CLINICAL RESEARCH STUDY

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Braden Skin Score Subdomains Predict Mortality Among Cardiac Intensive Care Patients

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ABSTRACT

BACKGROUND: The Braden Skin Score (BSS) is a bedside nursing assessment that may be a measure of frailty and predicts mortality among patients in the cardiac intensive care unit (CICU). We examined the association between each of the 6 individual BSS subscores with hospital mortality in patients in the CICU. We hypothesized that BSS subscores reflecting patient frailty would have a stronger association with outcomes.

METHODS: Retrospective cohort study of unique adult patients admitted to the Mayo Clinic CICU from 2007 to 2018 with BSS documented on admission. Primary outcome was all-cause hospital mortality. Odds ratios (ORs) were determined using multivariable logistic regression.

RESULTS: The 11,954 included patients had a mean age of 67.4 ± 15.2 years (37.8% women). Each individual BSS subscore was lower among patients who died in the hospital (all $P < .001$). The total BSS was inversely associated with in-hospital mortality across admission diagnoses and among patients with coma or mechanical ventilation; each individual subscore was inversely associated with in-hospital mortality. On multivariable regression, all subscores were inversely associated with hospital mortality after full adjustment. Shear had the strongest association (adjusted OR 0.59), followed by nutrition (adjusted OR 0.67), skin moisture (adjusted OR 0.76), mobility (adjusted OR 0.76), sensory perception (adjusted OR 0.82), and activity level (adjusted OR 0.85).

CONCLUSION: BSS can serve as a rapid noninvasive screening tool for identifying poor outcomes in patients in the CICU. BSS subdomains that are more strongly associated with mortality appear to reflect physical frailty. Insofar as the BSS and its subscores measure frailty, a low BSS may identify frail patients.
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KEYWORDS: Braden score; Cardiac critical care; Cardiac intensive care unit; Frailty; Mortality

INTRODUCTION

The contemporary cardiac intensive care unit (CICU) has evolved to treat a changing patient demographic.[1] The CICU population includes an increasingly complex cohort of patients with both cardiac and noncardiac diagnoses.[2] There is a need for easily available predictive metrics quantifying patient illness severity and hospital mortality risk that can be readily measured at the bedside.[3] Current illness severity scores require laboratory data not always available on admission and fail to incorporate the clinical impression of bedside nurses.[4]

The Braden Skin Score (BSS) is a bedside nursing assessment first described in 1987 to identify patients at risk for development of pressure-related skin injury; ranging from 6 to 23, a lower BSS reflects a higher risk of pressure injury.[5] Total BSS is derived by summation of 6 subscores. These include sensory perception (ability to perceive discomfort and move to decrease it), moisture (amount of skin exposure to moisture), activity (degree of physical activity the patient participates in), mobility (ability to relieve pressure through adjusting position), nutrition

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(patient's usual nutritional intake), and friction/shear (ability to keep skin free from contact with bed linens during repositioning).[5] All scores are graded from 1-4 except friction/shear, which is graded from 1-3, with lower scores reflecting more abnormal function. Bedside nurses are trained to record the BSS during job orientation and the BSS is entered into the medical record by the bedside nurse based on a standardized assessment table (Supplementary Table 1, available online). Routine BSS documentation by nursing staff is required by the Centers of Medicaid Services (CMS), and leverages the clinical assessment of bedside nurses to improve outcomes. We recently demonstrated a robust association between lower BSS scores and increased mortality among CICU patients, and the BSS was one of the top predictors of mortality in this cohort.[6,7]

Frailty encompasses age-related changes that decrease a patient's tolerance of physiologic stress from illness and predisposes to adverse outcomes.[8-12] Among several methods to quantify frailty, one of the most used is the Fried scale, which is composed of 5 components; frailty is defined as the presence of 3 or more of these components. The components of the Fried scale include weight loss, weakness of grip strength, decreased endurance and energy, slow gait, and low physical activity level. BSS subscores overlap with current definitions of frailty, and we have proposed that the BSS may identify patients with frailty.[6] This study aims to further characterize the association between the 6 individual BSS subdomains and mortality in patients in the CICU, and to investigate the extent to which the BSS indirectly measures patient frailty. We hypothesized that the BSS subscores most closely aligned with frailty would most strongly predict mortality.

CLINICAL SIGNIFICANCE

- The Braden Skin Score (BSS) is a nursing-reported score ubiquitously available to clinicians, which leverages the expertise of bedside nurses for patient assessment.
- The BSS has been previously associated with mortality, and this association is further explored in this study.
- The BSS may be useful in identifying patients at risk for poor outcomes and higher levels of frailty.

METHODS

This study was approved by the Mayo Clinic's institutional review board under a waiver of informed consent as minimal risk to participants. We retrospectively reviewed a previously constructed database of consecutive unique adult patients who were admitted to the CICU at Mayo Clinic's Saint Mary's Hospital in Rochester, Minnesota, between January 1, 2007, and April 30, 2018.[7] Patients were excluded if they did not have a BSS recorded at admission. To avoid potential bias due to readmissions, we only analyzed data from each patient's first CICU admission during the study period.

Data were electronically extracted from the electronic medical record, including demographics, vital signs, laboratory studies, and inpatient procedures and therapies. Admission diagnoses were defined as all *International Classification of Diseases (ICD)-9/10* diagnosis codes reported within 1 day before or after CICU admission; these were not mutually exclusive, and the primary diagnosis could not be identified.[13] A validated electronic algorithm was used to determine individual comorbidities and the Charlson Comorbidity Index (CCI).[1] Data from the first 24 hours of the CICU stay were used to automatically calculate the Sequential Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health Evaluation (APACHE)-III and -IV scores.[13] The minimum Glasgow Coma Scale (GCS) during the first 24 hours was recorded, and coma was defined as a minimum GCS less than 9. The first total BSS after CICU admission was recorded, as well as individual BSS subscores for the admission BSS and the highest and lowest individual admission BSS subscores. In the Mayo Clinic CICU, each patient's bedside nurse assesses and records the BSS on admission; the BSS is reassessed during each subsequent nursing shift, but repeated assessments during the same shift (or upon admission) are not standard.

