A New Look at the Braden Scale for Pressure Ulcer Risk Among Older Adults in Home Health Care

A NEW LOOK AT THE BRADEN SCALE FOR PRESSURE ULCER RISK AMONG OLDER ADULTS IN HOME HEALTH CARE

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ABSTRACT

Only two previous studies have examined Braden Scale use in home health care. Findings are mixed and suggest the Braden Scale is not a reliable tool for identifying elder home health care patients who are at risk for pressure ulcer development. However, each previous study was limited to one home health care agency and no subsequent study has been conducted to clarify these results. The purpose of this study was to reexamine the validity of the Braden Scale in a large sample of elder home health care patients from multiple (N=5) agencies across the United States. The Conceptual Schema for the Study of the Etiology of Pressure Sores guided the research study. Secondary analysis of data from a retrospective cohort study was performed. The sample included 2120 patients age 60 years and older who were admitted for intermittent skilled home health care and had a documented admission Braden Scale score. New pressure ulcer development (n=30) was determined from OASIS (Outcome and Assessment Information Set) data completed after patient admission. Statistical analyses included a description of the sample and new pressure ulcers by stage. Specificity, sensitivity, predictive value positive, and predictive value negative values across the range of Braden Scale scores were calculated for the total sample (n=2120) and a subset of patients who were pressure ulcer free on admission (n=2111) to determine the optimal cutoff score for pressure ulcer risk. A Braden Scale score of 18 or less yielded the best balance between sensitivity (73.30%) and specificity (65.50%) for the total sample and for the subset of patients who were pressure ulcer free on admission (sensitivity = 71.43; specificity = 65.60). Receiver-Operator Characteristic curve analyses confirmed the cutoff score for both groups. The area under the curve was 0.76 for the total sample (95% CI=0.66-0.85) and 0.73 for patients who were pressure ulcer free on admission (95% CI=0.620.84). Results will guide home health care provider use of the Braden Scale for identifying elder patients at risk for pressure ulcer development.

INTRODUCTION

Pressure ulcers are defined by the National Pressure Ulcer Advisory Panel (2010) as localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear. The development of a pressure ulcer is especially problematic in elderly people due in part to a reduction in collagen associated with aging, reduced tissue perfusion, compromised nutritional intake, lack of mobility and incontinence (Braden & Bergstrom 1989). The costs both personally and medically are high. The presence of a pressure ulcer has been reported to increase the risk of death four-fold in elderly patients (Braden & Bergstrom, 1996); some estimates of mortality for persons who develop pressure ulcers are as high as 60%. Additionally, the annual financial burden this places on the health care system is estimated to be about $11billion (Zulkowski, Langemo, Posthauser and the National Pressure Ulcer Advisory Panel, 2005). Preventing pressure ulcers is key to reducing their incidence and the associated negative sequelae. The first step in preventing pressure ulcers is identifying the persons at risk for acquiring them. Appropriate interventions can then be directed to at-risk persons to prevent the formation of the ulcers (Bergquist, 2001).

Most organizations utilize an assessment tool to identify those patients at risk for pressure ulcers. The Braden Scale is one of the most commonly used tools to assess pressure ulcer risk in hospitalized and nursing home patients. While many studies have examined Braden Scale use in hospitalized and nursing home patients, only two previous studies have examined Braden Scale use in home health care. Findings from these two studies are mixed and suggest the Braden Scale is not a reliable tool for identifying elder home health care patients who are at risk for pressure ulcer development (Bergquist-Beringer, protocol 2007). However, each of the two previous studies was limited to one home health care agency and no subsequent study has been conducted to clarify these results. This study will reexamine the validity of the Braden Scale in a large sample of elder home health care patients from multiple (N=5) agencies across the United States.

