

# ICU Admission Day Braden Risk Assessment Score Association with the Development of Pressure Ulcers in Critically Ill Patients

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## ABSTRACT

**Objectives:** This study aims to investigate the association between patient pressure ulcer prevalence and Braden risk assessment scores on the first day of ICU admission.

**Design:** This study was designed as a prospective cohort study. **Settings:** The survey was performed in medical and General ICUs of AlBasheer Hospital in Jordan from December 1, 2023, to January 31, 2024.

**Materials and methods:** The Braden Risk Assessment Scale was used to prospectively analyze data from a cohort of hospitalized acutely sick patients to determine the patient's risk of developing pressure ulcers on the first day of intensive care unit admission. Patients were divided into two groups based on whether they had pressure ulcers. Four risk groups were identified based on their Braden scores: extremely high risk (scores of nine or less), high risk (scores of ten to twelve), moderate risk (scores of thirteen to fourteen), and low risk (scores of fifteen to eighteen). For every patient, the existence or lack of pressure ulcers was noted. The relationship between pressure and Braden risk assessment scores was examined using a cross-tabulation technique.

**Results:** A sample of sixty people participated in this study. A total of 27 individuals experienced at least one pressure ulcer throughout their stay, translating to a 45% incidence of pressure ulcers. According to the univariate analysis, the Braden scale was linked to the emergence of pressure ulcers.

**Conclusion:** The Braden Scale from the initial day of ICU admission is a reliable indicator of the occurrence of pressure ulcers during the inpatient stay. Therefore, management efforts for pressure ulcer risk should focus on early skin examination.

**Keywords:** Pressure ulcers, Braden Scale, acutely ill patients

## INTRODUCTION

According to the Revised National Pressure Ulcer Advisory Panel, pressure ulcers (PUs) are limited injuries to the skin and soft tissue beneath. The staging system for pressure injuries is usually over bony prominence or connected to medical or other equipment. The wound may cause pain and manifest as an open ulcer or undamaged skin. The injury is brought on by shear with either strong, continuous, or both types of pressure. The capacity of a tissue to tolerate pressure and shear can also be impacted by microclimate, concurrent disorders, nutrition, perfusion, and soft tissue conditions [1].

Inpatients frequently have this problem, particularly in critical care units (ICUs). These patients are more complex comorbid patients, have unstable hemodynamics, elevated tissue pressure, or cannot react appropriately to tissue pressure due to analgesia, sedation, mechanical ventilation, prolonged bed rest, and/or muscle relaxant use [2, 3]. Study design affected the incidence, which ranged from 3.3% to 59.4% [3, 4, 5, 6, 7, 8, 9, 10].

Increased morbidity, death, and a lower quality of life are among the various unfavorable health consequences that patients with pressure ulcers are more likely to experience [3, 11]. Even while some PUs cannot be prevented [12, 13], active prevention is still essential for reducing the likelihood of PUs. Furthermore, it is a nursing care indication of the quality of care that necessitates a personalized treatment plan to reduce or manage PU risk factors [7]. Early identification of patients who are at risk is, therefore, a complex problem. There are currently

instruments for assessing the risk of pressure ulcers. There isn't yet a tool that works well in every clinical context because it depends on the different kinds of care, the abilities of healthcare professionals, and potential risk factors in diverse settings [8, 14].

Accurate risk assessment is hampered by the absence of a PI risk assessment scale designed specifically for critical care patients.[15] Currently, the most used instrument for determining PI risk is the Braden Scale [16], which is advised to be utilized by clinical practice guidelines. It has been discovered that PI can be significantly predicted by the subscales measuring sensory perception, wetness, movement, and shear, but not by the subscales measuring activity and nutrition. [17] Systematic evaluations have demonstrated that there is still debate regarding the Braden Scale's direct applicability to intensive care units [18]. Therefore, this study aimed to assess the predictive usefulness of the Braden scale in PI with good diagnostic features in an intensive care setting and ascertain whether the Braden scale on Day 1 of ICU admission corresponded with the likelihood of PIs in patients receiving critical care. Healthcare professionals may use this tool to risk-stratify patients at the beginning of their treatment.

## MATERIALS AND METHODS

**Study design:** This study was designed as a prospective cohort study.

**Setting:** The survey was performed in medical and General ICUs of AlBasheer hospital in Jordan from December 1, 2023, to January 31, 2024.

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**Participants:** The following patients met the inclusion criteria: (1) They had to be at least 18 years old at the time of admission; (2) They had to be free of pressure ulcers in categories or stages I through IV at the time of the initial skin and tissue integrity evaluation. Patients who had palliative treatment, were discharged to another site, developed new pressure ulcers, or passed away were not included in this study.

**Variables:** The study's main focus was the development of PU in any part of the body, its stage from I to IV, and its location based on the Braden scale on the first day of ICU admission.