All-cause in-hospital mortality during the index hospitalization was the primary outcome, and all-cause CICU mortality was the secondary outcome. Data are reported as mean ± standard deviation (SD) for continuous variables and number (percentage) for categorical variables. Continuous variables were compared between groups using Student *t*-tests, and categorical variables were compared between groups using Pearson χ^2 test. Classification and regression tree (CART) analysis was used to separate patients into 4 risk groups by defining optimal individual Braden subscore cutoffs for prediction of hospital mortality. Receiver-operator characteristic (ROC) curves were generated, and area under the curve (AUC) values were calculated for discrimination of mortality. Odds ratio (OR) and 95% confidence interval (CI) values for hospital mortality were generated using logistic regression, before and after multivariable adjustment. Candidate variables for the multivariable analysis included demographics, comorbidities, severity of illness scores, commonly available admission laboratory values, and CICU procedures and therapies. To determine the variables included in the final multivariable models, stepwise forward variable selection was performed to minimize the value of the Bayesian Information Criterion (a parsimonious measure of model fit that represents deviation from ideal prediction). All subsequent multivariable models were adjusted for all the variables selected using this minimum Bayesian Information Criterion strategy (Supplementary Table 2, available online). All analysis was performed using JMP 14.0 Pro (SAS Institute).

Table 1 Baseline Characteristics of the Final Study Population

Variable	Final Study Population (n=11,954)
Age	67.6 ± 15.2
Female	4524 (37.8)
White	11042 (92.4)
BSS	17.7 ± 3.4
BSS subcategories	
Sensory perception	3.5 ± 0.9
Skin moisture	3.6 ± 0.5
Patient mobility	2.9 ± 0.9
Patient nutrition	3.0 ± 0.7
Friction/shear	2.6 ± 0.6
Patient activity level	2.2 ± 1.2
First GCS after admission	13.8 ± 3.2
CICU length of stay (days)	2.5 ± 4.3
Hospital length of stay (days)	8.0 ± 13.5
Hospital days before CICU	0.7 ± 2.7
Noninvasive ventilator use	1908 (16)
Invasive ventilator use	1958 (16.4)
Inpatient PCI	4163 (34.8)
Inpatient coronary angiogram	6940 (58.1)
Vasoactive drug use	2310 (19.3)
Pulmonary artery catheter	1173 (9.8)
Blood transfusion	1344 (11.2)
Acute coronary syndrome	5037 (42.4)
Heart failure	5857 (49.3)
Prior myocardial infarction	2226 (18.7)
Prior heart failure	2455 (20.6)
Prior stroke	1444 (12.1)
Prior diabetes mellitus	3442 (28.9)
Prior lung disease	2312 (19.4)
APACHE-III score	61.1 ± 25
Day 1 SOFA	3.5 ± 3.2
Max week 1 SOFA	4.0 ± 3.4
Charlson Comorbidity Index	2.4 ± 2.6

APACHE = Acute Physiology and Chronic Health Evaluation; BSS = Braden Skin Score; CICU = cardiac intensive care unit; GCS = Glasgow Coma scale; PCI = percutaneous coronary intervention; SD = standard deviation; SOFA = Sequential Organ Failure Assessment.

Data are reported as mean ± SD for continuous variables and number (percentage) for categorical variables.

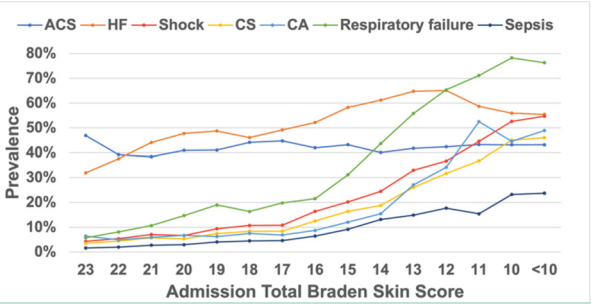

Figure 1 Prevalence of disease in population as a function of total BSS. BSS = Braden Skin Score. ACS = Acute Coronary Syndrome; HF = Heart Failure; CS = Cardiogenic Shock; CA = Cardiac Arrest.

RESULTS

Baseline Characteristics

Out of a database of 12,428 unique CICU patient admissions, we excluded 474 (3.8%) patients without BSS data, yielding a final study population of 11,954 patients. The mean age of the final study population was 67.6 ± 15.2 years, and 4,524 (37.8%) were females (Table 1). Admission diagnoses included heart failure, 49.3%; acute coronary syndrome, 42.4%; respiratory failure, 24.3%; cardiogenic shock, 11.8%; cardiac arrest, 11.6%; and sepsis, 6.4%.

Braden Skin Score Values

The mean admission total BSS was 17.7 ± 3.4 (Supplementary Figure 1, available online), with a median of 18 (interquartile range, 16, 20). The admission total BSS varied as a function of admission diagnosis, being higher in patients with acute coronary syndrome or heart failure and lower among patients with critical care admission diagnoses (Supplementary Figure 2, available online). Likewise, the prevalence of individual admission diagnoses varied as a function of admission BSS (Figure 1); critical care diagnoses and heart failure were increasingly prevalent at lower admission BSS.

