# Predictive Value of Braden Risk Factors in Pressure Ulcers of Outpatients With Spinal Cord Injury

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**Abstract-** Pressure Ulcers (PUs) remain among the most common complications after traumatic spinal cord Injuries (SCIs). The main goal of risk factor assessment with different tools has been to provisionally estimate the chance of developing pressure ulcers in patients with Spinal Cord Injury (SCI). Braden tool has been of good predictive value and most commonly employed in hospital communities for risk assessment of pressure sore development. The objective of this study was to determine the Braden risk factors as well as the prevalence of pressure injuries in SCI patients. This cross-sectional study was performed from June 2013 to December 2015 on 163 consecutive referred outpatients with chronic traumatic SCI in our tertiary SCI rehabilitation clinic. We assessed pressure induced skin injuries as well as their Braden risk factors and analyzed their association with stage and location of Pressure Ulcer (PU) and calculated prevalence of PU. One hundred and sixty-three patients out of 580 were found to have active pressure sores, with a prevalence of 28.1%. In the multiple models, only the Braden scale had significant association with the presence of active pressure sore. Patients with severe and moderate Braden scores were 2.36 and 1.82 times, more at risk of pressure sore development, as compared with those having mild scores ($P \leq 0.01$). It may be deduced that in various stages of SCI rehabilitation, the Braden scale may be calculated, and patients with moderate and severe risks (according to Braden sale) may need more attention and/or inpatient care for PU prevention.



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**Keywords:** Braden scalel; Pressure ulcer; Spinal cord injury

## Introduction

Pressure Ulcers (PUs) are amongst the most common complications in patients with Spinal Cord Injuries (SCIs). These ulcers may be life-threatening, with expensive, time-consuming treatment protocols, and can cause long-term hospitalization. They delay independent life, reduce the quality of life, and destroy self-confidence in the patient (1-5).

Despite a plenty of recommendations, for prophylaxis and timely treatment for PUs, they constitute the second cause of re-hospitalization in patients with Spinal Cord Injury (SCI). It is estimated that management of PUs in SCI, costs 1.4 billion$ per year for United States (5-6).

According to relevant literature in spinal cord medicine, the prevalence of Pressure Ulcer (PU) during the first year after SCI is 8%, and the cumulative figure rises to 33% in resident-community cases (1,7-8). It is estimated that 50% to 80% of subjects with SCI may develop PU at least once in their lives (2,9).

Detailed assessment of risk factors in SCI cases clarifies the necessity of in-depth education to reduce the incidence of new PUs. Comparison of various statistics about PUs between different countries is not plausible because of difficulty in matching the social and health system, discrepancies (2,7).

Timely detection of PU risk factors may help to prevent the majority of the PUs. Recognizing patients at high risk for PU also is of vital importance for rehabilitation facilities. At present, four different validated scales are being used in clinical practice for

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assessing the risk of PU development including Norton, Waterlow, Braden (10), and the SCI Pressure Ulcer Scale (SCIPUS) (11). The SCIPUS, a SCIs specific risk assessment based on risk factors associated with PU development post-SCI (12), could predict PU occurring within 2-3 days following administration during acute, but unable to predict over a longer term within acute or inpatient rehabilitation (13). The Braden scale can be used for chronic cases, like our cases in the post-rehabilitation phase of SCI. The main goal of assessment with Braden tool is to detect those at the risk of developing PU after SCI (10). It has been of good predictive value when employed on hospital basis (5,11-12).

It has been based on assessment of six subscales, including, sensory perception, mobility, activity, skin moisture, nutritional status and friction/shear. Each subscale is ranked in a four scale system, except friction and shear which is classified from 1 to 3.Total Braden scale scores range from 6 to 23 with lower scores indicating the severe risk. Risk scores range from 6 to18, from at risk to very high risk (14,17-23).

In this study, we have assessed the Braden scores for skin areas at risk and analyzed its association with stage and location of PU in patients with SCI. In addition correlation of other factors such as neurological level, smoking, substance abuse and depression with PU also has been assessed.

