ORIGINAL ARTICLE

Comparison of Braden Score vs APACHE to Predict Occurrence of Bed Sores in a Tertiary Care ICU

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Received on: 31 December 2024; *Accepted on*: 22 January 2025; *Published on*: 31 January 2025

Abstract

Introduction: Pressure sores, or bedsores, pose a challenge in intensive care unit (ICU) care due to patients' immobility and compromised circulation. This study explores the effectiveness of the Braden Scale and acute physiology and chronic health evaluation II (APACHE II) in predicting pressure sore occurrences.

Materials and methods: Conducted over a year in an Indian ICU, this observational study assessed the predictive capability of both scores. Participants (≥18 years) underwent Braden and APACHE II assessments upon admission, with daily monitoring for pressure sore development. Statistical analysis compared scores and ulcer occurrences.

Results: Older patients, particularly males, showed a higher tendency for ICU admission. 20.3% had pressure ulcers, significantly correlating with lower Braden and higher APACHE II scores. Acute physiology and chronic health evaluation II showed superior efficiency in predicting ulcers.

Discussion: While Braden scores' variability was less in ICU patients, APACHE II scores reflected acute illness severity, strongly correlating with ulcer incidence. The study advocates for a combined utilization of both scores for tailored interventions.

Conclusion: Acute physiology and chronic health evaluation II demonstrated better efficiency in predicting pressure ulcers, while the Braden score remains valuable for focused assessments. The study highlights the importance of considering age, gender, acute health status, and localized risk factors in ICU pressure ulcer assessment.

Future directions: Further research might explore integrated scoring systems or protocols combining the strengths of both scores for more precise risk assessment in ICU settings.

Keywords: Acute physiology and chronic health evaluation II, Braden score, Pressure sores.

Indian Journal of Critical Care Medicine (2025): 10.5005/jp-journals-10071-24908

Introduction

Pressure sores, also referred to as pressure ulcers or bedsores, manifest as localized injuries to the skin and underlying tissue due to prolonged pressure, posing a common challenge in intensive care unit (ICU) patients, who frequently experience immobility and compromised circulation.[1] Several risk factors contribute to their occurrence, including immobility, impaired circulation, altered skin sensation, incontinence, malnutrition, hypotension, mechanical ventilation, and the use of medical devices.[2] These pressure sores commonly appear on the sacrum, heels, buttocks, elbows, occiput (back of the head), greater trochanters (outside of the hips), and malleoli (ankle bones).[3]

The severity of pressure sores is categorized into four stages, ranging from skin redness (stage I) to extensive tissue involvement, including muscle or bone (stage IV). Prevention is crucial, involving nurse-led assessments of risk factors, cautious patient positioning, and the utilization of pressure-relieving equipment. This preventive approach extends to maintaining optimal skin care, ensuring proper nutrition and hydration, managing incontinence, and addressing underlying medical conditions. Treatment strategies vary based on the stage of the wound, ranging from basic preventive measures for stage I to more intensive interventions like debridement and dressings for stages II and III, and potential surgery for stage IV. Ultimately, early prevention and prompt treatment are pivotal in managing pressure sores as a consequential complication of ICU care.[4]

The Braden scale, a widely adopted nursing assessment tool, plays a pivotal role in evaluating the risk of pressure sore development in ICU patients, given their heightened susceptibility due to immobility, compromised circulation, and other related factors.[5] This assessment tool examines six key risk factors: Sensory perception, moisture, activity, mobility, nutrition, and friction/shear, assigning scores ranging from 1 to 4 for each factor, with higher scores indicating lower risks. The cumulative Braden score spans from 6 to 23, with higher scores signifying a reduced likelihood of pressure sores. Interpretation of the scores classifies patients into different risk categories, ranging from very low to very high risk. In ICU settings, utilizing the Braden scale aids in identifying high-risk patients, enabling the development of tailored preventive care strategies.

The acute physiology and chronic health evaluation (APACHE) II scoring system is a well-established and widely used

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How to cite this article: Maqbool K, Chauhan M, Dewan S. Comparison of Braden Score vs APACHE to Predict Occurrence of Bed Sores in a Tertiary Care ICU. Indian J Crit Care Med 2025;29(2):164–169.