The distribution of individual admission BSS components is shown in Figure 2. Among the different BSS subscores, most (>60%) patients had normal values (a score of 3 for Friction/Shear, or score of 4 for all other values) of Sensory Perception, Skin Moisture, and Friction/Shear. By contrast, fewer than 25% of patients had normal values of Mobility, Nutrition, and Activity Level. A total of 9,595 (81.1%) of patients had a maximum score of 4 (normal) for at least 1 BSS subscore, while 5,949 (49.8%) patients had a minimum score of 1 (abnormal) for at least one BSS subscore. All of the individual admission BSS subscores correlated significantly with each other (all $P < .001$), with most Pearson r coefficients in the ~0.3-0.4 range; Sensory Perception and Mobility had the strongest correlation (Pearson $r = 0.63$), whereas Skin Moisture and Activity Level had the weakest correlation (Pearson $r = 0.19$).

Unadjusted CICU and In-Hospital Mortality

A total of 1,036 (8.7%) patients died during the index hospitalization, including the 627 (5.2%) who died in the CICU. The total admission BSS was higher among hospital survivors compared with inpatient deaths (18.0 ± 3.1 vs 14.1 ± 3.6, $P < .001$), as were each of the individual admission BSS subscores and the maximum and minimum admission BSS subscores (all $P < .001$). We observed strong inverse relationships (Supplementary Figure 3, available online) between admission BSS and both CICU (unadjusted OR 0.70, 95% CI 0.68-0.71, $P < .001$; AUC 0.81) and in-

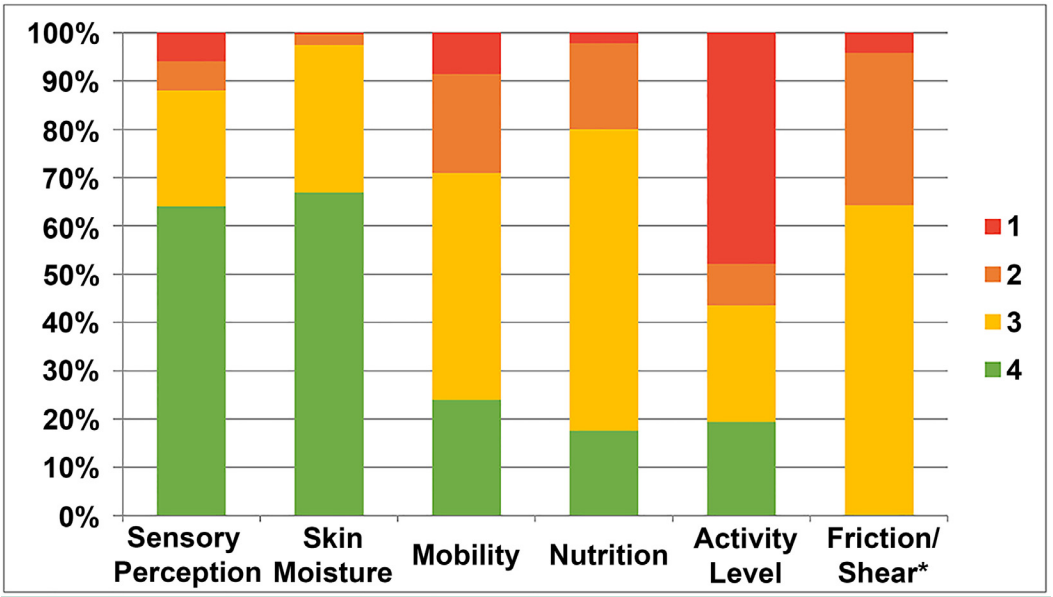

Figure 2 Distribution of individual BSS subscores across our population. BSS = Braden Skin Score. *Denotes that there is a maximum score of 3 for the Friction/Shear subscore.

hospital (unadjusted OR 0.71, 95% CI 0.70-0.73, $P < .001$; AUC 0.79) mortality. The strength of the association between admission BSS with CICU and hospital mortality varied as a function of admission diagnosis (Supplementary Table 3, available online), being strongest for acute coronary syndrome and weaker for critical care diagnoses such as cardiogenic shock. The BSS was associated with in-hospital mortality in patients who were and were not mechanically ventilated, and in patients who were and were not comatose (Supplementary Figure 4, available online). Likewise, both the minimum GCS during the first 24 hours and the admission BSS provided complementary mortality risk stratification (Supplementary Figure 5, available online).

Clear stepwise associations between the individual BSS subscores and both CICU and in-hospital mortality were observed (Figure 3). A similar relationship was seen for the maximum and minimum admission BSS subscores (Supplementary Figure 6, available online). Each of the individual admission BSS subscores was inversely associated with both CICU and in-hospital mortality (Table 2), as were the maximum and minimum BSS subscores (all

Figure 3 CICU and hospital mortality as a function of each individual admission BSS subscore. BSS = Braden Skin Score; CICU = cardiac intensive care unit.

Table 2 Unadjusted and Adjusted OR and 95% CI Values for Hospital Mortality for Each Admission BSS Subscore

Admission BSS subscore	Unadjusted OR (95% CI)*	Adjusted OR (95% CI)	*P* Value
Total BSS	0.71 (0.70-0.73)	0.89 (0.87-0.92)	.0001
Sensory Perception	0.38 (0.36-0.40)	0.82 (0.73-0.90)	<.0001
Skin Moisture	0.39 (0.35-0.43)	0.76 (0.65-0.88)	.0003
Mobility	0.33 (0.31-0.36)	0.76 (0.67-0.86)	<.0001
Nutrition	0.30 (0.27-0.33)	0.67 (0.58-0.77)	<.0001
Activity Level	0.58 (0.55-0.62)	0.85 (0.77-0.94)	.0011
Friction/Shear	0.27 (0.25-0.30)	0.59 (0.51-0.69)	<.0001
Minimum subscore	0.46 (0.42-0.51)	0.83 (0.72-0.94)	.0047
Maximum subscore	0.24 (0.21-0.27)	0.67 (0.56-0.80)	<.0001

BSS = Braden Skin Score; CI = confidence interval; OR = odds ratio.

