	62	43.3	1	0.7	8	5.6	143	100.0

Note. UPI, unstageable pressure injury.

TABLE 2 Associations between patient and clinical factors and pressure injury (n = 766)

	Pressure injury						
	Absent		Present		Total		
Demographic variable	*n*	%	*n*	%	*n*	%	*p*-Value
Sex							
Masculine	355	79.6	91	20.4	446	100.0	0.146[a]
Feminine	268	83.8	52	16.2%	320	100.0	
Total	623	81.3	143	18.7	766	100.0	
Age (years)							
Median	57.0		61.0		58.0		0.005[b]
Minimum–maximum	17–99		19–93		17–99		
Admission diagnosis							
Digestive	96	15.4	15	10.5	144	14.5	0.189[a]
Neurological	92	14.8	28	19.6	120	15.7	
Circulatory	93	14.9	15	10.5	108	14.1	
Trauma	85	13.6	22	15.4	107	14.0	
Infectious	66	10.6	20	14.0	86	11.2	
Respiratory	65	10.4	18	12.6	83	10.8	
Neoplastic	58	9.3	14	9.8	72	9.4	
Others	50	8.0	5	3.5	55	7.2	
Urological	18	2.9	6	4.2	24	3.1	
Total	623	100.0	143	100.0	766	100.0	
Type of hospitalization							
Clinical	404	80.0	101	20.0	505	100.0	0.056[a]
Elective surgery	107	89.2	13	10.8	120	100.0	
Surgical emergency	112	79.4	29	20.6	141	100.0	
Total	623	81.3	143	18.7	766	100.0	
Palliative care status							
No	620	82.8	129	17.2	749	100.0	<0.001[a]
Yes	3	17.6	14	82.4	17	100.0	
Total	623	81.3	143	18.7	766	100.0	
Exit condition							
Not survivor	78	60.9	50	39.1	128	100.0	<0.001[a]
Survivor	545	85.4	93	14.6	638	100.0	
Total	623	81.3	143	18.7	766	100.0	

(Continues)

TABLE 2 (Continued)

Demographic variable	Pressure injury: Absent n	Absent %	Present n	Present %	Total n	Total %	p-Value
Mattress							
Pyramidal	3	37.5	5	62.5	8	100.0	0.017[a]
Pneumatic	80	81.6	18	18.4	98	100.0	
Conventional	534	81.7	120	18.3	654	100.0	
Total	617	81.2	143	18.8	760	100.0	
Charlson comorbidity index (CCI)							
Median	1		1		1		0.299[b]
Minimum–maximum	0–13		0–9		0–13		
Hospitalization time (in days)							
Median	4		12		4		<0.001[b]
Minimum–maximum	2–78		2–160		2–160		
Simplified acute physiologic II (SAPS II)							
Median	12.8		15.3		12.8		0.205[b]
Minimum–maximum	0.5–86.1		0.5–95.4		0.5–95.4		
Logistic organ dysfunction system (LODS)							
Median	0.3		0.3		0.3		0.087[b]
Minimum–maximum	0.0–14.7		0.0–16.3		0.0–14.7		
Nursing activities score (NAS)							
Median	70		72		71.6		<0.001[b]
Minimum–maximum	26.9–173.1		36–147.8		26.9–173.1		
Number of surgeries							
Median	0		0		0		0.195[b]
Minimum–maximum	0–5		0–4		0–5		
Surgery							
No	558	81.9	123	18.1	681	100.0	0.223[a]
Yes	65	76.5	20	23.5	85	100.0	
Total	623	81.3	143	18.7	766	100.0	
Vasoactive drugs (days)							
Median	0		1		0		<0.001[b]
Minimum–maximum	0–22		0–21		0–5		
Vasoactive drugs							

(Continues)

TABLE 2 (Continued)

Demographic variable	Pressure injury: Absent n	%	Present n	%	Total n	%	p-Value
No	462	87.7	65	12.3	527	100.0	<0.001[a]
Yes	161	67.4	78	32.6	239	100.0	
Total	623	81.3	143	18.7	766	100.0	
Mechanical ventilation (days)							
Median	0		4		0		<0.001[b]
Minimum–maximum	0–39		0–82		0–82		
Mechanical ventilation							
No	425	92.0	37	8.0	462	100.0	<0.001[a]
Yes	198	65.1	106	34.9	304	100.0	
Total	623	81.3	143	18.7	766	100.0	

[a]Pearson's chi-squared test.
[b]Mann–Whitney test.

difference ($p < 0.001$) was found, that is, patients who developed pressure injuries on average remained hospitalized for more days.

