

## Predictive values of Braden and waterlow scales to assess the risk of pressure ulcer : Review article

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### Abstract

**Introduction:** Pressure ulcer is a kind of skin disorder that is developed due to increase of localized pressure on a part of body. Due to the terrible consequences of pressure ulcer, it is essential to prevent it. A common method to prevent is using risk assessment scales. The aim of this review study is to identify the best risk assessment to prevent and reduce the incidence of pressure ulcer.

**Materials and methods:** The studies and experiments in field of pressure ulcer risk assessment that had been exhibited on SID, PUBMED and Google Scholar sites were used.

**Results:** According to literature, compared to waterlow scale, Braden scale is more appropriate measure to assess the risk of pressure ulcer in hospitals. In the other hand, Waterlow scale indicates the better predictive value and contains more subscales. It also focuses closely on details in prone patients.

**Discussion:** It is suggested that patients on admission time should be evaluated by Braden scale for first screening, but during the hospitalization time, waterlow scale is more effective to assess the pressure ulcer. Waterlow scale is more sensitive and focuses on effective details in development of pressure ulcer.

**Keywords:** Skin, Pressure ulcer, Braden scale, Waterlow scale, Assess

### Introduction

Skin as largest vertebrate tissue has many functions including: temperature regulation, and physical sense conduction. This mechanical barrier protects the body against invading microorganisms and harmful environmental factors such as radiation, mechanical, thermal and chemical damages. This ever-changing organ is made of 2 layers: the epidermis which is the ectodermal layer consists of different types of cells. The main cells of epidermis are keratinocyte. These cells protect the body from excessive water loss and environmental risks such as infection, chemicals, and UV radiation. The dermis as a connective tissue of mesodermal cells responsible for flexibility and mechanical integrity of the skin and nourishing the epidermis. Damaging of the skin is very important. Recently, one of the most important concerns of hospital staff such as nurses is the pressure ulcer in patients who have to be

hospitalized in health centers and at home for long time particularly in situations of complete immobilization, anesthesia, or loss of consciousness (1). In the past, wounds caused by inactivity and long-term pressure on one area of the body was called bedsore. But by recognizing the main cause of these wounds -too much pressure on the skin and tissue ischemia- the pressure ulcers have been accepted. Increasing the pressure on the skin tissue close to the bones causes the blockage in capillary blood flow resulting in impaired tissue perfusion and necrosis of the skin cells. These necrosis cells damage the beneath layers and pressure ulcer are appeared (2, 3).

According to many studies, various factors have contributed to development of pressure ulcers. Halfens suggested that aging is effective factor in formation of pressure ulcers (2).

Margolis et al. concluded that the underlying disease including Alzheimer's disease, congestive heart

failure, COPD, spinal injuries, diabetes, deep vein thrombosis, pelvic fracture, surgery pelvic limb paralysis, lower limb edema, malignancies, eating disorders, osteoporosis, Parkinson's disease, rheumatoid arthritis, and urinary tract infections have the highest association with the prevalence of pressure ulcers. On the other hand, high blood pressure, angina, pneumonia and lesions are the most negatively relevant factors (3).

Some of other risk factors are related to different degrees of pressure ulcers such as immobility, older age, decreased level of consciousness, incontinence and fecal (4, 5), increased humidity, low level hemoglobin, hematocrit, total protein and albumin, diabetes (6), systolic and diastolic blood pressure and low body temperature (7), smoking, dry skin (5), damage complete spinal cord, autonomic dysreflexia, severe spasticity, alcoholism, and emotional stress (4, 8).

Several groups of people are at risk. The main groups who are the patients with spinal cord injuries, the elderly people, hospitalized patients especially those undergoing orthopedic surgery and patients are admitted to ICU. due to long time immobilization, the latter group is more susceptible for developing of pressure ulcers (9). In Iran prevalence of pressure ulcers have been reported 5% in general units of hospitals and 10.1%-21% in ICU. Different studies were performed to define pressure ulcer prevalence. In a hospital in England the prevalence of this ulcer was reported between 9.6% to 11.9 in adult patients and incidence in elderly patients and persons who had surgery were respectively 12% and 22%. In a recent study, prevalence and incidence of pressure ulcer in America and Canada vary in different environments. According to this study prevalence rates in acute care setting were 4.7-29.7% and in society were between 19.2 and 29% (10).