LITERATURE REVIEW

The Braden Scale was created by Barbara Braden, PhD, RN, FAAN, and Nancy Bergstrom, PhD, RN, FAAN, in 1987 (Braden & Bergstrom, 1987). The Braden Scale has 6 subscales: sensory perception, moisture, activity, mobility, nutrition, and friction/shear. These categories address the two primary etiologic factors of pressure ulcer development: intensity and duration of pressure and tissue tolerance for pressure. Sensory perception, mobility, and activity address clinical situations that predispose a patient to intense and prolonged pressure, while moisture, nutrition, and friction/shear address clinical situation that alter tissue tolerance for pressure. Each of the subscales is ranked with a numerical score. Five of the subscales-sensory perception, mobility, activity, moisture, and nutrition-have scores that range from 1 to 4, with 1 representing the lowest score and 4 representing the highest. Friction/shear has a score that ranges from 1 to 3. Each of the 6 subscale scores are then totaled to give a final Braden Scale score. Scores can range from 6 to 23. As Braden Scale scores become lower, predicted risk becomes higher (Ayello & Braden, 2002).

It is necessary that any tool used to assess pressure ulcer risk be both valid and reliable. Validity refers to the ability of an instrument to accurately reflect or represent what it is intended to measure. Reliability refers to the capacity of a measuring device to produce "consistent" measures (Magnan & Maklebust, 2008). Choice of an optimal cut score for a screening tool should be influenced by the nature of the phenomena being predicted and should provide the lowest rate of misclassification while maintaining a sensitivity, specificity, and predictive value positive and negative tests acceptable for clinical decision making from both a practical and an ethical perspective (Braden & Bergstrom, 1994). Sensitivity indicates a tool's accuracy in differentiating true positives from false negatives; for the Braden Scale this is given as the percentage of people who develop pressure ulcers and were predicted to develop them. Specificity indicates a tool's accuracy in differentiating true negatives from false positives; in this case it is given as the percentage of people who do not develop pressure ulcers and were not predicted to develop them (Braden & Maklebust, 2005). Predictive value positive is defined as the probability that a person with a given Braden Scale score will actually develop a pressure ulcer. Predictive value negative is defined as the probability that a person with a given Braden Scale score will remain pressure ulcer free (Gerstman, 1998).

The majority of studies regarding pressure ulcer risk and development have concentrated on patients admitted to hospitals and nursing homes. Previous studies to validate the Braden Scale in the acute care setting have shown that a cut score of 16 resulted in the optimal prediction of pressure ulcer outcome (Braden & Bergstrom, 1994). The earliest of these studies was conducted in an adult intensive care unit (Bergstrom, Demuth & Braden, 1987). The purpose of this study was to describe the protocol by which predictive instruments can be tested for validity and to evaluate the use of the Braden Scale for predicting pressure ulcer risk in an adult intensive care unit. The sample size was 60 adults age 21 to 84 with a mean age of 58.53. The participants were pressure ulcer free upon admission. They were assessed for risk within 24 to 72 hours after admission. Comprehensive skin assessments were performed at the beginning of the study and every 48 hours for 2 weeks or until discharge. The study provided a basis for creating a clinical cut-off point with the greatest validity for adult intensive care units. The study identified that at a score of 16, the instrument was 83% sensitive and 64% specific.

In a later study among 102 residents in a skilled nursing facility, Bergstrom & Braden (1994) found that a cut score of 18 simultaneously maximized sensitivity (75% to 79%) and specificity (64% to 75%). The primary discernable difference between patients in this study and previously studied hospitalized patients was that these patients were considerably older with a mean age of 75.9. According to the authors, it is not unusual for predictive characteristics of screening tools to vary with the age of the population screened. While a score of 16 seems to be an appropriate predictor of mild risk for the stable adult patients, a score of 18 may be more appropriate for patients who are older, hemodynamically unstable, more severely ill, and have less access to individualized or attentive care (Braden & Bergstrom, 1996). The AHCPR (Agency for Health Care Policy and Research) Guideline stresses evaluation of the risk cut-off score within individual settings (Harrison et al, 1996).