Adjusted OR values are from the full multivariable model where each of the admission BSS subscores were included individually.

**P* value is from the adjusted analysis; all unadjusted analyses had $P < .0001$.

$P < .001$). When all 6 individual admission BSS subscores were included together in a nonadjusted multivariable model for prediction of either CICU or in-hospital mortality, Activity Level was not a significant predictor ($P > .1$), whereas Skin Moisture was associated with hospital mortality ($P < .0001$), but not CICU mortality ($P = 0.06$). All other subscores were strongly associated with both CICU and in-hospital mortality in the multivariable model ($P < .0001$).

Adjusted In-Hospital Mortality

After full multivariable adjustment, the admission total BSS was the fourth strongest predictor of in-hospital mortality (adjusted OR 0.89, 95% CI 0.87-0.92, $P < .0001$). When each admission BSS subscore was included separately in the fully adjusted model, they were all significantly associated with adjusted in-hospital mortality (Table 2). When all individual BSS subscores were included together in the fully adjusted model, only Friction/Shear (adjusted OR 0.70, 95% CI 0.59-0.83, $P < .0001$) and Patient Nutrition (adjusted OR 0.80, 95% CI 0.68-0.94, $P = .006$) were significantly associated with in-hospital mortality. Both the minimum (adjusted OR 0.83, 95% CI 0.72-0.94, $P = .005$) and maximum Braden subscore (adjusted OR 0.67, 95% CI 0.56-0.80, $P < .0001$) were associated with adjusted in-hospital mortality. The association between BSS and in-hospital mortality was stronger among patients without mechanical ventilation (adjusted OR: 0.72; 95% CI: 0.7-0.74; $P < .001$) than it was among those who were ventilated (adjusted OR: 0.81; 95% CI: 0.77-0.84; $P < .001$),as was observed for each individual subscore (Supplementary Table 4, available online).

CART Analysis

CART analysis suggested that Sensory Perception was the most important individual Braden subscore for prediction of in-hospital mortality. Using CART analysis, patients were separated into 4 groups with low, intermediate-low, intermediate-high, and high risk of in-hospital mortality (Figure 4). We observed a stepwise increase in CICU and hospital mortality across these groups (Figure 4). After multivariable adjustment, all other groups had higher hospital mortality than the low-risk group (all $P < .001$); other between-groups differences were not significant (all $P > .1$).

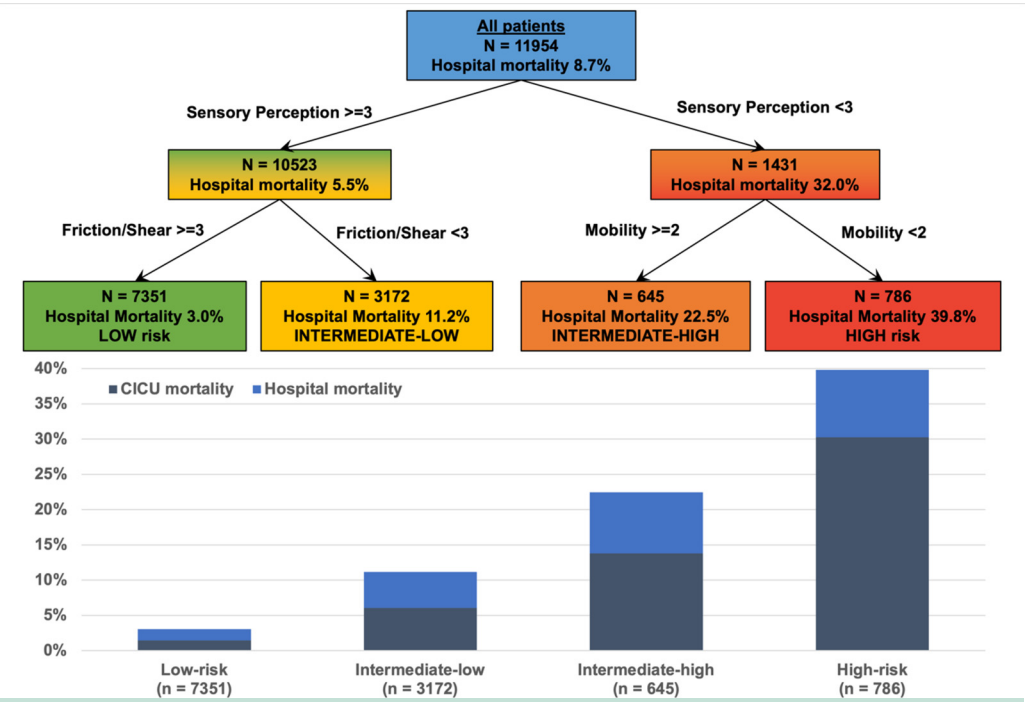

Figure 4 CICU and hospital mortality after use of BSS subscores to separate population into 4 groups with low, intermediate-low, intermediate-high, or high risk of hospital mortality. BSS = Braden Skin Score; CICU = cardiac intensive care unit.

DISCUSSION

Summary of Main Findings

In this CICU population, the total BSS and all 6 individual BSS subscores demonstrated significant inverse associations with in-hospital mortality, as did the minimum and maximum BSS subscore. Lower BSS values correlate with more abnormal physiology, whereas higher scores identify healthier patients. Among the admission BSS subscores, Friction/Shear (representing the ability to move independently) and Sensory Perception (representing level of alertness) had the strongest association with adjusted in-hospital mortality, whereas Activity Level was not independently associated (perhaps due to overlap with other subscores, such as Mobility). The BSS is a Centers for Medicare and Medicaid Services-mandated evaluation that does not require laboratory or vital sign data and, therefore, is highly generalizable and available as a risk assessment tool. Furthermore, the BSS is a unique measure that transforms routine bedside nursing assessments into a high-yield tool for identifying patients at increased risk for poor outcomes, highlighting the importance of multidisciplinary patient assessment in the CICU to guide prognostication.