**Instrument**

- **Braden scale:** The Braden scale is the most often utilized instrument in the clinical setting. It was created in the US [19] and validated in several other nations, in non-ICU and ICU settings [20, 21, 22, 23]. Its six constituent elements include sensory function, hydration, activity, movement, nourishment, shearing force, and friction . It uses a three- or four-point rating system, and the sum of the scores falls between 6 and 23. Lower scores are associated with an increased risk of developing pressure ulcers. In critical care, the cut-off marks have ranged from 12 to 13. Its sensitivity and specificity at the 12-point cut-off were 55.8% and 66.7% on the first day of admission and 77.8% and 73.4% on the second. Its sensitivity and specificity were 81% and 66%, respectively, at the 13-cut-off point [20].
- **Skin assessment tool:** The skin condition that delineated the bony prominences was evaluated using a skin assessment tool that requested the assessor to grade the presence or absence of lesions at each place. To stage any lesion on any skin surface that might be connected to pressure, we applied the following criteria: I non-blanchable erythema (II) blisters and abrasions; III) skin breaks that expose subcutaneous tissue; IV) skin breaks that show and/or extend into bone or muscle [24]. Non-blanchable erythema that persisted in the same area for two study days in succession (at intervals of 48–72 hours).

**Procedure:** All potential patients were invited to participate in the trial. After consent, patient data was then collected. If patients were unable to provide consent, the paperwork would be signed by their caretakers. Patient demographics were included in the clinical data every 24 hours and at admission to the intensive care units. These were the existence of pressure ulcers, the duration of hospitalization, the use of mechanical ventilation, age, sex, and the initial cause for ICU admission. Every 24 hours, a skin assessment tool was also distributed in compliance with the ICU routine pressure-ulcer evaluation procedure, with the Braden

scale being assessed on the first day. Patients were categorized as either having developed a pressure ulcer at the time of assessment during their ICU stay; or as not developing one, and they remained in the non-pressure ulcer group until they met the termination requirements.

**Statistical analysis:** Descriptive statistics, such as the mean, standard deviation, median, interquartile range, frequency, and percentage, were used for the statistical analysis. The chi-square test was employed for categorical variables, and the Mann-Whitney or Student's t-test was utilized for continuous variables. P values less than 0.05 were deemed statistically significant. IBM SPSS Statistics for Windows, version 22.0, was used for statistical analysis (IBM Corp).

**RESULT**

The percentage of patients with pressure ulcers was 45% . The highest percentage (81.5% & 69.7%) of patients were male in the group of patients with and without pressure ulcers, respectively. The mean and SD of age was 45.96±16.02 in patients with pressure ulcers, versus 39.39±13.45 in patients without pressure. Patients with spinal cord injury were the most common diagnosis (40.7%) in patients with pressure ulcers, versus (39.4%) in patients without pressure ulcers. Among patients with immobility, (88.9%) of patients had pressure ulcer. The mean and SD of ICU stay in patients with pressure ulcers was 21.70±5.58 versus 19.90±5.75 in patients without pressure ulcers. Patients with pressure ulcer have a mean duration of mechanical ventilation connection of 11.9 days, with a standard deviation 2.7. In contrast, patients without pressure ulcer have a mean duration of 9.9 days, with a standard deviation of 3.16. The p-value of <0.05 indicates a statistically significant difference in mobility and duration of mechanical ventilation connection (Table 1).

Regarding skin health assessment in patients with and without pressure ulcer groups. Moisture, skin turgor, tissue perfusion, and skin integrity has had statistically significant differences at on discharge day (Table 2). Regarding subscale of the Braden risk assessment subscale on day one of ICU admission, it was noticed that moisture, mobility, nutrition, and friction were significant predictors of PU development (Table 3).

Most patients assessed as "Very High Risk" (scores ≤ 9) by the total Braden risk assessment score on day one developed pressure ulcer (59.3%), followed by 25.9% of patients who developed pressure injuries in the "High Risk" group (scores 10-12) of Braden. A highly significant p-value of 0.001\* indicates a strong association between the Braden risk assessment scale and the development of pressure injuries (Table 4).