Only two previous studies have examined Braden Scale use in home health care. In the first study, Ramundo (1995) examined the validity of the Braden Scale in a community-based, suburban home care agency. Ten nurses volunteered to serve as data collectors for the study. They were instructed in the use of the Braden Scale. An inter-rater reliability study was completed to ensure consistency in Braden Scale scoring and skin assessment among the data collectors. Specifically, nurses who finished the education program were asked to complete a Braden Scale and a skin assessment tool for any patient newly admitted to the agency. Within 24 to 48 hours, one of two certified ET (enterostomal) nurses employed at the agency completed a second Braden Scale and skin assessment tool. Three to four pairs of observations were obtained before a nurse was cleared to begin admitting patients to the study. The study sample included only home health care patients unable to leave the bed or chair. Data were collected for 48 patients. Seven of the patients acquired a pressure ulcer, yielding an incidence rate of 17%. Incidence is defined as the number of new pressure ulcers that develop in a given period. The Braden Scale pressure ulcer risk tool was 100% sensitive and 0% to 34% specific in identifying patients at risk when a cutoff score of 18 was used. The limitations of this study include the use of a convenience sample and the potential bias of data because the same nurse completed the Braden Scale and the skin assessment.

The second study was conducted by Bergquist & Franz (2001). The purpose of this study was to examine the validity of using the Braden Scale in evaluating older adults that were receiving home health care. Specifically, the study was a secondary analysis of a retrospective cohort study involving risk factors in older adults that predispose them to developing pressure ulcers. The study was conducted in a large Midwestern urban home health care agency. Hospice patients were excluded for the study as were patients who had a pressure ulcer upon admission for home health care. The sample size was large (n=1,696). All patients were evaluated using the Braden Scale by a registered nurse upon being admitted to the Intermittent Skilled Division of the home health agency. The development of the ulcer was primarily determined by the visiting nurse report and documentation on the agencies wound assessment report. Of the 1,696 patients, 108 acquired a pressure ulcer after admittance to the home health care agency. The incidence rate was 6.3%. The patients who developed a pressure ulcer were older and had more medical issues. Although there were more women in the study than men, men developed more ulcers. The average length of time for a pressure ulcer to develop was 56.9 days after admission. There was not a difference in the outcomes of patients based on the number of visits or the number of patient care days in respect to who developed an ulcer and who did not. The study found that an admission score of 19 or less identified individuals who were at-risk for developing a Stage I-IV pressure ulcer with 61% sensitivity, 68% specificity and 11% predictive value positive (PVP). The low sensitivity and PVP found in this study suggests that the Braden Scale may not be useful for identifying patients at risk for pressure ulcers among elder adults in home health care. Results provide the rationale for this study which aims to reexamine the validity of Braden Scale use in elder home care.

METHODS

Design, Setting, Subjects

This study is a secondary analysis of data from a retrospective cohort study. The parent study included 5395 patients who were 60 years and older and admitted for intermittent skilled home health care between October, 2007 and February, 2009. The cohort sample for the parent study was accrued from five Medicare certified home health care agencies located across the United States. Only the first admission was considered for patients with more than one admission during the study period. Outcome Assessment Information Set (OASIS) data on age, gender, ethnicity, race and other OASIS data relevant to pressure ulcer risk were extracted from the electronic medical record of eligible home patients (Bergquist-Beringer, protocol 2007). When available, data on Braden Scale scores were extracted.

The sample for the current study was restricted to patients with a documented admission Braden Scale score. Excluded from the sample were subjects who were admitted with a pressure ulcer and did not develop a new pressure ulcer. The total sample for the current study was 2120.