Frailty and BSS Subscores

The standardized definition of frailty by Fried et al[12] focused on 5 physiologic domains reflecting chronic illness, including unintentional weight loss, weakness, poor endurance and energy, slowness, and low physical activity level.[8] Frailty has been consistently associated with mortality across many different populations, including the elderly,[8,14] those hospitalized with heart failure,[15] and those admitted to the intensive care unit (ICU).[16] Many methods to assess frailty are designed for outpatient use and require components that cannot be practically measured among ICU patients.[11] The BSS overlaps with concepts within the Fried Scale and can be easily measured at the bedside without the need for specialized equipment. Subscores within the BSS most closely associated with mortality in our study were Shear, Mobility, Nutrition, and Sensory Perception, which most align with the Fried scale supporting the BSS as a frailty metric.

Frailty in the ICU

Approximately 30% of patients admitted to the adult ICU demonstrate frailty characteristics,[16] and frailty appears more common among patients with cardiovascular disease.[8] To our knowledge, Goldfarb et al[17] are the only other authors that have systematically examined the prevalence of frailty in the CICU population. Due to concomitant critical illness and cardiovascular disease, patients in the CICU are at increased risk for frailty. The American Heart Association recently released a statement describing the aging population as a dominant demographic in the CICU, which is associated with high rates of frailty.[18] Although we did not directly measure frailty, the high prevalence of abnormal BSS subscores suggests that frailty was common in our cohort. The relationship between BSS and mortality has been investigated across several patient populations, including hospitalized patients with heart failure[19] or cirrhosis.[20] We confirmed the results of our prior analysis demonstrating a strong inverse relationship between the BSS and mortality in patients in the CICU; this analysis expands on our prior findings by 1) analyzing individual BSS subscores and 2) examining the role of impaired mental status as a potential confounder.

BSS and the Critically Ill Patient

A low BSS correlated with a higher prevalence of critical care diagnoses, and most patients with the lowest BSS values were comatose and mechanically ventilated. The BSS was inversely associated with the risk of hospital mortality in each examined subgroup, including the highest-risk admission diagnoses. The association between mortality and BSS was stronger among patients without mechanical ventilation than it was among those who were ventilated, possibly because an accurate assessment of the BSS in ventilated patients may be clouded by the presence of sedating medications leading to a falsely low BSS. A low BSS in awake patients who are not receiving sedating medications is likely more indicative of underlying frailty, explaining the stronger mortality risk prediction by the BSS in this group. Notably, the BSS outperformed the more familiar GCS as a predictor of mortality, and still provided mortality risk stratification in patients with decreased GCS. These findings emphasize how a simple bedside nursing assessment can integrate multiple markers of illness severity to predict prognosis.

BSS and Preprocedure Risk

Frailty is known to influence patient outcomes after invasive cardiac procedures, and recognition of frailty is important for periprocedural risk/benefit clinical decision-making at the bedside. Insofar as awake patients with a low BSS are likely to be frail, it is possible the BSS could be used to facilitate patient selection for invasive procedures in the CICU. Further research is needed to determine whether a low BSS prior to an invasive cardiac procedure predicts adverse outcomes in this population.

Pressure Ulcers and Mortality

The BSS was initially created to identify patients at increased risk for developing pressure ulcers and can predict the development of pressure injury in adult patients in the ICU.[21] Hospital-acquired pressure ulcers have been associated with increased in-hospital mortality in adults admitted to the ICU.[22] Our prior analysis did not demonstrate a high rate of pressure ulcers documented in this CICU cohort, arguing against pressure ulcers mediating the observed association between the BSS and outcomes. In our opinion, development of pressure ulcers is often indicative of patients at increased risk of mortality due to other underlying causes, such as higher levels of frailty or more severe underlying disease.

Limitations

Our study has several limitations inherent to single-center retrospective cohort analyses, including potential residual confounding despite multivariate analysis and inability to draw causal inference. Our tertiary referral CICU population may differ from other centers, potentially limiting generalizability. There is the potential for inter- and intraobserver variance in BSS reporting, although nursing staff use a standardized table for BSS grading. We do not have data available to determine inter- or intraobserver agreement for BSS reporting in this cohort. Prior studies among adult patient in the ICU have demonstrated good interobserver reliability of BSS scores reported by bedside nurses, suggesting that this factor is unlikely to have significantly altered our findings.[23] We did not have data on sedating medication use or standardized frailty measures. We could not determine mechanical ventilation at the time of BSS assessment or sedation at the time of the GCS assessment.

CONCLUSION

Patients admitted to the CICU with a low BSS are at increased risk for in-hospital mortality, even when accounting for other relevant outcome predictors. This relationship holds true across all subscores within the BSS, but less robust for activity level. The components of the BSS that are most strongly associated with mortality measure the standard domains of frailty and mental status. We posit that the BSS may serve as a readily available marker of frailty among patients in the CICU, particularly in nonsedated patients. The BSS can facilitate rapid identification of patients in the CICU who have low physiologic reserve and a high risk for adverse outcomes warranting early intervention. Our results additionally underscore the importance of integrating the clinical assessments made by bedside nurses into prognostic patient assessment.

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SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjmed.2022.01.046.

