



## Original article

# Predicting pressure ulcer risk with the Braden Q Scale in Chinese pediatric patients in ICU

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## ABSTRACT

*Objective:* The purpose of this study was to (a) observe the value of the score of Braden Q scale in predicting pressure ulcers in pediatric Intensive Care Unit (ICU) patients in China, (b) determine the critical cutoff point for classifying patient risk, and (c) describe the pressure ulcer incidence.

*Methods:* A prospective cohort descriptive study with a convenience sample of 198 patients bedridden for at least 24 h without pre-existing pressure ulcers enrolled from a pediatric intensive care unit (PICU). The Braden Q score and skin assessment were independently rated, and data collectors were blinded to the other measures. Patients were observed for up to 3 times per week for 2 weeks and once a week thereafter until PICU discharge.

*Results:* Fourteen patients (7.1%) developed pressure ulcers; 12 (85.7%) were Stage I pressure ulcers, 2 (14.3%) were Stage II, and there were no Stage III or IV pressure ulcers. Most pressure ulcers (64.3%) were present at the first observation. The Braden Q Scale has an overall cumulative variance contribution rate of 69.599%. Using Stage I+ pressure ulcer data obtained during the first observation, a Receiver Operator Characteristic (ROC) curve for each possible score of the Braden Q Scale was constructed. The area under the curve (AUC) was 0.57, and the 95% confidence interval was 0.50–0.62. At a cutoff score of 19, the sensitivity was 0.71, and the specificity was 0.53. The AUC of each item of the Braden Q Scale was 0.543–0.612.

*Conclusions:* PICU patients are susceptible to pressure ulcers. The value of the Braden Q Scale in the studied pediatric population was relatively poor, and it should be optimized before it is used in Chinese pediatric patients.

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## 1. Introduction

Curley et al developed the Braden Q Scale based on the Braden Scale. The Braden Q Scale has been proven to be valid in American pediatric patients.<sup>1</sup> However, no useful pressure ulcer risk assessment scale in China has been tested and published to date.

A pressure ulcer, or bedsore, is any lesion caused by unrelieved pressure that ultimately damages the underlying tissue.<sup>1</sup> Although pressure ulcers can develop on any part of the skin surface, they are predominantly found on the skin covering the bony prominences of the sacrum and heels in adults.<sup>2–4</sup> Pressure ulcer development is

associated with several adverse consequences, including increased pain to the patient, extended hospital stays, elevated medical costs and an increased mortality rate.<sup>5</sup>

The mechanism of pediatric pressure ulcer formation is similar to the mechanism in adults, but the affected sites differ. Children under the age of three most often suffer from pressure ulcers on the heels, ears, and the occipital area. In fact, pediatric patients who cannot move are at the highest risk for pressure ulcers.<sup>6</sup>

Prevention of pressure ulcer formation has been of paramount importance to clinicians, and many countries use pressure ulcer incidence as an indicator to evaluate nursing quality.<sup>7</sup> The incidence and prevalence of pediatric pressure ulcers varies across different populations. Baldwin reported that the occurrence rate of pediatric bedsores was 0.29%; however, the morbidity was 0.47%.<sup>8</sup> Curley and her colleagues showed an occurrence rate of 24% in PICU patients.<sup>9</sup> The incidence of pediatric pressure ulcers in

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Chinese patients was 17.56%.<sup>10</sup> Over 100 different risk factors have been identified for the development of pressure ulcers.<sup>11</sup> Given the high incidence of pressure ulcers in the pediatric patient population, an assessment scale that can evaluate the risk for pressure ulcers is both necessary and warranted.

The process of preventing pressure ulcer formation in patients is systematic and typically involves the implementation of a pressure ulcer risk assessment scale (RAS). Use of a pressure ulcer RAS is an integral part of intervention by nurses and improves nurse awareness of pressure ulcer prevention. The three most frequently used RAS scales are the Norton, Braden, and Waterlow scales. The Braden Q Scale, however, is the most often implemented in pediatric patient populations. Aside from the Braden Q scale, the Bedi, Garvin, Pickersgill, Cockett, Olding and Patterson and Pediatric Waterlow scales have also been improved to assess the risks of bedsores in children.<sup>12</sup>

In China, the implementation of RAS in pediatric patients has been poor, with only 33.3% of nurses using such assessment tools.<sup>13</sup> Instead, nurses make assessments according to their own experience.

Quigley & Curley<sup>14</sup> modified the adult Braden Scale so that it could be used in a pediatric population. The Braden Q Scale focuses on the special aspects of pediatrics, for example, the growing application of gastric tube feedings to fit the RAS to young patients.