Source of support: Nil

Conflict of interest: None

severity-of-disease classification method in critical care medicine. It was developed to assess the severity of illness in critically ill patients admitted to ICUs. Acute physiology and chronic health evaluation II incorporates physiological parameters, age, and chronic health status to generate a numerical score that helps clinicians evaluate the severity of a patient's condition and predict the risk of mortality.[6]

This scoring system considers various physiological measurements such as temperature, mean arterial pressure, heart rate, respiratory rate, arterial pH, serum sodium levels, hematocrit, white blood cell count, and Glasgow Coma Scale score within the first 24 hours of ICU admission.

Additionally, it accounts for the patient's age and any chronic health conditions present before admission.[7]

Several studies have shed light on the multifaceted pathogenesis of pressure ulcers, emphasizing the intricate interplay of factors contributing to their development. Investigations into cellular and molecular mechanisms associated with ischemia underline the critical role of compromised blood flow in tissue damage. Additionally, the role of inflammation in pressure ulcer pathogenesis, underscores the impact of immune responses on tissue integrity.[7,8]

Microbial colonization, infection, and neurological factors further complicate wound healing processes.[7] Considering these complexities, the comprehensive nature of critical illness factors encompassed within the APACHE II score such as hemodynamic instability, ventilatory requirements, and vasopressor use suggests its potential as a robust predictor for bed sore formation in critically ill patients. The inclusion of these critical health indicators in the APACHE II score may provide a more holistic approach to risk assessment for pressure ulcers in this vulnerable population.

Aim of the Study

The primary aim of this study was to evaluate and compare the predictive efficacy of the Braden scale and the APACHE II scoring system in anticipating pressure sore occurrences among patients admitted to a medical ICU over a 1-year period.

Objectives

- To assess the prevalence of pressure ulcers among patients in the medical ICU.
- To evaluate the association between Braden scores and the occurrence of pressure ulcers.
- To analyze the relationship between APACHE II scores and the presence of pressure ulcers.
- To compare the efficacy of the Braden scale and APACHE II scores in identifying pressure ulcers among ICU patients.
- To determine if there's a significant difference in the predictive abilities of the Braden scale and APACHE II scores in detecting pressure ulcers.
- To highlight potential strategies for risk assessment and prevention of pressure ulcers among critically ill ICU patients, based on the findings of the study.

Materials and Methods

In this investigation, we adopted an observational study design to assess the predictive efficacy of both the Braden scale and the APACHE II scoring system in anticipating pressure sore occurrences among patients admitted to a medical ICU over a duration of 1 year. Our participant pool comprised all adult individuals (age ≥ 18 years) admitted to the medical ICU during the study period, excluding patients with pre-existing pressure sores upon admission. Upon ICU admission, each patient underwent assessment using both scoring methods: The Braden score, evaluating sensory perception, moisture, activity, mobility, nutrition, and friction/shear factors, and the APACHE II score, considering physiological parameters, age, and chronic health conditions within the initial 24 hours of admission. Throughout their ICU stay, healthcare professionals conducted daily assessments to monitor pressure sore development, documenting occurrence, severity, and location. The collected data underwent statistical analysis to compare the predictive capabilities of the Braden and APACHE II scores for pressure sore occurrence, utilizing descriptive statistics, appropriate statistical tests (e.g., Chi-square test), and receiver operating characteristic (ROC) curve analysis. Ethical guidelines were strictly adhered to, obtaining necessary approvals from the Institutional Review Board (IRB) or Ethics Committee. This methodology aimed to elucidate the potential of these scoring systems in guiding preventive strategies against pressure sore occurrences among critically ill ICU patients.

Results

The study comprised a sample where 80.5% of patients were aged 50 years or older, signifying a significantly higher prevalence compared to patients under 50 years (19.5%). This indicated a higher tendency for ICU admission among the older age-group. Additionally, the male-to-female ratio was 1.6:1, with males constituting 61.8% and females 38.2%. Notably, males were found to be at a higher risk of ICU admission than females in this study.