Supplementary Table 1 Braden Skin Score Grading Rubric Used by Bedside Nurses

Subscale	Score 1	Score 2	Score 3	Score 4
Sensory Perception ability to respond meaningfully to pressure-related discomfort	**Completely Limited** Unresponsive (does not moan, flinch, or grasp) to painful stimuli, due to diminished level of consciousness or sedation ***OR*** limited ability to feel pain over most of body surface	**Very Limited** Responds only to painful stimuli; cannot communicate discomfort except by moaning or restlessness ***OR*** has a sensory impairment that limits the ability to feel pain or discomfort over half of body	**Slightly Limited** Responds to verbal commands but cannot always communicate discomfort or need to be turned ***OR*** has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities	**No Impairment** Responds to verbal commands, has no sensory deficit that would limit ability to feel or voice pain or discomfort
Moisture degree to which skin is exposed to moisture	**Constantly Moist** Skin is kept moist almost constantly by perspiration, urine, etc.; dampness detected every time patient is moved or turned	**Very Moist** Skin is often, but not always, moist; linens must be changed at least once a shift	**Occasionally Moist** Skin is occasionally moist, requiring an extra linen change approximately once a day	**Rarely Moist** Skin is usually dry, linen only requires changing at routine intervals
Activity degree of physical activity	**Bedfast** Confined to bed	**Chairfast** Ability to walk severely limited or nonexistent; cannot bear weight or must be assisted into chair or wheelchair	**Walks Occasionally** Walks occasionally during day, but for very short distances, with or without assistance; spends majority of each shift in bed or chair	**Walks Frequently** Walks outside the room at least twice a day and inside room at least once every 2 hours during waking hours
Mobility ability to change and control body position	**Completely Immobile** Does not make even slight changes in body or extremity position without assistance	**Very Limited** Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes	**Slightly Limited** Makes frequent though slight changes in body or extremity position independently	**No Limitations** Makes major and frequent changes in position without assistance.
Nutrition usual food intake pattern	**Very Poor** Never eats a complete meal; rarely eats more than one-third of any food offered; eats 2 servings or less of protein (meat or dairy products) per day; takes fluids poorly; does not take a liquid dietary supplement ***OR*** is NPO or maintained on clear liquids or IV for more than 5 days	**Probably Inadequate** Rarely eats a complete meal and generally eats only about half of any food offered; protein intake includes only 3 servings of meat or dairy products per day; occasionally will take a dietary supplement ***OR*** receives less than optimum amount of liquid diet or tube feeding	**Adequate** Eats over half of most meals; eats a total of 4 servings of protein (meat, dairy products) each day; occasionally will refuse a meal but will usually take a supplement if offered ***OR*** is on a tube feeding or TPN regimen that probably meets most of nutritional needs	**Excellent** Eats most of every meal; never refuses a meal, usually eats a total of 4 or more servings of meat and dairy products; occasionally eats between meals; does not require supplementation
Friction and Shear ability to keep skin free from contact with bed linen during repositioning	**Problem** Requires moderate to maximum assistance in moving; complete lifting without sliding against sheets is impossible; frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance; spasticity, contractures or agitation lead to almost constant friction	**Potential Problem** Moves feebly or requires minimum assistance; during a move, skin probably slides to some extent against sheets, chair, restraints, or other devices; maintains relatively good position in chair or bed most of the time but occasionally slides down	**No Apparent Problem** Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move; maintains good position in bed or chair at all times	

IV = intravenously; NPO = nothing by mouth; TPN = total parenteral nutrition.

Supplementary Table 2 Variables Selected for Inclusion in the Final Multivariable Logistic Regression Model, as Determined by Stepwise Forward Variable Selection to Minimize the Value of the Bayesian Information Criterion*

Demographics
Age
Year of CICU admission
Hospital Days before CICU admission
Severity of illness
APACHE-III score
Admission diagnoses
Shock
Respiratory failure
Cardiac arrest
Vital signs during the first 24 hours
Urine output
Minimum respiratory rate
Maximum respiratory rate
Therapies and procedures
Coronary angiography
Dialysis
Cardiopulmonary resuscitation
Number of vasoactive infusions
Admission laboratory values
Chloride
BUN
Creatinine
Anion gap
White blood cell count
Red cell distribution width

APACHE = Acute Physiology and Chronic Health Evaluation; BUN = blood urea nitrogen; CICU = cardiac intensive care unit.

*Bayesian Information Criterion is a parsimonious measure of model fit that represents deviation from ideal model prediction.

Supplementary Table 3 Unadjusted OR and 95% CI Values for Admission BSS as a Predictor of Hospital Mortality According to Admission Diagnosis

Admission diagnosis*	Unadjusted OR (95% CI)	AUC	*P* Value
All patients	0.71 (0.70-0.73)	0.79	<.0001
Acute coronary syndrome	0.71 (0.68-0.73)	0.79	<.0001
Heart failure	0.77 (0.75-0.79)	0.73	<.0001
Cardiac arrest	0.82 (0.79-0.85)	0.71	<.0001
Respiratory failure	0.82 (0.80-0.84)	0.69	<.0001
Shock	0.86 (0.83-0.88)	0.65	<.0001
Cardiogenic shock	0.86 (0.83-0.89)	0.65	<.0001
Sepsis	0.85 (0.81-0.89)	0.66	<.0001