**Table 1.** Patients' Demographic and Clinical Data

		Presence of Pressure Ulcer		P value
		Yes (27)	No (33)	
Age (Mean ± Sd)		45.96±16.02	39.39±13.45	
Sex	Male	22(81.5%)	23(69.7%)	0.29
	Female	5(18.5%)	10(30.3%)	
Diagnosis	Respiratory Failure	4(14.8%)	6(18.2%)	0.52
	Traumatic Brain Injury	9(33.3%)	11(33.3%)	
	Renal Failure	1(3.7%)	3(9.1%)	
	Spinal Cord Injury	11(40.7%)	13(39.4%)	
	Diabetic Ketoacidosis	2(7.4%)	0(0.0%)	
Immobility	Yes	24(88.9%)	2(6.1%)	0.001*
	No	3(11.1)	31(93.9%)	
Length of ICU Stays (Mean ± SD)		21.70±5.58	19.90±5.75	0.22
Duration of Connection with Mechanical Ventilation (Mean ± SD)		11.92±2.75	9.90±3.16	0.01*

**Table 2.** Day One Patient Skin Assessment Frequency Distribution **DISCUSSION**

			Presence of Pressure Ulcer		P value
			yes	no	
Temperature	Day One	Normal	24(88.9%)	31(93.9%)	0.48
		Fever	3(11.1%)	2(6.1%)	
	Discharge Day	Normal	24(88.9%)	29(87.9%)	0.9
		Fever	3(11.1%)	4(12.1%)	
Color	Day One	Pink	6(22.2%)	9(27.3%)	0.65
		Pallor	21(77.8%)	24(72.7%)	
	Discharge Day	Pink	3(11.1%)	17(51.5%)	0.001*
		Pallor	24(88.9%)	16(48.5%)	
Moisture	Day One	Moist	13(48.1%)	22(66.7%)	0.03*
		Excessive moist	5(18.5%)	0(0.0%)	
		Dry	9(33.3%)	11(33.3%)	
	Discharge Day	Moist	6(22.2%)	23(69.7%)	0.001*
Excessive moist		5(18.5%)	0(0.0%)		
Turgor	Day One	Normal (< 3Sec)	13(48.1%)	31(93.9%)	0.001*
		Impaired (>3Sec)	14(51.9%)	2(6.1%)	
	Discharge Day	Normal (< 3Sec)	8(29.6%)	31(93.9%)	0.001*
		Impaired (>3Sec)	19(70.4%)	2(6.1%)	
Tissue perfusion	Day One	Normal	10(37%)	33(100%)	0.001*
		Decreased	17(63%)	0(0.0%)	
	Discharge Day	Normal	6(22.2%)	31(93.9%)	0.001*
		Decreased	21(77.8%)	2(6.1%)	
Skin Integrity	Day One	Intact	27(100%)	33(100%)	-
	Discharge Day	Intact	0(0.0%)	33(100%)	0.001*
		Pressure Ulcer	27(100%)	0(0.0%)	

**Table 3.** Day One Subscale Braden Risk Assessment Frequency Distribution for Patients with or without Pressure Ulcers

		Presence of Pressure Ulcer		Total
		Yes	No	
Sensory Perception	Completely Limited	13(48.1%)	10(30.3%)	0.2
	Very Limited	12(44.4%)	16(48.5%)	
	Slightly Limited	2(7.4%)	7(21.2%)	
Moisture	Constantly Moist	3(11.1%)	0(0.0%)	0.001*
	Very Moist	14(51.9%)	2(6.1%)	
	Occasionally Moist	8(29.6%)	3(9.1%)	
	Rarely Moist	2(7.4%)	28(84.8%)	
Activity	Bedbound	27(100%)	33(100%)	-
Mobility	Completely Immobile	19(70.4%)	13(39.4%)	0.02*
	Very Limited	8(29.6%)	15(45.5%)	
	Slightly Limited	0(0.0%)	5(15.2%)	
Nutrition	Very Poor	12(44.4%)	2(6.1%)	0.001*
	Probably Inadequate	10(37%)	0(0.0%)	
	adequate	3(11.1%)	11(33.3%)	
	excellent	2(7.4%)	20(60.6%)	
Friction and Shear	Problem	9(33.3%)	0(0.0%)	0.001*
	Potential Problem	16(59.3%)	6(18.2%)	
	No Apparent Problem	2(7.4%)	27(81.8%)	

**Table 4.** Day one Total Score of Braden Risk Assessment Frequency Distribution for Patients with or without Pressure Ulcers

		Presence of Pressure Ulcer		P Value
		Yes	No	
Braden Scale (Mean ±SD)		9.70±2.21	15.09±1.68	0.001*
Braden Risk Assessment Score	Very High Risk (Scores Equal To Or Lower Than 9)	16(59.3%)	0(0.0%)	0.001*
	High Risk (Scores Between 10 And 12 Points)	7(25.9%)	2(6.1%)	
	Moderate Risk (Scores Between 13 And 14 Points)	3(11.1%)	7(21.2%)	
	Low Risk (Scores Between 15 And 18 Points)	1(3.7%)	24(72.7%)	