Variables

OASIS data items address sociodemographic, environmental, support system, health status, functional status and health service utilization characteristics of the patient (Ohio Department of Health, Ohio.gov, 2008). Home health care agencies collect OASIS data due to a federal mandate for prospective payment of services provided to Medicare/Medicaid patients and are completed at defined intervals (admission, after a significant change in patient condition ,and at discharge) during the patient's course of home health care (Bergquist-Beringer, protocol 2007). OASIS data are useful in home health care because the data is nationally uniform. It also has established reliability and validity, and it includes data on risk factors that have been shown to predict pressure ulcer development in elder home health care patients (Bergquist-Beringer, protocol 2007). Previous studies on the inter-rater reliability of OASIS data have found that reliability coefficients for the majority of OASIS items are substantial to excellent and that nurses and therapists rated the majority of functional items accurately and provided similar ratings on most items studied (Bergquist-Beringer, protocol, 2007). Inter-rater reliability is the degree to which two raters, operating independently, assign the same rating or values for an attribute being measured or observed (Polit and Beck, 2004). In general, data collectors were able to differentiate between individuals with and without pressure ulcers (Kottner et al, 2009). OASIS data important to the current study also included age, gender, ethnicity, existing diseases by ICD9 code, living arrangements, identification of the primary caregiver and risk factors.

Information on the Braden Scale available in the parent study included the total Braden Scale score and subscales but the focus of this study is on the total scores. The inter-rater reliability studies of the Braden Scale have produced favorable results with percentages of agreement ranging from 95% to 100% (Kring, 2007). Kottner and colleagues examined the reliability of Braden Scale scores in home health care and reported that the interclass correlation for the Braden Scale sum scores was .88 to .90 for two measures performed in 2007 and 2008 (Kottner et al, 2009). The inter-rater reliability for determination of new pressure ulcer development for the current study was 95%.

Outcomes

Patient OASIS data were followed forward from admission to new pressure ulcer development or discharge. New pressure ulcer development was defined as patients with or without a pressure ulcer on admission who developed a new pressure ulcer on the recertification or discharge OASIS assessment (Bergquist-Beringer, protocol, 2007).

Data Analysis

Statistical analyses include a description of patient age, gender, ethnicity/race, Braden Scale scores and the stages of the new ulcers. The statistical analysis also included a descriptive analysis of patient existing diseases by ICD9 code, living arrangements, identification of the primary caregiver and risk factors such as heavy smoking, obesity, alcohol dependency and drug dependency.

Specificity, sensitivity, predictive value positive and predictive value negative values across the range of Braden scale scores were calculated to determine the optimal cutoff score for pressure ulcer risk for the total sample (n=2120). An analysis also was conducted on a subset of patients who did not have a pressure ulcer on admission (n=2111) to determine whether or not patients who were admitted with a pressure ulcer may have influenced Braden Scale validity parameters. Additionally, Receiver-Operator Characteristic (ROC) curve analyses were completed to confirm the appropriate cutoff score for both groups (Figure 1 and 2).

RESULTS

The total sample had ages ranging from 60 to 100 years. The mean age was 77.5 SD ± 8.803. See Table 1 for a description of the sample. Most of the patients in the study were white n = 1917 (90.4%) and female n = 1314 (62%).

Table 1 Demographic Characteristics of the Sample (n=2120)

Characteristic	Total Patients in Sample
Age, mean ± SD	77.53 ± 8.803
Gender, n (%)	
Female	1314 (62.0)
Male	806 (38.0)
Ethnicity, n (%)	
American Indian or Alaskan Native	9 (0.4)
Asian	39 (1.80)
Black or African American	126 (5.90)
Hispanic or Latino	20 (0.9)
Native Hawaiian or Pacific Islander	1 (0.0)
White	1917 (90.40)
Other	15 (0.7)

The majority of the patients in this study had hypertension n = 1142 (53.9%). (See Table 2) Heart disease and diabetes also were highly prevalent in these older adults. The primary caregiver was often the spouse n = 739 (34.9%) or son /daughter n = 776 (36.6%). Many patients lived with their spouse or significant other n = 895 (42.2%) and owned or rented their residence n = 1660 (78.3%). Few patients smoked n = 113 (5.3%) or claimed alcohol or drug dependency. Approximately 15% of the patients were obese.