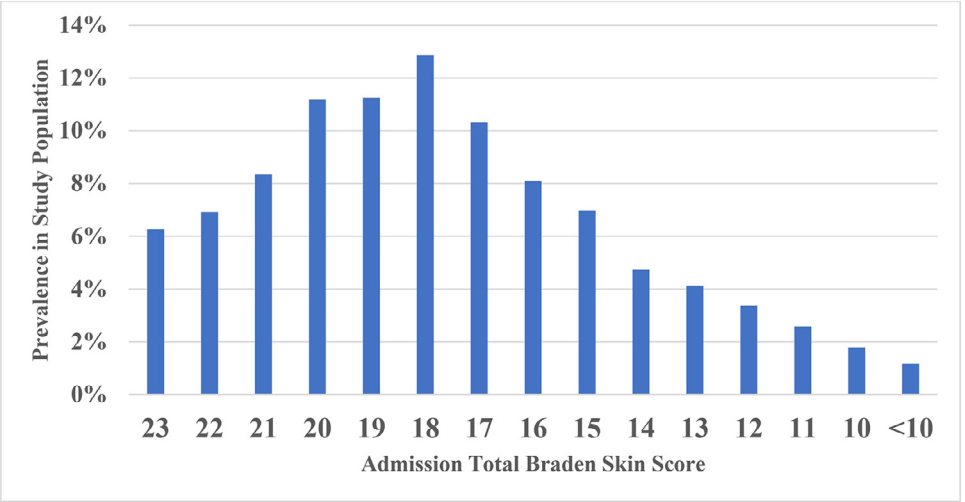
AUC = area under the curve; BSS = Braden Skin Score; CI = confidence interval; OR = odds ratio.

*Note that admission diagnoses are not mutually exclusive.

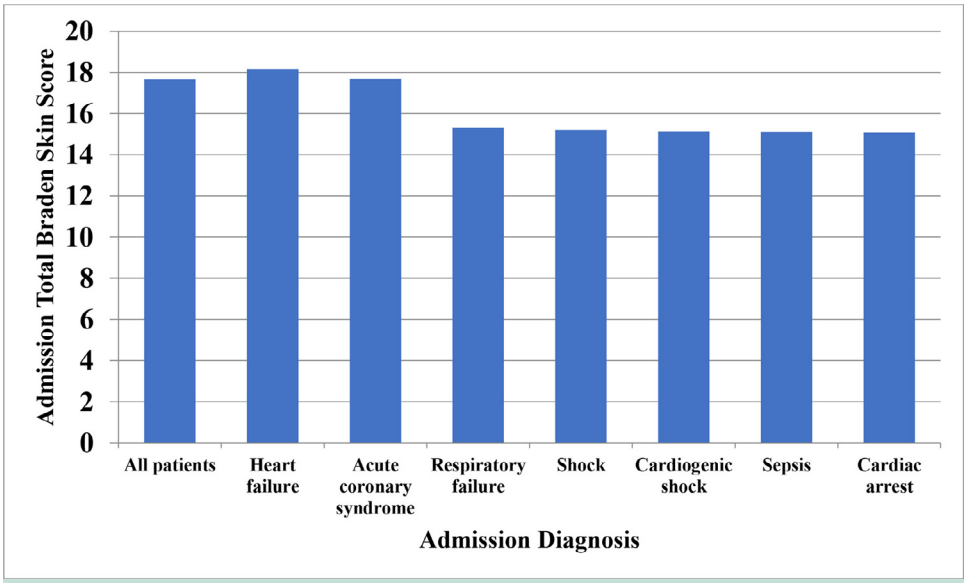
Supplementary Table 4 Adjusted Unit-OR and 95% CI Values for Admission BSS Subdomains as a Predictor of Hospital Mortality Among Patients with or Without Mechanical Ventilation

BSS Subdomains	Nonventilated Adjusted OR (95% CI)	*P* Value	Mechanical Ventilation Adjusted OR (95% CI)	*P* Value
Shear	0.57 (0.49-0.67)	<.0001	0.59 (0.48-0.73)	<.0001
Nutrition	0.64 (0.55-0.75)	<.0001	0.71 (0.59-0.85)	0.0002
Sensory Perception	0.64 (0.56-0.74)	<.0001	0.77 (0.67-0.88)	0.0002
Mobility	0.65 (0.55-0.76)	0.0007	0.88 (0.72-1.08)	0.2191
Skin Moisture	0.76 (0.65-0.89)	<.0001	0.84 (0.70-1)	0.0551
Activity	1.07 (0.97-1.18)	0.2072	1.1 (0.9-1.34)	0.3352

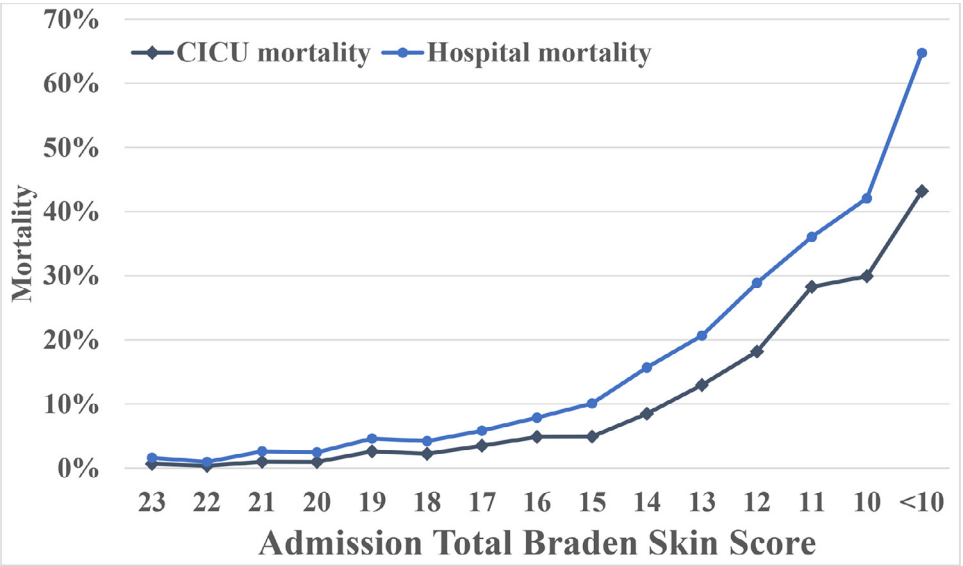
BSS = Braden Skin Score; CI = confidence interval; OR = odds ratio.