## 2. Materials and methods

### 2.1. Settings

This prospective cohort study was conducted in a 20-bed PICU located in Shanghai, China. The PICU is a free-standing facility affiliated with Shanghai Jiao Tong University Children's Hospital. This study was reviewed and approved by the Clinical Investigation Committee of the hospital's Institutional Review Board.

### 2.2. Study population

The study population included 198 consecutive PICU patients bedridden for at least 24 h. Written informed consent was obtained from all subjects that participated in the study. Patients with pre-existing pressure ulcers were excluded from this study. Patients older than 21 postnatal days of age were included in the study because, at 3 weeks of age, the skin is considered mature even if an infant was prematurely born.<sup>15</sup> Patients over the age of eight were excluded because the American Heart Association considers patients >8 years old to be adults in terms of medical treatment.<sup>16</sup>

### 2.3. Instruments

In addition to the Braden Q Scale, three other instruments were used for data collection. The Demographic Data Collection Tool was used to collect patients' personal information, such as sex, age, weight, etc. The Daily Patient Assessment and Intervention Tool was used to record patients' medical information, such as temperature, blood pressure, etc.

The Skin Assessment Tool<sup>17</sup> drew every bony bulge and required that the evaluator indicate whether ulcers appear or not at each point. Pressure ulcers were staged according to the following American National Pressure Ulcer Advisory Panel<sup>18</sup> recommendations:

- Stage I. Nonblanchable erythema not resolving within 30 min of pressure relief, epidermis remains intact.
- Stage II. Partial thickness loss of skin layers involving epidermis and possibly penetrating into but not through the dermis, may present as blister.
- Stage III. Full-thickness tissue loss extending through the dermis to involve subcutaneous tissue.
- Stage IV. Deep-tissue destruction extending through subcutaneous tissue to fascia and may involve muscle layers, joints, and/or bone.

### 2.4. Protocol

Prior to data collection, the principal investigator trained the data collectors in the study procedures, scoring the Braden Q, and staging pressure ulcers. The original inquirer and information collectors gave the patients' score until the patients achieved a clear status on each subscale of the Braden Q Scale. After that, staff members graded ten patients separately, and they stopped when they achieved a similarity of 90% on Braden Q scores and when the differences within each subscale of the Braden Q Scale were no more than one point. Thereafter, the percent agreement between the data collectors was re-evaluated bimonthly.

Two nurses, blinded to the other assessments and scores, observed patients up to 3 times a week (Monday, Wednesday, and/or Friday) for 2 weeks, then once a week (Wednesday) until discharge from the PICU. Nurse I enrolled patients who met the inclusion criteria, completed the Demographic Data Collection Tool and the Daily Patient Assessment and Intervention Tool, then rated each patient using the Braden Q Scale. Nurse II completed a head-to-toe skin assessment using the Skin Assessment Tool. The initial skin assessment occurred within a few hours of enrollment. If a pressure ulcer was identified, the patient's nurse was notified so that treatment could be implemented and/or continued.

### 2.5. Data analysis

Parametric and nonparametric statistics were used to describe the patient sample. Pressure ulcer positive (PU +) subjects were compared to pressure ulcer negative (PU -) subjects using data obtained during the first observation because most pressure ulcers (64%) noted were present at this time. Diagnostic capacity parameters (sensitivity, specificity, positive predictive value, and negative predictive value) were computed according to the Braden Q scores.<sup>19</sup> Sensitivity is the percentage of people who have the dysfunction of interest and a positive result on x test. Specificity is the percentage of people who do not have the dysfunction of interest and a negative result on x test. The positive predictive value (PPV) is the percentage of patients who have a positive result on x test and also have the dysfunction of interest. The negative predictive value (NPV) is the percentage of patients who have a negative x test result and do not have the dysfunction of interest.

Receiver operator characteristic (ROC) curve analysis plotted sensitivity against 1 – specificity over the range of Braden Q scores to confirm the critical value of the Braden Q Scale. As described by Bergstrom, Braden, Kemp and others,<sup>20</sup> an ROC curve provides a visual representation of the tradeoff between sensitivity and specificity for a test with a range of values. Using the same scale on both axes, the sensitivity is plotted on the vertical axis against 1 – specificity on the horizontal axis over a range of potential cutoff scores. The AUC is a commonly used summary measure for ROC curves, with higher AUC arising from more accurate tests. When the test has no diagnostic ability to predict the outcome, the AUC would equal 0.5.

The optimal cutoff point is usually identified in the region where the ROC curve changes direction—the inflection point. Because predicting patients at risk for pressure ulcers is more important

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