Patients who remained on mechanical ventilation had a higher incidence of pressure injury ($p < 0.001$). There was also a statistically significant difference ($p < 0.001$) concerning the mean number of days on mechanical ventilation.

The incidence of pressure injury was higher among patients who were in palliative care ($p < 0.001$), as well as among those who died ($p < 0.001$).

Older patients presented higher incidences of pressure injuries ($p = 0.005$ for the mean, and $p = 0.058$ borderline for the age groups) with higher coefficients after 60 years. When combining the 60–84 years and 85 or more age groups, there was an incidence of 47.8%.

There was also a statistically significant difference ($p < 0.001$) regarding the mean of the NAS. For the patients who developed pressure injury, the mean was 68.5% (*SD* = 16.2), the median was 72%, ranging from 36% to 147.8%. For those who did not develop pressure injury, the mean was 62.4% (*SD* = 17.6), the median was 70%, the minimum was 26.9%, and the maximum was 173.1%. When these results were translated into hours of care, the patients who developed pressure injury required 16.4 hr, while those who did not, required 15 hr of nursing care. Table 2 shows the associations between the variables surveyed and pressure injury.

The logistic regression of associated clinical and demographic variables with the incidence of pressure injury (Table 3) shows that each day of hospitalization increased the odds of pressure injury by 10.9%. Patients on mechanical ventilation present a three times greater chance of developing pressure injuries, and being in palliative care increases the chance of pressure injury by 6.7 times. The increase of each year of age increases the possibility of pressure injury by 10.2%. Finally, each point of the NAS increases the chance of pressure injury by 1.2%. The area under the ROC curve (AUC 0–1), resulted in a good regression model (AUC = 0.82; IC 95% 0.78–0.86).

4 | DISCUSSION

The incidence of pressure injury is considered an essential indicator of the quality of care provided, in addition to being used as a parameter in the evaluation of strategies and protocols for its prevention.

TABLE 3 Predictors of pressure injury incidence ($n = 766$)[a]

Variable	Odds ratio	CI 95%	p-Value
Length of stay	1.091	1.064–1.120	<0.001
Mechanical ventilation	3.352	2.126–5.347	<0.001
Palliative care	6.690	1.939–31.144	0.005
Age	1.019	1.006–1.032	0.003
NAS	1.015	1.003–1.027	0.012

[a]Logistic regression with Simultaneous approach for the variables inclusion.

In this study, the incidence of pressure injury was similar to findings in other studies in Brazil, such as that of Ventura, Moura, and Carvalho (2014), who followed 64 patients hospitalized in a public ICU and found an incidence of pressure injury of 18.8%. However, Becker et al. (2017) found a lower incidence of pressure injury of 13.6% (45), in a prospective cohort of 332 patients admitted to ten ICUs in the state of Paraná.

In the past 10 years, the incidence of pressure injuries in ICUs in Brazil varied from 50.0% (Fernandes & Torres, 2009) to 10.8% (Campanili et al., 2015). Other countries such as Indonesia, USA, and Spain have reported incidences of 33.3% (Suriadi et al., 2007), 3.0% (Frankel, Sperry, & Kaplan, 2007), and 8.1% (González et al., 2018) respectively. Differences in the study population, quality of care provided, the presence of prevention protocols and, especially, design and methods of the studies are some of the factors that may contribute to the variability of the results, making comparisons difficult. However, assuming that most pressure injuries are avoidable adverse events, also due to structural factors such as the nursing workload, the incidence found in the majority of these studies can be considered high.

The significant predictors of the pressure injury incidence were length of hospitalization, mechanical ventilation, palliative care, age and NAS. The length of hospitalization is an important risk factor for the development of pressure injuries and other lesions in critically ill patients. For the patients who participated in this study, each additional day of hospitalization increased the chances of developing pressure injury by 10.9%. The length of ICU stay was also related to the development of pressure injuries in other studies, corroborating the findings of this investigation (Campanili et al., 2015; Cox, 2011; Fernandes & Torres, 2009).

In a study performed with 40 patients hospitalized in two ICUs of a private hospital, one general and the other cardiac, an association was identified between an ICU stay greater than 7 days and the occurrence of two pressure injuries (Fernandes & Torres, 2009).