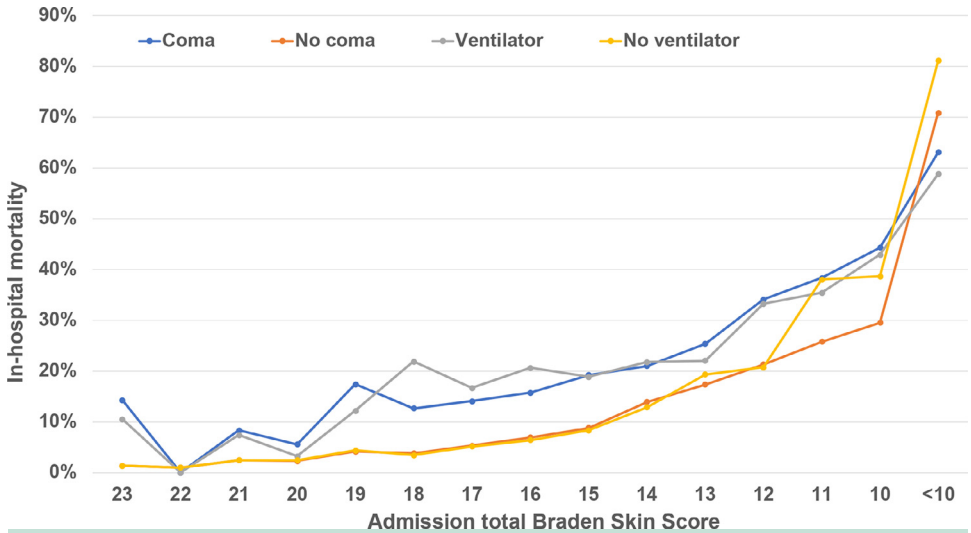
Supplementary Figure 1 Distribution of admission total BSS in the study population. BSS = Braden Skin Score.



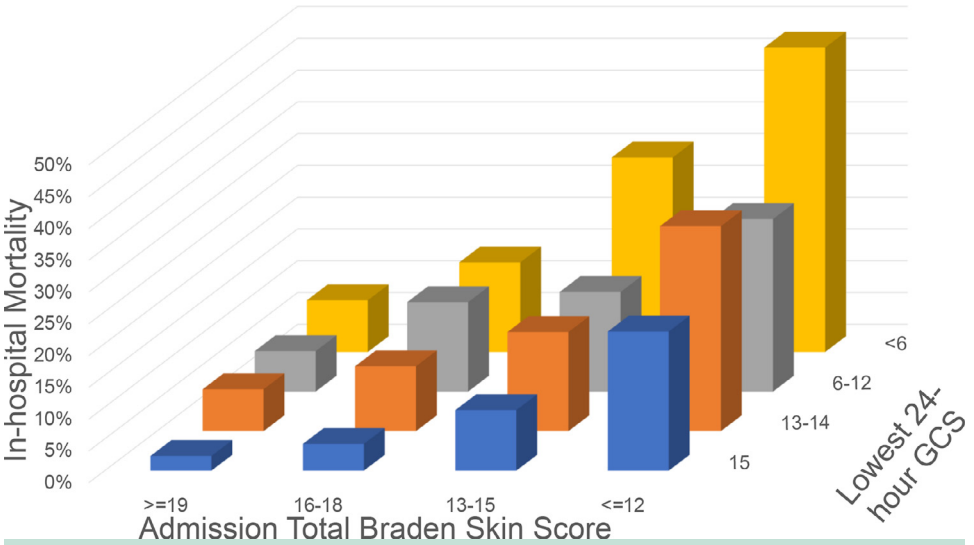
Supplementary Figure 2 Admission BSS as a function of admission diagnoses. BSS = Braden Skin Score.



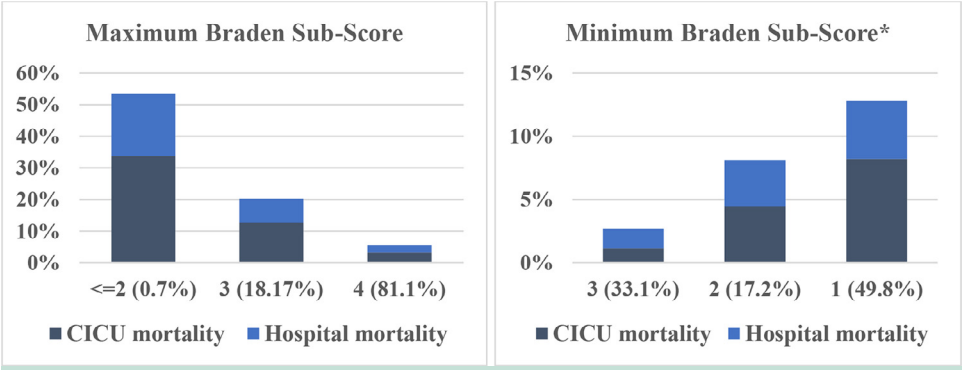
Supplementary Figure 3 Relationship between total admission BSS and CICU and hospital mortality. BSS = Braden Skin Score; CICU = cardiac intensive care unit.



Supplementary Figure 4 Association between total BSS and mortality stratified by presence or absence of coma or mechanical ventilation. BSS = Braden Skin Score.



Supplementary Figure 5 Association among hospital mortality, admission BSS, and lowest 24-h GCS. BSS = Braden Skin Score; GCS = Glasgow Coma Scale.



Supplementary Figure 6 CICU and hospital mortality as a function of the maximum and minimum individual admission BSS subscore. BSS = Braden Skin Score; CICU = cardiac intensive care unit.*Denotes that there is a maximum score of 3 for the minimum BSS subscore.