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# Validity of the Braden Scale in grading pressure ulcers in trauma and burn patients



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## ABSTRACT

**Background:** Pressure ulcers are a costly hospital-acquired condition in terms of clinical outcome and expense. The Braden Scale was developed in 1987 as a risk scoring method for pressure ulcers and uses six different risk factors: sensory perception, moisture, activity, mobility, nutrition, and friction and shear. A score of  $\leq 18$  is considered high risk. To date, research on the utility of the Braden Scale has focused on general medicine and non-trauma/burn surgery patients. We hypothesize that the Braden Scale does not accurately discriminate who will get a pressure ulcer among trauma and burn patients.

**Methods:** We collected data from medical records regarding documented Braden scores and presence of pressure ulcers regardless of staging. Patients with ulcers present on admission were excluded from analysis. For each patient, the lowest Braden score documented before the occurrence of the pressure ulcer was determined. A logistic regression was used to estimate odds ratios and associated 95% confidence intervals for the association between pressure ulcer likelihood and lowest Braden Scale measurement. To determine the discriminatory ability of the Braden Scale on pressure ulcer risk, four measures of performance (i.e., sensitivity, specificity, positive likelihood ratio, and negative likelihood ratio) were calculated for four nonmutually exclusive groups: a Braden Scale measurement  $\leq 18$ ,  $\leq 14$ ,  $\leq 12$ , and  $\leq 9$ .

**Results:** From 2011 through 2014, a total of 2660 patients were admitted to the trauma/burn intensive care unit. Of these patients, 63 (2.3%) subsequently developed a pressure ulcer. A Braden Scale of  $\leq 18$  as the threshold for being at-risk of pressure ulcer had a sensitivity of 100% and specificity of 6%, whereas a Braden Scale of  $\leq 9$  had a sensitivity of 28.6% and a specificity of 90%. For all Braden Scale measurements, the positive likelihood ratio never reached the value of 10 that suggests high likelihood of an ulcer.

**Conclusions:** The Braden scale has mediocre discriminatory ability among the trauma/burn population. In addition, the low positive likelihood ratio suggests that the Braden scale may not be a useful clinical tool as it may result in unnecessary expenditure of time and personnel resources in preventing pressure ulcer formation.

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## Introduction

Pressure ulcers are a common complication of care in hospitals and range in prevalence from 15%-20% in critical care units and 8%-14% in general acute care medical and surgical units range.<sup>1</sup> Pressure ulcers cause pain and prolonged recovery for patients and result in prolonged length of patient stay and increased costs for hospitals.<sup>2</sup> Between 1990 and 2001, pressure ulcers were listed as a cause of death for approximately 115,000 people in the United States.<sup>3</sup> According to a recent study by the American College of Physicians, the estimated cost of treating each case of pressure ulcers ranges from \$37,800 to \$70,000, and up to \$11 billion is spent annually in the United States to treat pressure ulcers.<sup>3</sup> The National Pressure Ulcer Advisory Panel<sup>4</sup> developed a staging tool that categorizes pressure ulcers into one of four different stages. Stage I pressure ulcers are described as nonblanching erythema without damage that lasts for >30 min after removing pressure. Stage II ulcers invade the epidermis and dermis and include visible partial superficial ulcers, abrasion, and blisters. Stage III is defined as the presence of subcutaneous tissue and extensive damage with exudate and necrotic tissue, whereas stage IV involves the exposure of muscle, tendon, or bone with exudative necrotic tissue.<sup>5</sup>

The Braden Scale is one of several scoring methods (i.e., Waterlow, Norton, and Cubbin-Jackson) used to determine a patient's risk for developing a pressure ulcer.<sup>6</sup> The Braden Scale was designed by Bergstrom and Braden and is recommended by the US Agency for Health Care Policy and Research to be the best score for predicting pressure ulcer risk.<sup>7</sup> The Braden Scale assesses risk using six different risk factors: sensory perception, the ability to respond meaningfully to pressure-related discomfort; moisture, degree to which skin is exposed to moisture; activity, degree of physical activity; mobility, ability to change and control body position; nutrition, usual food intake pattern; and friction and shear.<sup>8</sup> These risk factors are assessed by nurses, and the patient is assigned a total score between 6 and 23, with a lower score indicating a higher risk for developing a pressure ulcer.

Several studies have been conducted to determine the utility of the Braden Scale in predicting pressure ulcer risk in various patient populations.<sup>5-7,9-20</sup> Jin *et al.*<sup>5</sup> performed a retrospective study using electronic medical records of 5932 patients admitted to both the general units and intensive care units (ICUs) of a university hospital to determine an appropriate Braden Scale cutoff score for risk of pressure ulcer development. The study reported that a score  $\leq 18$  was an appropriate indicator of risk for developing a pressure ulcer. Park *et al.*<sup>6</sup> conducted a meta-analysis of 21 articles from 1966-2013 that showed the Braden Scale to have a moderate predictive validity; however, each individual study looked at different populations of adults aged >18 y using different Braden Scale cutoff scores. Hyun *et al.*<sup>15</sup> retrospectively examined 7790 medical and surgical ICU patients over a 4-year period. While they found a Braden score of 13 to show the best balance of sensitivity, specificity, positive predictive value and negative predictive value; they found

this score to over predict the number of patients that would develop a pressure ulcer and thus cause unnecessary and costly interventions to be implemented. To date, only a small study has been done to test the validity of the Braden Scale in trauma patients which found that, while useful, the Braden Scale does not include certain factors such as age and level of consciousness that may affect pressure ulcer development.<sup>7</sup> The injuries sustained by trauma patients produce many of the risk factors associated with pressure ulcer development such as immobility, decreased sensation, impaired mentation and altered nutrition.<sup>2</sup> Trauma patients are also often subject to medical devices (e.g., casts, splints, backboards, cervical collars and endotracheal tubes) that have the potential to cause skin breakdown.<sup>2</sup> To address the paucity of research of the appropriateness of the use of the Braden Scale in a trauma population, the current study was designed to assess the utility of the Braden Scale in predicting pressure ulcer development in a larger population of trauma and burn patients admitted to the ICU. Based on the results of the previously mentioned studies, as well as the different factors present in trauma and burn ICU patients (risk factors and medical devices), we hypothesize that the Braden Scale does not accurately predict the development of pressure ulcers among trauma and burn ICU patients.

## Methods

### Study population and variable definitions

This retrospective study included patients who were admitted to the trauma/burn intensive care unit (TBICU) at the Level 1 trauma center of the University of Alabama at Birmingham hospital between 2011 and 2014. After receiving approval from the University of Alabama at Birmingham Institutional Review Board, for each patient, information was collected from the trauma/burn registry on demographic (i.e., age, race, and sex), injury characteristics including injury mechanism and severity, and clinical information including hospital length of stays, number of days in the TBICU, transfer status, and in-hospital mortality. Injury mechanism was defined as trauma or burn, with the former further separated into blunt or penetrating trauma. Trauma injury severity was measured by the Injury Severity Score and burn injury severity was measured by percent total body surface area burn. Transfer status was categorized as not transferred, transferred within 24 h of injury, and transferred more than 24 h after injury.

In addition to the previously mentioned, data were collected from electronic medical records on the presence of pressure ulcers and documentation of the Braden Scale. These data were assessed and entered by nurses into the electronic medical record during the course of patient care. The minimum Braden Scale was defined as the lowest Braden Scale measurement that was taken in the ICU before the first nursing documentation of a pressure ulcer; Braden Scale measurements taken after the first documentation of a pressure ulcer were excluded from the analysis.

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