In another study performed with critically ill patients, the mean ICU stay for patients who developed pressure injuries was 11.7 days compared with 3.3 days for those who did not (Campanili et al., 2015). The logistic regression analysis showed that an ICU stay time of 9.5 days or more also classified pressure injury patients. All these findings confirm a longer ICU stay as one of the predictors for the occurrence of pressure injury.

In our study, patients receiving ventilatory support were 3.4 times more likely to develop a pressure injury. As a frequent intervention in this type of patient, mechanical ventilation may lead to decreased venous return to the heart, left ventricular end-diastolic volume, cardiac output, and hypotension, leading to reduced tissue perfusion. Decreased oxygenation can lead to cell death and tissue necrosis. When pressure on bony prominences is associated with decreased tissue perfusion, this ischaemia leads to the formation of pressure injury (Apostolopoulou et al., 2014); which could explain our findings.

Along with oxygenation problems, mechanical ventilation also makes patients more vulnerable to pressure injury as it limits the possibilities of bed movement. In addition, haemodynamic instability, usually present in patients requiring this type of support, may restrict and even prevent periodic changes in decubitus. A reduction of sensory capacity should also be considered due to sedation and analgesia, to which patients under mechanical ventilation are often submitted, greatly hindering effective changes in their positioning (Apostolopoulou et al., 2014).

In a multicentre prospective cohort in the southwest of Brazil, 80% (72; $p < 0.001$) of patients with invasive mechanical ventilation (mean duration of 10.1 days, $SD = 10.6$) developed pressure injury, directly influencing their incidence (Becker et al., 2017). In a prospective study in two Greek medical and surgical ICUs, an incidence of pressure injury of 29.6% was also identified in patients under mechanical ventilation. Besides density coefficients incidence of 14 pressure injuries per 1,000 mechanical ventilation-days and 13.9 pressure injuries per 1,000 days of patient-stay in the ICU (Apostolopoulou et al., 2014) corroborated our findings.

The end of life is a determining factor for fragility of the skin. Skin, like any other organ, can also die forming wounds known as Kennedy terminal ulcers (KTU) (Yastrub, 2010). When the dying process compromises the homeostatic mechanisms of the body, vital organs are privileged by circulation, resulting in decreased perfusion of the skin and soft tissues, and, consequently, impairment of the metabolic processes of the skin. Small traumas are capable of causing major complications such as friction injury and pressure injury. The tolerance to pressure and friction decreases in such a way that it can be almost impossible to prevent the breakdown of skin integrity and consequent opportunistic infections (Tayyib et al, 2013; Yastrub, 2010).

Risk factors, symptoms, and signs associated with end-of-life skin changes are not very well elucidated and are often related to other factors such as age, preexisting conditions, and adverse drug reactions. Among them, the most frequent are weakness, and progressive limitation of mobility. Loss of appetite and weight, a reduction of tissue perfusion, oxygenation deficiency, and a loss of skin integrity, the latter being due to incontinence, chronic exposure to body fluids, pressure, friction, shearing, and infections, as well as to deficient immune function (Yastrub, 2010).

In this study, being in palliative care increased the odds of pressure injury by 6.7 times. Since changes that occur as a result of the dying process substantially affect the skin and soft tissues, individuals in end-of-life palliative care are considered at high risk for the development of pressure injury. However, in this study, the pressure injuries occurring in elderly and palliative care patients could be a KTU subset, but they were not differentiated.

Moreover, Frank (2016) reported in a follow up cohort of 24 patients at an inpatient palliative care unit, the incidence of skin changes in 16.7% of the patients, with 75% of these changes due to pressure injuries, concluding that the presence of skin changes at the end of the life was an indicator of imminent death ($p = 0.035$). The authors related that physiological changes and susceptibility to ageing diseases compromise the ability of tissues to tolerate pressure and expose the elderly to pressure injuries more than any other at-risk group.

According to this, increasing age is an important predictor in the development of pressure injuries in many settings. Specifically, in critical patients, a number of studies have identified the relationship between advanced age and the development of pressure injury (Campanili et al., 2015; Cox, 2011; Slowikowski & Funk, 2010).

In this study, each extra year was associated with an increase in the odds of pressure injury by 10.1%. This result compares with a study of 347 elderly, critically ill patients, admitted to a medical-surgical ICU, also composed of the elderly, where those who developed pressure injury had an average age of 73 years (Cox, 2011). A higher predisposition of developing age-related pressure injury was also found in a study performed on a cohort in a cardio-pneumological ICU that followed 370 patients, of which 6.48% of patients aged 60 years or older developed pressure injuries. According to logistic regression, an age equal to or superior to 42.5 years more adequately discriminated the group that formed pressure injuries (Campanili et al., 2015).