## Materials and Methods

This cross-sectional study, was approved by the local ethical committee, among the patients referred to out-patient tertiary SCI rehabilitation clinic from June 2013 to December 2015. Those aged over 18 years and less than 55-year-old with traumatic SCI more than 6 months (24), having informed consent for the study were enrolled. Demographic characteristic of the patients and duration of injury were evaluated and registered. Clinically examining the patient and reviewing their MRI scans, the neurological level was documented by the consultant neurosurgeon. All patients were routinely examined by the attending physician to diagnose the presence of any PU based on the clinical guidelines defined by the National Pressure Ulcer Advisory Panel (NPUAP) for staging PU (25). Also, the location of PU was registered. The Braden score was documented for all of the cases by our staff nurse. Smoking, substance and alcohol abuse were recorded. Our psychiatrist classified the mood status of the patient according to Beck's Depression Inventory (BDI) and a BDI≥31was assumed as major depression and recorded.

### Statistical analysis

The correlation of demographic and clinical factors with pressure sore stage, size, and the location was evaluated by Pearson chi-square test. Multiple logistic regression was used to examine the adjusted relationship between the studied risk factors and PU stage and location. All of the variables having correlation with a *P* less than 0.20 in univariate analyses were entered into the multiple logistic regression models. For the better fit of the model, standardized form of the variable, "age" (in years) was used in the multiple models. A two-tailed *P* of less than 0.05 was considered as statistically significant. All analyses were conducted using SPSS version 18 software for Windows (SPSS Inc. ® headquarter, Chicago, IL, USA).

## Results

Five hundred and eighty SCI patients were enrolled in this study. Demographic and clinical characteristics of the patients have been shown in Table 1.

Most of the patients (79%) were male and less than 30-year-old (42.1%). Regarding education level, 6.4% of the patients were illiterate, and 18.1 % had university education. Among them 13.6% smoked cigarette. Almost 31.7% of the patients had cervical level of injury, while 68.3% were thoracolumbar. About twenty-seven percent of the patients used a wheelchair pad during active daily living at the time of evaluation. One hundred and forty-one patients (24.3%) had major depression (BDI≥31). About 8.3% of the study sample had severe risk of pressure sore development as estimated by Braden scale, while 70.1% had mild risk of pressure sore.

One hundred and sixty-three patients had active pressure sores, (the total prevalence of patients with PU was 28.1%). Among them, stage one, two, three and four pressure sores were 1.2, 41.7, 38.0 and 19.0 percent, respectively. Most of the pressure sores (60.7%) were located in the sacral region (Table 2).

Pressure sore correlation with demographic and clinical findings has been shown in Table 3.

*Chi*-square test revealed major correlation between Braden scale (severe, *P*=0.001), as well as major depression (BDI≥31, *P*=0.018), with pressure sore development. Also, there was a marginally significant association between substance abuse (*P*=0.093), and PU.

There was no significant association between sex, age, education level, smoking status, level of injury, using wheelchair pad at the time of evaluation, and the chance of having at least one active PU. Multiple logistic regression models for active PU in relation to demographic and other clinical findings (with $P<0.20$ in the univariate model) was performed. In multiple models, the only significant factor was Braden scale, and none of those with significant association in univariate analysis remained significant in the multiple models. Patients with severe and moderate Braden scores, had 2.36 and 1.82 times, more risk of pressure sore development compared to those with mild risk respectively ($P\leq0.01$) (Table4).

**Table 1. Demographic and clinical characteristics of included patients (580) with spinal cord injury**

| Variables | | N (%) |
|---|---|---|
| **Sex** | Male | 458 (79.0) |
| | Female | 122 (21.0) |
| **Age groups (in years)** | <30 | 244 (42.1) |
| | 30-39 | 191 (32.9) |
| | 40-49 | 93 (16.0) |
| | ≥50 | 52 (9.0) |
| | Mean ± SD (years) | 33.5 ± 10.7 |
| **Education** | Illiterate | 37 (6.4) |
| | Elementary | 165 (28.4) |
| | High school | 136 (23.4) |
| | GED | 137 (23.6) |
| | University degree | 105 (18.1) |
| | Mean ± SD (years) | 9.2 ± 4.4 |
| **Smoking status** | Yes | 79 (13.6) |
| | No | 501 (86.4) |
| **Substance abuse** | Yes | 81 (14.0) |
| | No | 499 (86.0) |
| **Level of injury** | Cervical | 184 (31.7) |
| | Thoracolumbar | 396 (68.3) |
| **BDI** | ≤30 | 439 (75.7) |
| | ≥31 | 141 (24.3) |
| **Wheelchair pad** | Yes | 155 (26.7) |
| | No | 425 (73.3) |
| **Braden Score** | Severe or high (<13) | 49 (8.3) |
| | Moderate (13-14) | 125 (21.6) |
| | Mild (15-18) | 406 (70.1) |