People with this type of ulcer were also exposed to pressure ulcer complications including pain, depression, loss of function and independence, an increased incidence of infection, sepsis, and surgical procedures. All of these conditions could potentially increase the hospitalization length (9). Prolonged hospitalization particularly in intensive care units resulting in additional costs and workload of nurses (11). The cost of pressure ulcer treatment depends on the severity of it. The expenses of the first and second degree ulcers are about 125 to 451 dollars and the costs of the third and fourth degree ulcers are respectively 14,000 to 23,000\$ (12). 65% of the additional costs of pressure ulcers in hospitals are due to prolonged hospitalization, 25% for nurse's

cares, and 7% on items such as beds and mattresses, and 3% for the drug, dressings, physical therapy and diet. Because of increased longevity of patients and medical advances, the number of patients at risk of pressure ulcers is increasing. So the best approach is early detecting of at risk patients and the setting of the preventive actions (13). In fact, prevention is the most effective way for solving this problem. In addition high quality nursing care is also a key factor to overcome the problem. Preventive activities include 1) Development of pressure ulcer risk assessment 2) Skin care and initial treatment 3) Use of pressure reducing support surfaces such as mattresses and 4) Training to at risk patients (14).

## Methods

The aim of this study to recognize the best tool to assess the pressure ulcer risk. Among 40 scales, we selected Braden and Waterlow which are the most significant tools. We wanted to answer some questions including: what type of these two tools (Braden or Waterlow) is more sensitive and specific, Which tools concentrating on the creation and development of pressure ulcer intensively and consequently reduce the prevalence and incidence of pressure ulcer? In our study, these questions were used for recognizing the patients at risk of pressure ulcer and also in the next step, applying the appropriate preventive measures.

At present, there are at least 40 pressure ulcer risk assessment scales resulted from specialist thoughts, reviewing the literatures and modifying the initial scales (12). In fact, exact and defined clinical practice guidelines (healthcare protocols) are made of comprehensive, logical and classified information by nurses. Between these 40 risk assessment scales the validity of 6 scales has been evaluated. Norton and Waterlow scales were evaluated just for 2 times and Braden scale evaluated for 9 times (15).

## Braden Scale

The Braden scale, which was presented first by Braden and Bregstorm in 1985, contains 6 parameters including: sensory perception, moisture, activity, mobility, nutrition, friction, and shear. Among 6 subscales of Braden only 4 subscales (moisture, activity, friction and shear and sensory perception) had significantly associated with the development of pressure ulcers in ICU (Intensive Care Units) patients (16, 17). These parameters are scored 1 to 4 except for the friction which has a

rating of 1-3. Score 1 implies major risk and score 4 implies minor risk. The final score is the sum of all points achieved while the low point indicates the most risk. According to the Braden scale maximum score point was 23 and patients are classified into 3 groups including: high risk patients with score below 12, the moderate risk patients with score between 13 and 14 and low risk patients with score ranging from 15-16 in less than 75 year old individuals and 15-18 in more than 75 year old ones 22 (18). Although the Braden risk assessment scale is widely used in the United States and in home care, hospitals and intensive care (19-23), it was introduced valid in a few assessment (24-26).

### Waterlow scale

Waterlow scale includes 11 parameters: height/weight relationship, continence, skin appearance, mobility, age/sex, appetite, tissue malnutrition, neurological deficit, trauma, surgery, and medication. Each of factors, scores were from 0 to 8 points. The sums of points indicate the final scores and the higher scores implies the major risk (27). These scales are both useful and complementary and also improve the systematic assessment of the patients. Daily use of these scales are suggested particularly in patients with changing clinical conditions (28).

### Data and Research Sources

In this research, the literatures were investigated in English and Persian. We used Persian articles presented at SID site from 2006 and 2014 and English literatures exhibited at PubMed and Google scholar in 2014 and 2015 were applied.

### Results

Literatures were evaluated in details. In a series of papers, Braden scale and other articles, Waterlow were introduced as appropriate measure to identify at risk patients.