For this study, the average nursing workload, according to the NAS, was 63.5%; which is equivalent to saying that, on average, 15.2 hr were spent on nursing care per patient-day. National studies, which also used NAS to gauge the nursing workload in the ICU, found average values that varied from 68.1% (Leite, Silva, & Padilha, 2012) to 74.4% (Altafin et al., 2014). In international studies (Carmona-Monge et al., 2013) the averages varied from 65.9% (Lucchini et al., 2014) to 96.2% (Stafseth, Solms, & Bredal, 2011).

The different NAS scores, found in these studies, could be explained by the characteristics of the patients admitted to these ICUs, by the very nature of the hospitals, as well as technical and operational differences in the application of the instrument.

Specifically, for those who developed pressure injuries, the mean of the NAS score was 68.5%, compared with 62.4% for those who did not develop them. For the time spent on interventions performed by the nursing team, these percentages represent 16.4 and 15 hr of nursing care per patient-day for patients with and without pressure injuries, respectively. According to the logistic regression analysis, each NAS point increased the odds of pressure injury by 1.02%. Increased labour demand increases the chances of failures in the execution of pressure injury prevention protocols and, therefore, increases the risk for the occurrence of this adverse event (Gonçalves et al., 2012; Oliveira, Garcia, & Nogueira, 2016).

There is evidence that workload is one of the most important stressors among ICU nurses, interfering with the results of the care provided (Inoue, Kuroda, & Matsuda, 2011). There is also evidence that excessive nursing workload results in an increased incidence of pressure injury in these units (Oliveira et al., 2016).

A cross-sectional study carried out in the medical and surgical clinics of five general hospitals in Kuwait (Al-Kandari & Thomas, 2009) that investigated the nurses' perception of the occurrence of adverse events related to the nursing workload, also showed a correlation between increasing workload and developing pressure injuries. In contrast to this and other previous studies already mentioned, a study performed in three ICUs of a third-level university hospital located in São Paulo; the authors investigated the associations between NAS and Braden scores on the occurrence of pressure injuries. They found no association between nursing workload and the risk of development of pressure injury (Cremasco, Wenzel, Sardinha, Zanei, & Whitaker, 2009). To them, a greater workload meant that the patient would be sufficiently cared for and, consequently, this would reduce the occurrence of pressure injuries.

Taking into account that the incidence of pressure injuries is an indicator of assistance quality, much still needs to be done in the area of prevention, to consider both the condition of the patients and the nursing workload, aiming to reach more acceptable levels.

5 | LIMITATIONS

The review of medical records may incur retrospective bias, that is, the tendency to impute cause when the result is previously known. As the study was based on analyses of medical records and not by direct examination of the patients involved, the actual incidence of pressure injuries may be underestimated (relying on secondary data). There was also difficulty in the lack of uniformity in the diagnostic criteria, as well as in the classification of pressure injuries, among the different hospitalization units. Primarily, in one of the institutions where risk assessment had recently been introduced, there was no protocol of care for the prevention of pressure injuries.

Finally, although the present study was carried out in two institutions of different complexities, it cannot be considered multicentre and, therefore, generalizations should be considered with caution. Further studies are needed to ensure confidence in the effect estimate for all the statistical associations between variables and the incidence of pressure injuries.

6 | CONCLUSIONS

Assuming that pressure injury is an adverse event and that its occurrence is also related to a poorer quality of care, the incidence found here (18.7%) may be considered high. The predictive factors associated with the onset of pressure injury were (a) an older age; (b) being in palliative care; (c) longer hospital stay; (d) mechanical ventilation and (e) nursing workload.

7 | IMPLICATIONS FOR NURSING MANAGEMENT

The incidence of pressure injuries is still high in intensive care units, due to the characteristics of patients and the limitations of care for some risk groups. This study supports the existing evidence concerning the development of pressure injuries while identifying a new, important predictive factor. Additional nursing resources may assist in reducing the rates of pressure injury.

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ETHICAL APPROVAL

The project was approved by the Research Ethics Committees of two institutions: University Hospital (HU), University of São Paulo: Approval CEP-HU-USP No. 1086/10; Hospital das Clínicas of Medical School, University of São Paulo HCFMUSP: CAPpesq No. 0196/11.

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