Regarding skin conditions, a substantial majority (79.7%) of patients had intact skin, significantly outnumbering those with other skin issues. Notably, the prevalence of pressure ulcers among ICU patients in this study was 20.3%.

The analysis revealed a significant association between Braden scores and pressure ulcers among patients, showcasing a higher occurrence of high to severe Braden scores among those with pressure ulcers compared to those without.

Interestingly, while there was no significant difference in the mean age between patients with and without pressure ulcers, there were significant differences observed in the mean Braden and APACHE II scores. Specifically, patients with pressure ulcers exhibited significantly lower mean Braden scores and higher mean APACHE II scores compared to patients without pressure ulcers.

In summary, this study highlighted the higher vulnerability of older individuals, particularly males, to ICU admission. It also emphasized the prevalence of pressure ulcers among ICU patients and showcased the potential utility of APACHE II scores over Braden scores in efficiently detecting pressure ulcers, despite their distinct characteristics and assessment approaches.

Discussion

The study's observation in Table 1 of a significantly higher percentage (80.5%) of patients aged 50 years or older being admitted to the ICU underscores the vulnerability of this demographic group. This finding suggests a potential correlation between age and the need for intensive care, possibly due to age-related health complications or a higher prevalence of chronic conditions among older individuals.

Additionally, the study noted a gender disparity, depicted in Table 2, with males constituting 61.8% of the sample, displaying a

Table 1: Age of the patients

Age (in years)	*Number*	*%*
<20	1	0.8%
20–34	7	5.7%
35–49	16	13.0%
50–64	33	26.8%
65–79	44	35.8%
80–94	22	17.9%
Total	123	100.0%
Mean ± S.D.	63.64 ± 16.27	
Median	65	
Range	16–93	

About 80.5% of the patients were with age ≥50 years, which was significantly higher than the patients with age <50 years (19.5%) ($Z = 10.46$; $p < 0.0001$). Thus, in this study, ICU admission was more prevalent among the patients with age ≥50 years

Table 2: Gender of the patients

Gender	*Number*	*%*
Male	76	61.8%
Female	47	38.2%
Total	123	100.0%
Male:Female	1.6:1	

The ratio of male and female (Male:Female) was 1.6:1. The proportion of males (61.8%) was significantly higher than that of females (38.2%) ($Z = 3.39$; $p = 0.0007$). Thus, in this study, the males were at higher risk of ICU admission than females

Table 3: Pressure ulcer

Pressure ulcer	*Number*	*%*
Present	25	20.3%
Absent	98	79.7%
Total	123	100.0%
No risk (>19)	*7*	*5.7%*
Total	123	100.0%
Mean ± S.D.	14.85 ± 2.32	
Median	14	
Range	9–20	

20.3% of the patients were having pressure ulcer. Thus, in this study the prevalence of pressure ulcer was 20.3% among the ICU patients

higher tendency for ICU admission compared to females (38.2%). This disparity could be multifactorial, possibly stemming from differences in health- seeking behavior, biological factors, or varying susceptibility to certain health conditions between genders. Such insights emphasize the need for tailored healthcare approaches considering age and gender-specific vulnerabilities.

The study's examination of skin conditions (Table 3) among ICU patients revealed that a majority (79.7%) had intact skin, but a notable proportion (20.3%) suffered from pressure ulcers. This substantial prevalence of pressure ulcers in the ICU setting warrants attention, considering the associated risks, discomfort, and potential complications for patients. The association between Braden scores and pressure ulcers highlighted a significant finding,

Table 4: Braden score

Braden score	*Number*	*%*
Severe risk (<9)	1	0.8%
High risk (10–12)	24	19.5%
Moderate risk (13–14)	43	35.0%
Mild risk (15–18)	48	39.0%

Moderate to high score (54.5%) was significantly higher than other scores ($Z = 3.38$; $p = 0.0007$)

Table 5: APACHE-II score

APACHE-II score	*Number*	*%*
5–9	41	33.3%
10–14	28	22.8%
15–19	27	22.0%
20–24	17	13.8%
25–29	9	7.3%
30–34	1	0.8%
Total	123	100.0%
Mean ± S.D.	13.92 ± 6.64	
Median	12	
Range	5–31	