Table 2 Additional Characteristics of the Sample (n=2120)

Other Characteristics	**Total Patients in Sample**
Baseline comorbid conditions (ICD-9-CM category), n (%)	
Infectious disease (001-139.0)	69 (3.30)
Neoplasms (140-239.0)	177 (8.30)
Diabetes (250-250.9)	568 (26.80)
Anemia (280-285.9)	210 (9.90)
Mental disorders (290-319.0)	364 (17.20)
Degenerative diseases of the nervous system and paralysis (331-344.9)	197 (9.30)
Hypertension (401-405.9)	1142 (53.90)
Heart disease (410-429.9)	845 (39.90)
Stroke (430-439.9)	176 (8.30)
Peripheral arterial disease (440-448.9)	98 (4.60)
COPD (490-496.9)	380 (17.90)
Genitourinary system diseases (580-629.9)	271 (12.80)
Musculoskeletal and connective tissue disease (710-739.9)	997 (47.0)
Who patient lives with, n (%)	
Lives alone	621 (29.30)
With spouse or significant other	895 (42.20)
With other family member	534 (25.20)
With a friend	26 (1.20)
With paid help (other than home care agency staff)	141 (6.70)
With other than above	19 (0.9)
Current residence, n (%)	
Patient's owned or rented residence (house, apartment, or mobile home owned or rented by patient/couple/significant other)	1660 (78.30)
Family member's residence	285 (13.40)
Boarding home or rented room	9 (0.4)
Board and care or assisted living facility	154 (7.30)
Other	11 (0.50)
Primary caregiver, n (%)	
No one person	188 (8.90)
Spouse or significant other	739 (34.90)
Daughter or son	776 (36.60)
Other family member	144 (6.80)
Friend or neighbor or community or church member	71 (3.30)
Paid help	165 (7.80)
Missing information	37 (1.70)
Risk factors, n (%)	
Heavy smoking	113 (5.30)
Obesity	315 (14.90)
Alcohol dependency	34 (1.60)
Drug dependency	5 (0.20)
None of the above	1651 (77.90)
Unknown	29 (1.40)

Of the 2120 patients, 30 patients (1.4%) developed a new pressure ulcer. The stages of the pressure ulcers developed in this sample are as follows: Stage I = 9 (0.4%), II= 13 (0.6%), III = 4 (0.2%), IV = 2 (0.1%) and V = 2 (0.1%).

The reported Braden Scale scores within the sample ranged from 9 to 23. Approximately one third (35%) of the total sample had a Braden Scale score of 18 or less. The remaining 65% of the sample had a score of 19 and greater.

Sensitivity, specificity, PVP and PVN for the total sample was calculated by Braden Scale Score. (See Table 3) The optimal cutoff score for these patients was 18. For a cut off score of 18, the sensitivity was 73.30% and the specificity was 65.50%. The percentage of patients that were correctly classified was 65.61%. A ROC curve for this group was also calculated. (See Figure 1)

Table 3 Sensitivity, specificity, Predictive Value Positive (PVP) and Predictive Value Negative (PVN) of Braden Scale by score for all patients in the study (n=2120)

BS Score*	**Incidence**	**Sensitivity**	**Specificity**	**PVP%**	**PVN%**
9	1	3.33	99.95	50.00	98.63
10	2	6.66	99.90	50.00	98.68
11	2	6.66	99.76	28.57	98.67
12	4	13.33	99.52	28.57	98.77
13	4	16.66	99.04	20.00	98.81
14	7	23.33	97.66	12.50	98.89
15	7	23.33	95.60	7.00	98.86
16	11	36.66	91.20	5.64	99.00
17	16	53.33	82.30	4.14	99.19
18	22	73.30	65.50	3.00	99.40
19	25	83.33	47.37	2.22	99.50
20	29	96.66	26.50	1.85	99.82
21	29	96.66	11.77	1.55	99.60
22	29	96.66	2.68	1.40	98.25
23	30	100.00	0.00	0.00	0.00

BS = Braden Scale

*Patients whose Braden Scale score was less than or equal to the stated number in column

The area under the curve represents those patients with a cutoff score of 18. The area is 0.755 with a standard error of 0.046. The lower boundary is 0.664 and the upper boundary is 0.845 at a 95% Confidence Interval.