Tomazini et al. (29) performed a prospective study in March and June 2013 on 55 patients admitted to the intensive care unit at the University Hospital of Cassiano Antonio Mouraes. Pressure ulcer with incidence of 30.9% was developed in 17 patients. Participants in the study included 28 men (51%), 38 white skin color (69%), 33 married patients (60%), 35 women with primary education (64%) and 44 patients admitted to the ICU (80 percent). Patients aged were between 19-85 years with an average of

50.4 years. According to clinical variables the mean length of ICU stay was 16.6 days ( 5-110 days), 30 patients (54%) were stayed in the hospital for less than 10 days, 38 patients (69%) due to injuries, 33 (60%) with clinical diagnosis of digestive disorders and 11 patient (20%) were hospitalized for Cardiorespiratory disorder. According to Waterlow scale patients were in the range of 6-26 points (average point: 15.49) and they were classified in at high risk groups. The average obtained score for the Braden were in the range of 6-22 (average point: 12.8) and patients were classified in moderate risk group. By using Waterlow scale, it was cleared a score of 16 and the sensitivity was 71% and specificity was 47% in the first assessment. In the second assessment a score of 15 (sensitivity; 71%, specificity; 42%) was reported and in the third evaluation a score of 14 (sensitivity; 88%, specificity; 50%) gave the best balance between sensitivity and specificity. when Braden scale was analyzed in the first assessment, a score of 12 (sensitivity; 41%, specificity; 21%), in the second evaluation, a score of 12 (sensitivity; 53%, specificity; 39%) and in the third assessment, a score of 11 (sensitivity; 41%, specificity; 18%) represented the best balance. Analyzing the ROC curve of Waterlow scale suggested that it was better tool to predict the patients at risk for pressure ulcers. By using Braden an assessment of the ROC curve displayed that was not an ideal tool to predict patients at risk for developing pressure ulcers. In previous study both measures provide higher sensitivity and lower specificity. Braden had suggested good sensitivity but lower specificity and it could be considered as a good screening tool. The Waterlow scale give the better balance between sensitivity and specificity and it was proved that it was a better tool for predicting risk in patients. Waterlow scale was able to show better predictive value. So using this scale was suggested as a risk assessment measure for developing of pressure ulcers in clinical practice in the hospital. Further it should be mentioned that Braden scale also has shown good screening for pressure ulcer development.

Hyun et al (30) conducted a study in two intensive care units; medical ICU and surgical ICU. Patients who developed pressure ulcer had international codes to identify and classify their scars. Patient with ICD-9 code such as: 707.05 (hip pressure ulcer) were placed in the group of people with pressure ulcers. On the other hand, if a patient had no ICD-9 code was classified in individuals without pressure ulcers (the control group). All of the patients were coded

and analyzed. Predictive validity of the Braden scale evaluated using sensitivity, specificity, positive predictive value and negative predictive value, and calculated the area under the Roc curve. A total of 7790 ICU patients were included in the study. Patients at risk for pressure ulcers development were white men and older than patients without pressure ulcers. The average day of ICU stay for patients with pressure ulcers was 12.8 days while average length of ICU stay was 9.7 days for patients without pressure ulcers. Braden scale score was 12.1 in ICU patients who developed pressure ulcers while the scores of patients without pressure ulcers was 14.2. In previous study Braden gave high sensitivity but low specificity and positive predictive value while abundant range of false positive results was observed. These results indicated that preventative actions may perform for patients who not are at risk of pressure ulcers. The score of 13 showed the best balance between sensitivity, specificity, positive predictive value and negative predictive value. Sensitivity actually means that the scale classifies a patient with pressure ulcer in group of patients with developed pressure ulcers. Specificity means that the scale doesn't classify the patients who have not pressure ulcers in group of patients with developed pressure ulcers. Ideal results obtained when all of four above criteria be high but when sensitivity increased, actually the specificity came down. Positive predictive value was the proportion of patients who were at risk of developing pressure ulcer while negative predictive value was the proportion of patients who weren't at risk of developing pressure ulcers (26)

The findings of the Hyur's study were compatible with "Kim" and colleagues' observations (31). It seems Braden scale is more reliable among numerous of scales to assess risk in a systematic review (14) Due to different health conditions of ICU patients such as; unstable hemodynamic conditions, vasoactive medications, and ventilator, Braden scale isn't a perfect reflection of characteristics of the patients (32).