Moderate to high score (54.5%) was significantly higher than other scores ($Z = 3.38$; $p = 0.0007$). Furthermore, statistical analysis demonstrated a significant association between APACHE-II Score and the presence of pressure ulcers among patients

indicating that patients with pressure ulcers displayed higher occurrences of high to severe Braden scores (score < 14) as stated in Table 4. This observation underscores the relevance of the Braden score in assessing the risk of pressure ulcers by focusing on factors contributing to compromised skin integrity.

The study's comparison between the Braden and APACHE II scores (Tables 4 and 5) yielded intriguing insights. Although no significant difference in mean age existed between patients with and without pressure ulcers, distinct variations were noted in mean Braden and APACHE II scores.

Patients with pressure ulcers exhibited significantly lower mean Braden scores (Table 6) and higher mean APACHE II scores (Table 7) compared to patients without pressure ulcers. This emphasizes the relevance of both scores in identifying patients at risk, with the Braden score assessing localized risk factors and the APACHE II score evaluating acute health status and disease severity.

The Braden score, assessing sensory perception, moisture, activity, mobility, nutrition, and friction/shear, focuses on localized risk factors for pressure ulcers. In contrast, the APACHE II score evaluates acute physiology and chronic health conditions, offering a broader assessment of acute health status and disease severity.[7,9] In the context of ICU patients, it's evident that most, if not all, of these Braden score components are nearly universally present. Intensive care unit patients typically experience compromised sensory perception due to their critical health status, often have issues related to moisture and immobility, might be sedated or unconscious impacting activity levels, have varied nutritional needs, and are susceptible to friction/shear due to positioning aids and medical equipment.

Table 6: Braden score and pressure ulcer

	Pressure ulcer		
Braden score	*Present*	*Absent*	*Total*
No risk	0 (0.0%)	7 (7.1%)	7 (5.7%)
Low	0 (0.0%)	0 (0.0%)	0 (0.0%)
Mild	6 (24.0%)	42 (42.9%)	48 (39.0%)
Moderate	11 (44.0%)	32 (32.7%)	43 (35.0%)
High	7 (28.0%)	17 (17.3%)	24 (19.5%)
Severe	1 (4.0%)	0 (0.0%)	1 (0.8%)
Total	25 (100.0%)	98 (100.0%)	123 (100.0%)

$\chi^2 = 10.41$; $p = 0.041$; S, significant. Chi-square (χ^2) test showed that there was significant association between Braden score and pressure ulcer of the patients ($p = 0.041$). High to severe Braden score was significantly higher among the patients with pressure ulcer (76.0%) than the patients without pressure ulcer (50.0%) ($p < 0.0001$)

Table 7: APACHE-II score and pressure ulcer

	Pressure ulcer		
APACHE-II score	*Present*	*Absent*	*Total*
5–9	0 (0.0%)	41 (41.8%)	41 (33.3%)
10–14	1 (4.0%)	27 (27.6%)	28 (22.8%)
15–19	7 (28.0%)	20 (20.4%)	27 (22.0%)
20–24	9 (36.0%)	8 (8.2%)	17 (13.8%)
25–29	7 (28.0%)	2 (2.0%)	9 (7.3%)
30–34	1 (4.0%)	0 (0.0%)	1 (0.8%)
Total	25 (100.0%)	98 (100.0%)	123 (100.0%)

$\chi^2 = 49.26$; $p < 0.001$; S, significant, Chi-square (χ^2) test showed that there was significant association between APACHE-II score and pressure ulcer of the patients ($p < 0.001$)

Conversely, in ward patients, variability in Braden scores might be more pronounced. Some ward patients may be more immobilized, potentially affecting their activity and mobility scores. The variability arises from a diverse spectrum of health conditions and functional statuses observed among ward patients, leading to a wider range of Braden scores within this population.