**Table 5.** Day of Discharge Pressure Ulcer Stages and Location Frequency Distribution

		Presence Of Pressure Ulcer
		Yes
Pressure Ulcer Stages	First "Non-Bleachable Erythema	21(77.8%)
	Second "Partial Thickness Of Skin Loss	5(18.5%)
	Third "Full Thickness Of Skin Loss	1(3.7%)
Pressure Ulcer Location	Occiput	3(11.1%)
	Heel	5(18.5%)
	Buttock	5(18.5%)
	Occiput And Buttock	3(11.1%)
	Sacrum And Buttock	1(3.7%)
	Ischium And Buttock	2(7.4%)
	Sacrum And Heal	2(7.4%)
	Heal And Elbow	1(3.7%)
	Heal And Buttock	5(18.5%)

Regarding pressure ulcer stages and the location on the day of discharge, the results indicated that the first "non-bleachable erythema" was the most common stage of PU with a percentage of 77.8. There is a notable variation in pressure injuries across different anatomical locations. Heal and buttock injuries are the most prevalent (18.5 %) in patients, with pressure injuries (Table 5).

The results of this study illustrated that the Braden scale is more accurate in determining the likelihood of getting pressure ulcers (PU) in critically sick patients on the first day of ICU admission. By identifying individuals most prone to acquiring pressure ulcers (PU), risk assessment techniques enable a greater focus on preventative therapy for this patient subgroup. Nonetheless, a recent study discovered that implementing PU preventive measures for every patient, irrespective of risk classification, was the most economical approach.[26] However, when choosing preventive actions that aren't practical for every patient due to cost or availability, a tool with good accuracy can be helpful. [27]

The Braden scale is the most widely utilized measure when evaluating a critically ill patient's risk of suffering pressure injury (PI). The Braden scale's AUROC to distinguish between the PI's development and progression was 0.78 in a meta-analysis.[28] The Braden scale also performed poorly in different cohort research, indicating the need for either change to this instrument or the creation of new ones with higher predictive capacity.[29] In the same study, it was discovered that patients who were more seriously ill—those who needed renal replacement therapy, MV, or vasopressors—performed much worse on the Braden scale.[29] These conclusions were not supported by the current study's findings, which showed that the Braden scale had an excellent predictive capacity for the PI's development.

In this most recent study, the incidence of pressure ulcers was 45%. Most patients have a mean age of 45 years, and most of them have spinal cord injury. Most patients in the Brazilian study [30] were surgical, and less than half of the cases involved vasopressors. Thirty-five percent of cases had PI. Merely 20% and 17% of patients with PI in the Thai [31] research, utilized MV and vasopressors, respectively. Merely 11% of cases were PI. With an incidence of PI of 56.9%, the group in this paper was older, required more MV and vasopressors, and spent more time in the intensive care unit. Variations in ICU-acquired PI rates can be attributed to multiple factors. It is essential to consider case-mix and regional elements like staffing levels and PI preventive action protocols. [32] This discrepancy may be explained by the patients' higher severity and the study's poor adherence to preventative measures.

The Mobility, Activity, and Sensory Perception subscales of the Braden scale represent risk variables that are theoretically different but linked. [33,34] Because these three risk factors—impaired sensory perception, decreased activity, and altered mobility—often coexist in the clinical situation, particularly in the ICU population, it can be challenging to assess the relative contributions of each factor to overall PU risk. In two investigations, including critical care patients, the Moisture subscale significantly predicted PU development [35]. These results corroborated our findings that illustrated the subscale of Braden risk assessment on day one of ICU admission, as moisture, mobility, nutrition, and friction were significant predictors of PU development.

Most of the study's "Very High Risk" participants experienced pressure injuries on day one, with a significant p-value of 0.001\*. This suggests that because scores draw attention to weak areas and emphasize the value of ongoing evaluation, they are essential for determining the likelihood that a pressure injury would develop. A literature review also confirmed a significant difference (P = 0.001) in the scores of critical patients with and without pressure damage using univariate analysis. The mean Braden scale risk score for patients with pressure injuries was 11 (with a range of 8 to 19) [36]. For patients with pressure injury, other authors found a median Braden scale risk score of 10 (high risk); values ranged from 6 to 19, and 59% were at high risk. The median Braden risk score for individuals without pressure injury was 14 (range 8–20); 68% of these patients had a moderate risk of developing pressure injury (P = 0.003) [37].

## CONCLUSION

**The crosstabulation of Braden risk assessment scores and pressure ulcers on day one provides valuable information for healthcare practitioners. It reinforces the importance of accurate risk assessment for identifying individuals at higher risk of developing pressure ulcers. However, it also highlights that pressure ulcers can occur in patients across all risk categories, albeit with varying frequencies. This underscores the need for individualized care plans and ongoing vigilance to prevent pressure ulcer development in all patients. Further research may be warranted to explore the specific factors contributing to the outcomes observed in each risk category, which could lead to more precise risk assessment and prevention strategies.**

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acquisition, analysis and interpretation of data; (2) drafting the article and revising it critically for important intellectual content; and (3) final approval of the manuscript version to be published. Yes

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**Competing Interest:** None

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