**Table 2. Pressure sore's stage (using NPUAP grades) and location in 163 spinal cord injury patients harboring pressure sores at presentation**

| Variables | | N (%) |
|---|---|---|
| **Pressure sore stage** | *I* | 2 (1.2) |
| | *II* | 68 (41.7) |
| | *III* | 62 (38.0) |
| | *IV* | 31 (19.0) |
| | *X(unstageable)* | 0 (0) |
| **Pressure sore location** | *Coccyx* | 8 (4.9) |
| | *Foot* | 3 (1.8) |
| | *Heel* | 7 (4.3) |
| | *Iliac crest* | 3 (1.8) |
| | *Ischium* | 27 (16.6) |
| | *Knee* | 3 (1.8) |
| | *Sacrum* | 99 (60.7) |
| | *Trochanter* | 13 (8) |

Abbreviations: NPUAP, National Pressure Ulcer Advisory Panel

**Table 3. Association of demographic and clinical findings with existence of active pressure sores in 163 involved patients**

| Variable | | Active Pressure sore | | *P* |
|---|---|---|---|---|
| | | N | % | |
| **Sex** | *Male* | 134 | 82.2 | 0.202 |
| | *Female* | 29 | 17.8 | |
| **Age** | *<30* | 73 | 44.8 | 0.763 |
| | *30-39* | 52 | 32.0 | |
| | *40-49* | 23 | 14.1 | |
| | *≥50* | 15 | 9.2 | |
| **Education** | *Illiterate* | 11 | 6.7 | 0.237 |
| | *Elementary* | 44 | 27.0 | |
| | *High school* | 47 | 28.8 | |
| | *GED* | 39 | 23.9 | |
| | *University degree* | 22 | 13.5 | |
| **Smoking status** | *Yes* | 27 | 16.6 | 0.266 |
| | *No* | 136 | 83.4 | |
| **Substance abuse** | *Yes* | 29 | 17.8 | 0.093 |
| | *No* | 134 | 82.2 | |
| **Level of injury** | *Cervical* | 48 | 29.4 | 0.465 |
| | *Thoracolumbar* | 115 | 70.6 | |
| **BDI** | *≤30* | 112 | 68.7 | 0.018 |
| | *≥31* | 51 | 31.3 | |
| **Using wheelchair pad** | *Yes* | 47 | 28.8 | 0.421 |
| | *No* | 116 | 71.2 | |
| **Braden score** | *Sever or high (<13)* | 22 | 13.5 | 0.001 |
| | *Moderate (13-14)* | 45 | 27.6 | |
| | *Mild (15-18)* | 96 | 58.9 | |

Abbreviations: GED, General Education Development diploma; BDI, Beck Depression Inventory

**Table 4. Results of multiple logistic regression models**

| Variable | | OR (95% CI) | *P* |
|---|---|---|---|
| **Age (years)** | | 0.86 (0.69 – 1.01) | 0.070 |
| **BDI≥31** | | 1.22 (0.79 – 1.90) | 0.372 |
| **Substance abuse** | | 1.47 (0.88 – 2.45) | 0.143 |
| **Braden score** | *Severe or high (<13)* | 2.36 (1.23 – 4.51) | 0.010 |
| | *Moderate (13-14)* | 1.82 (1.17 – 2.83) | 0.008 |
| | *Mild (15-18)* | Reference | |

Abbreviation: BDI, Beck Depression Inventory

## Discussion

A survey of pressure sore risk factors after SCI yields a plenty of personal, and/or environmental factors, in different references. They report different importance for pressure sore prevention measures, and/or educational interventions. Low education level, smoking, and substance abuse have been reported as pressure sore risk factors (26-27). They include prolonged immobilization, malnutrition, spasticity, incontinence, and comorbidities such as diabetes, cardiovascular, and pulmonary diseases (28).

A more pluralistic tool may be necessary to assess the overall risk of pressure sore development. High risk SCI cases need more frequent follow-ups, associated with meticulous education programs regarding preventive measures. Also, sore prevention maneuvers need to be more frequent for this subgroup. Control of the more important risk factors may reduce the duration of possible inpatient care, and job leave. This study included a homogenous group of SCI clients including cervical and thoracic cases, among them 28.1% had active pressure sores, which is in concordance with other reports (6,29-30).