While specific data on ward patients are absent from this study, it's notable that the Braden score components are largely present in ICU patients, potentially limiting its utility in this setting. Intensive care unit patients often exhibit complex health conditions encompassing factors such as the use of vasopressors, hemodynamic instability, and specific ventilatory requirements, all of which are comprehensively encapsulated within the APACHE II score. This broader inclusion of critical health indicators in the APACHE II score might result in increased variability, potentially rendering it a more effective predictor for pressure ulcer formation in the ICU. Contrarily, the perceived suitability of the Braden score for ward patients stems from its relevance to factors such as activity, mobility, and sensory perception, which might be more variable in ward settings.[8] However, the absence of direct study data on ward patients limits the definitive determination of the Braden score's effectiveness in this context. In summary, while the APACHE II score incorporates crucial variables potentially linked to pressure ulcer development in ICU patients, further investigation specifically focusing on ward patients is warranted to ascertain the most effective risk assessment tool for different healthcare settings.

Table 8: Comparison of parameters of the patients with and without pressure score

Parameters	*Pressure score*	*n*	*Mean*	*S.D.*	*T*	*p-value*
Age	Present	25	64.56	12.85	0.372	0.712 NS
	Absent	98	63.41	17.08		
Braden score	Present	25	13.64	1.89	3.42	<0.001 S
	Absent	98	15.16	2.33		
APACHE II score	Present	25	22.00	4.66	9.41	<0.001 S
	Absent	98	11.86	5.38		

There was no significant difference in the mean age of the patients with and without pressure ulcer ($p = 0.712$). The mean Braden score of the patients with pressure ulcers was significantly lower than the patients without pressure ulcers ($p < 0.001$). The mean APACHE II score of the patients with pressure ulcers was significantly higher than the patients without ($p < 0.001$). The study revealed that the AUC of the APACHE II score in detecting pressure ulcers was significantly superior to that of the Braden score. Consequently, the APACHE II score was deemed more efficient in detecting pressure ulcers than the Braden score in this study

Contrasting this with the APACHE II score, the variability in scores was notably higher as seen in Table 5. Higher APACHE II scores, indicative of more severe acute health conditions, were found to be associated with a greater incidence of pressure ulcers. This suggests a significant association between the severity of acute illness, as indicated by APACHE II scores, and the development of pressure ulcers, reinforcing the relevance of acute health status in pressure ulcer development. Therefore, the study's findings underscore the consistency of Braden score components among ICU patients, resulting in less variability in scores compared to ward patients. Meanwhile, the variability in APACHE II scores, reflecting acute illness severity, appears to strongly correlate with the occurrence of pressure ulcers. This supports the notion that acute health status plays a crucial role in the development of pressure ulcers, emphasizing the need for tailored risk assessment strategies that consider both acute and localized risk factors in different healthcare settings.

The study's findings in Table 8 demonstrated that while both scores are associated with pressure ulcers, the APACHE II score exhibited higher efficiency in identifying the presence of pressure ulcers compared to the Braden score. This distinction could be attributed to the comprehensive nature of the APACHE II score, which encompasses broader health indicators, including acute physiological parameters, thereby potentially capturing patients at higher risk for pressure ulcers due to their critical health status.

However, despite APACHE II's superior performance in identifying pressure ulcers in this study as seen in Table 9 and Figure 1, it's essential to acknowledge the differing clinical purposes of these scoring systems. The Braden score is specifically designed for assessing the risk of pressure ulcers, considering factors directly related to skin integrity and localized tissue damage. On the other hand, the APACHE II score serves a broader function in evaluating overall disease severity and predicting ICU outcomes.

Our study on pressure ulcers among ICU patients, echoes findings from Yamazaki et al.[9] and Shahin et al.[10] confirms the Braden scale's relevance in assessing pressure ulcer risk while emphasizing the superior efficiency of the APACHE II score in detecting pressure ulcers among ICU patients (Fig. 1), a distinction not extensively highlighted in existing literature.