According to Persian literature Braden scale compared with Waterlow scale has a higher sensitivity, specificity and predictive values. This scale is a trustful measurement for screening pressure ulcers in the hospitals (2, 33-37).

The Braden scale can be used in different patients (including patients with acute and chronic bed sores and in different care centers). This scale could be considered as a tool to indicate the risk factors for pressure ulcers development and it has the best

sensitivity, specificity and more effective scoring. Braden scale requires less time and includes risk factors which are objective and easier to employ in hospitals. On the other hand Waterlow has high sensitivity but its specificity is very low. Hence false-positive results might be observed and adopted preventive measures for these patients waste the cost and human resources (38).

Hidalgo and his colleagues in their finding observed that Waterlow scale was involved risk factors which were difficult to understand. So this is caused errors to calculate the scores. Actually, patient medical information and history are required for using Waterlow scale (36).

The reliability of Braden and waterlow scales were compared and obtained respectively 83% and 40%, respectively. The reliability of the Braden scale is appropriate (38). The results of the meta-analysis conducted by Pedro and colleagues demonstrated that Braden scale -as an assessment measure in the prevention of pressure ulcers- is more valid than Waterlow scale (14).

Generally, sensitivity, specificity, reliability, validity, time and understanding the parameters of Braden scale. Since the score of at risk patients will be less than 14, predisposed patients are identified (27) and the following and necessary actions will be performed as below:

1. Medical cares with short intervals are necessary for changing the position of the patient in order to prevent continuous contact with the substrate or as an alternative method, air fluidized bed (AFB) can be used. The continuous air flow mattresses neutralize the weight of the body in different positions and hence, the risk of pressure ulcer is reduced.
  2. Increasing the number of private bathing, use of mild detergent and avoid hot water and sever rubbing
  3. Applying a moisturizer for dry skin
  4. Using the correct methods of patients' rotation, movement and changing their in order to minimize damages
  5. The use of lubricant or protective coatings to reduce the damage of friction
  6. The use of nutritional supplements
  7. Employing a rehabilitation program in order to maintain or improve the activity and movement (8).
- According to literature, white male and elderly patients were more at risk for pressure ulcers development. Since some factors (such as: age, sex and skin color) are not considered in the Braden scale the criteria provided by the Braden Scale, to assess the risk of pressure ulcer, was lower and

easier to understand compare to Waterlow (6 to 11). On the other hand, patient medical information and history is not essential for assessment by Braden scale.

### Discussion and suggestions

In conclusion, it is suggested that patients on admission time should be evaluated by Braden scale. This scale requires less time and checks the critical risk factors. Using this powerful scale patients are classified in 3 groups: 1- patient without pressure ulcer, 2- patient prone to pressure ulcer and 3- patients with pressure ulcers. During the hospitalization time waterlow scale is more effective and sensitive tool to assess the pressure ulcer development.

Despite the use of the best methods for prevention, there is still the risk of pressure ulcers. Treatment methods include pressure relief, changing the positions, nutritional support and dressing (35, 39). The common dressing in the treatment of pressure ulcers is hydrocolloid dressing and the best one is comfeel (40). The other research implies that honey dressing is efficient in the treatment of pressure ulcers. Honey has the high sugar content and acidity and the other nutrients which plays an essential role in the healing process. In addition honey by increasing oxygen in the ulcer environment leads to the growth of new tissue (41).

Another point in treatment of pressure ulcer is ointments, that phenytoin can be noted. Researcher evaluated the effect of *Calendula officinalis* in treatment of pressure ulcer and concluded that this ointment have the anti- inflammatory, regenerative and anti-bacterial property (42). Thus this ointment can be used in the treatment of skin inflammation, eczema, ulcers, fissures and a variety of wounds (43).

### Conclusion

Due to complementary roles of Braden and Waterlow scales with each other, both of these scales could be able to have significant roles in prevention of pressure ulcers. It should be noted that employing Professional nursing care, conducting the relevant seminars and classes, updating the knowledge and the promotion of scientific and technical potential in treatment group can be a major help to prevent and treat the pressure ulcers. Finally, incidence and prevalence of pressure ulcer development will be reduced by using these actions.

### Conflict of Interest

The authors declare that they have no conflict of interests.

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