The most common site for PU in our cases was sacral area (60.7%). Many studies also report sacrum as the most frequent site (1,27,31) while some studies suggest ischial tuberosities as the most frequent location, possibly because of prolonged wheelchair use (29). The discrepancy may be due to higher prevalence of active sacral pressure sores in cervical patients (31.7%) which are more in recumbent position than using wheelchair, as compared to the study by Chan *et al*., (29).The presence of major depression was also associated with active PU development (*P*=0.018), in our cases however further studies on this issue may be necessary, because

the causal relationship needs, to be established.

On the other hand, age, sex, injury level, smoking, and using wheelchair pad at the time of evaluation did not show significant positive or negative correlation with PU development. Other authors also have published the same results (26-27).

Timely use of wheelchair pad has always been an important recommendation for patients with SCI and wheelchair users. However, our results don't support the association of wheelchair pad use and PU prevention. Because the use of wheelchair pad had begun lately after the development of pressure sore in our cases, and this finding is supported by other studies (5).

Moderate and severe Braden scores were also significantly associated with PU development ($P$=0.001). This finding was concordant with other studies. In multivariate analysis, the only significant risk factor for PU development was the severity of Braden scale. The severe and high scores of Braden scale (<13) were associated with 2.26 times more risk of PU development, while moderate score (13-14) was associated with 1.82 times risk of PU when compared with low risk (15-18) cases. A score below 18 has been a deterministic cut off point, for predicting PU development risk in other studies (17), as in our study.

The study has a cross sectional design and does not report Braden score at the very beginning of SCI. Also, it does not clarify that, depression or PU, which one came first. Another limitation is that self-report of substance abuse is known to be flawed.

It may be deduced that in various stages of SCI rehabilitation, the Braden scale may be calculated, and patients with moderate and severe risks (according to Braden sale) may need more sophisticated education and/or inpatient care for PU prevention. Also, timely use of wheelchair pads could not be overemphasized.

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## References

1. Pressure ulcer prevention and treatment following spinal cord injury: a clinical practice guideline for health-care professionals. J Spinal Cord Med 2001;24:S40-101.
2. Caliri MH. Spinal cord injury and pressure ulcers. Nurs Clin North Am 2005 ;40:337-47.
3. Richards S, Waites K, Chen Y, Kogos S, Schmitt M. The epidemiology of secondary conditions following spinal cord injury. Top Spinal Cord Inj Rehabil 2004;10:15-29.
4. Rabadi MH, Vincent AS. Do vascular risk factors contribute to the prevalence of pressure ulcer in veterans with spinal cord injury? J Spinal Cord Med 2011;34:46-51.
5. Regan M, Teasell RW, Keast D, Aubut J, Foulon B, Mehta S. Pressure ulcers following spinal cord injury. Spinal cord injury rehabilitation evidence Vancouver (Canada): SCIRE 2006 .
6. Gelis A, Dupeyron A, Legros P, Benaim C, Pelissier J, Fattal C. Pressure ulcer risk factors in persons with spinal cord injury part 2: the chronic stage. Spinal Cord 2009;47:651-61.
7. Thomason SS, Evitt CP, Harrow JJ, Love L, Moore DH, Mullins MA, et al. Providers' perceptions of spinal cord injury pressure ulcer guidelines. J Spinal Cord Med 2007;30:117-26.
8. Garber SL, Rintala DH. Pressure ulcers in veterans with spinal cord injury: a retrospective study. J Rehabil Res Dev 2003;40:433-41.
9. Wilczweski P, Grimm D, Gianakis A, Gill B, Sarver W, McNett M. Risk factors associated with pressure ulcer development in critically ill traumatic spinal cord injury patients. J Trauma Nurs: 2012;19:5-10.
10. Šateková L, Žiaková K, Zeleníková R. Predictive validity of the Braden Scale, Norton Scale, and Waterlow Scale in the Czech Republic. Int J Nurs Practice 2016 [Epub ahead of Print.[
11. Salzberg CA, Byrne DW, Cayten CG, van Niewerburgh P, Murphy JG, Viehbeck M. A New Pressure Ulcer Risk Assessment Scale for Individuals With Spinal Cord Injury1. Am J Phys Med Rehabil 1996;75:96-104.
12. Scovil CY, Flett HM, McMillan LT, Delparte JJ, Leber DJ, Brown J, et al. The application of implementation science for pressure ulcer prevention best practices in an inpatient spinal cord injury rehabilitation program. J Spinal Cord Med 2014;37:589-97.
13. Krishnan S, Brick RS, Karg PE, Tzen Y-T, Garber SL, Sowa GA, et al. Predictive validity of the Spinal Cord Injury Pressure Ulcer Scale (SCIPUS) in acute care and inpatient rehabilitation in individuals with traumatic spinal cord injury. Neuro Rehabil2016;38:401-9
14. Mortenson WB, Miller WC. A review of scales for assessing the risk of developing a pressure ulcer in individuals with SCI. Spinal Cord 2008;46:168-75.
15. Brown SJ. The Braden Scale. A review of the research evidence. Orthop Nurs 2004;23:30-8.
16. Braden BJ, Maklebust J. Preventing pressure ulcers with the Braden scale: an update on this easy-to-use tool that assesses a patient's risk. Am J Nurs 2005;105:70-2.
17. Kring DL. Reliability and validity of the Braden Scale for