Table 9: Comparison of area under curve (AUC) of Braden score and APACHE II score in detecting pressure ulcer

Area under the curve	*Area*	*SE*
Braden score	0.326	0.005
APACHE II score	0.921	0.027

The AUC of APACHE II score in detecting pressure ulcers was significantly higher than the AUC of the Braden score ($p < 0.0001$). SE, standard error

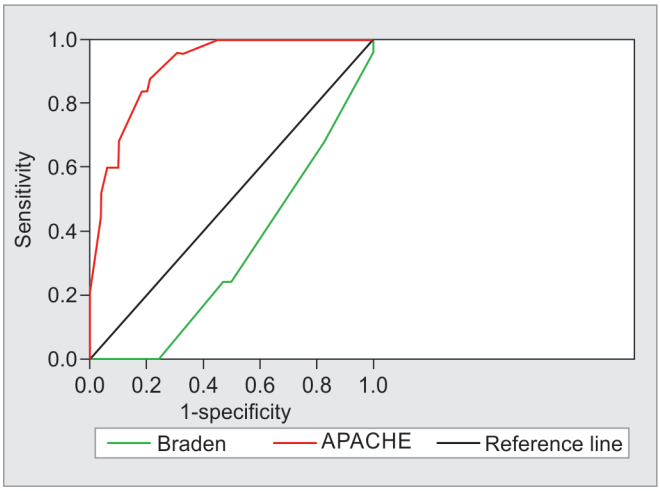

Fig. 1: Comparison of efficacy of Braden score APACHE II score in detecting pressure ulcer

Additionally, similar to Tang W et al.[11] and others, our research correlates higher APACHE II scores, indicating acute illness severity, with a greater incidence of pressure ulcers. Notably, our study uniquely focuses on ICU patient variability in Braden and APACHE II scores, providing deeper insights into scoring system applicability in diverse healthcare settings. Moreover, our research strongly advocates for a combined utilization of both scoring systems, suggesting a comprehensive risk assessment strategy, differing from existing literature that primarily acknowledges the individual utility of these scores. Pressure ulcers can diminish global life quality, contribute to rapid mortality in some patients, and pose a significant cost to healthcare organizations.[12]

The study's findings align with existing literature, albeit limited, supporting the utility of both scores in predicting pressure ulcers while acknowledging their distinct strengths and limitations.

Limitation of Study

Comparison of these scores with ward patients wasn't done. It would give us better insight about the utility of these scores in different health care settings.

Conclusion

While the APACHE II score demonstrated superior efficiency in identifying pressure ulcers in this study, acknowledging the differing clinical purposes of these scoring systems is crucial. The Braden score remains valuable for focused assessment and preventive measures targeting pressure ulcer risk factors, while the APACHE II score provides insights into overall disease severity and ICU outcomes through acute health assessment (APACHE II) and localized risk evaluation (Braden score).

Our findings suggest that the APACHE II score may be superior to the Braden score for predicting the occurrence of pressure sores in ICU patients. The Braden score, which assesses sensory perception, moisture, activity, mobility, nutrition, and friction/shear, has limited utility in ICU settings because most of these factors are almost always present in critically ill patients. This reduces the variability and predictive value of the Braden score in this population. In contrast, the APACHE II score, with its broader assessment of physiological and clinical parameters, provides more variability and a better prediction of pressure sore risk, making it a more practical and time-saving tool for ICU clinicians.

In conclusion, the study's detailed analysis underscores the importance of considering age, gender, acute health status, and localized risk factors in assessing pressure ulcer risks among ICU patients. The nuanced understanding of both the Braden and APACHE II scores allows clinicians to tailor interventions based on specific patient characteristics and clinical contexts.

The study's results advocate for a balanced approach in utilizing both scoring systems to better identify patients at risk for pressure ulcers, thereby enhancing preventive measures and patient care. Future research avenues could explore hybrid scoring systems or integrated protocols that combine the strengths of both scores for a more precise risk assessment strategy in ICU settings.

Take Home Message

The Braden Score, while widely used, is insufficient for predicting pressure ulcers in ICU patients as it does not account for significant physiological disturbances. To address this limitation, a new scoring system is required that integrates relevant parameters from both the Braden score and the APACHE 2 scoring system, thus enhancing the accuracy of pressure ulcer prediction in this complex patient population.

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