predicting pressure ulcer risk. J Wound Ostomy Continence Nurs 2007 2007;34:399-406.

18. Kelechi TJ, Arndt JV, Dove A. Review of pressure ulcer risk assessment scales. J Wound Ostomy Continence Nurs 2013;40:232-6.
19. Magnan MA, Maklebust J. Braden Scale risk assessments and pressure ulcer prevention planning: what's the connection? J Wound Ostomy Continence Nurs 2009;36:622-34.
20. Lyder CH, Ayello EA. Pressure Ulcers: A Patient Safety Issue Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Hughes RG, editor. Rockville MD 2008. (Accessed December 18, 2017, at https://www.ncbi.nlm.nih.gov/books/NBK2651/).
21. Cox J. Predictive power of the Braden scale for pressure sore risk in adult critical care patients: a comprehensive review. J Wound Ostomy Continence Nurs 2012;39:613-21.
22. Ayello EA, Braden B. How and why to do pressure ulcer risk assessment. Adv Skin Wound Care 2002;15:125-31.
23. .Bergstrom N, Braden B, Laguzza A, Holman V. The Braden Scale for predicting pressure sore risk. Nursing Research, 36 (4), 205-210. Orthop Nurs 1988;7:42.
24. Saberi H, Derakhshanrad N, Yekaninejad M. Review of recently documented clinical neuroprotective and cellular treatment for spinal cord injury: an analysis of outcomes. J Neurorestoratol 2014;2:15-24.
25. Kruger EA, Pires M, Ngann Y, Sterling M, Rubayi S. Comprehensive management of pressure ulcers in spinal cord injury: current concepts and future trends. J Spinal Cord Med 2013;36:572-85.
26. Garber SL, Rintala DH, Hart KA, Fuhrer MJ. Pressure ulcer risk in spinal cord injury: predictors of ulcer status over 3 years. Arch Phys Med Rehabil 2000;81:465-71.
27. Dowd SE, Sun Y, Secor PR, Rhoads DD, Wolcott BM, James GA, et al. Survey of bacterial diversity in chronic wounds using pyrosequencing, DGGE, and full ribosome shotgun sequencing. BMC Microbiol 2008;8:43.
28. Richard-Denis A, Thompson C, Bourassa-Moreau E, Parent S, Mac-Thiong JM. Does the Acute Care Spinal Cord Injury Setting Predict the Occurrence of Pressure Ulcers at Arrival to Intensive Rehabilitation Centers? Am J Phys Med Rehabil 2016;95:300-8.
29. Chan BC, Nanwa N, Mittmann N, Bryant D, Coyte PC, Houghton PE. The average cost of pressure ulcer management in a community dwelling spinal cord injury population. Int Wound J 2013;10:431-40.
30. Derakhshanrad N, Yekaninejad MS, Vosoughi F, Sadeghi Fazel F, Saberi H. Epidemiological study of traumatic spinal cord injuries: experience from a specialized spine center in Iran. Spinal Cord 2016;54:901-7.
31. Makhsous M, Lin F, Knaus E, Zeigler M, Rowles DM, Gittler M, et al. Promote pressure ulcer healing in individuals with spinal cord injury using an individualized cyclic pressure-relief protocol. Adv Skin Wound Care 2009;22:514-21.