An analysis was conducted on the subset of patients who did not have a pressure ulcer on admission (n=2111) to determine whether or not patients who were admitted with a pressure ulcer may have influenced Braden Scale validity parameters (See Table 4). The optimal cutoff score for these patients was also 18. For a cut off score of 18 the sensitivity was 71.43% and the specificity was 65.50%. The percentage of the patients that were correctly classified was 65.56%. A ROC curve for this group was also calculated (See Figure 2).

Table 4 Sensitivity, specificity, Predictive Value Positive and Predictive Value Negative of Braden Scale by score for the subset of patients who did not have a pressure ulcer upon admission (n=2111)

BS Score*	Incidence	Sensitivity%	Specificity%	PVP%	PVN%
9	1	4.76	99.95	50.00	99.05
10	2	9.50	99.90	50.00	99.10
11	2	9.50	99.76	28.57	99.10
12	2	9.50	99.52	9.10	99.09
13	3	14.29	99.04	13.04	99.14
14	4	19.00	97.66	7.50	99.17
15	4	19.05	95.6	4.20	99.16
16	6	28.57	91.19	3.16	99.22
17	10	47.62	82.30	2.63	99.36
18	15	71.43	65.50	2.03	99.56
19	17	80.95	47.37	1.52	99.6
20	20	95.24	26.46	1.28	99.82
21	20	95.24	11.77	1.07	99.60
22	20	95.24	2.68	0.97	98.25
23	21	100.00	0.00	0.00	0.00

BS = Braden Scale

*Patients whose Braden Scale score was less than or equal to the stated number in column

Figure1 Receiver Operator Characteristic (n=2120)

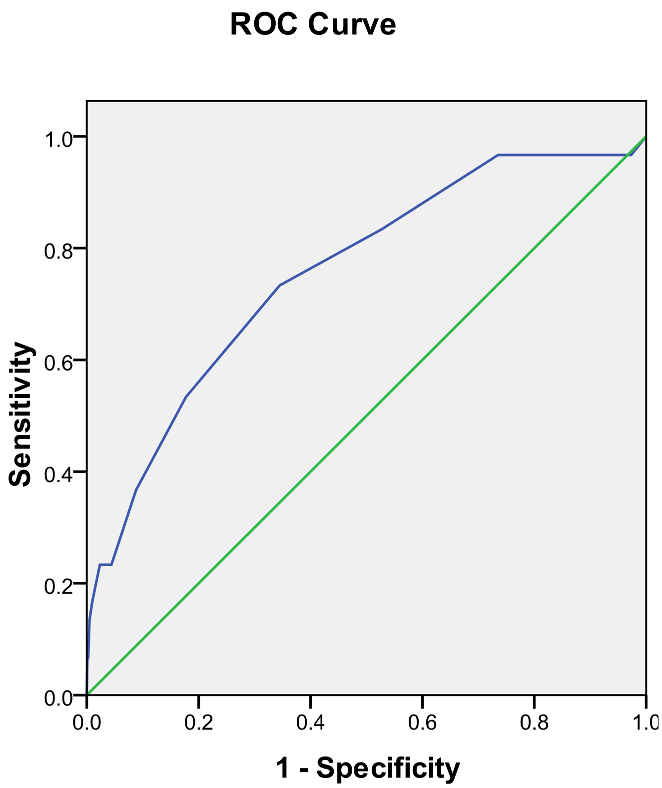
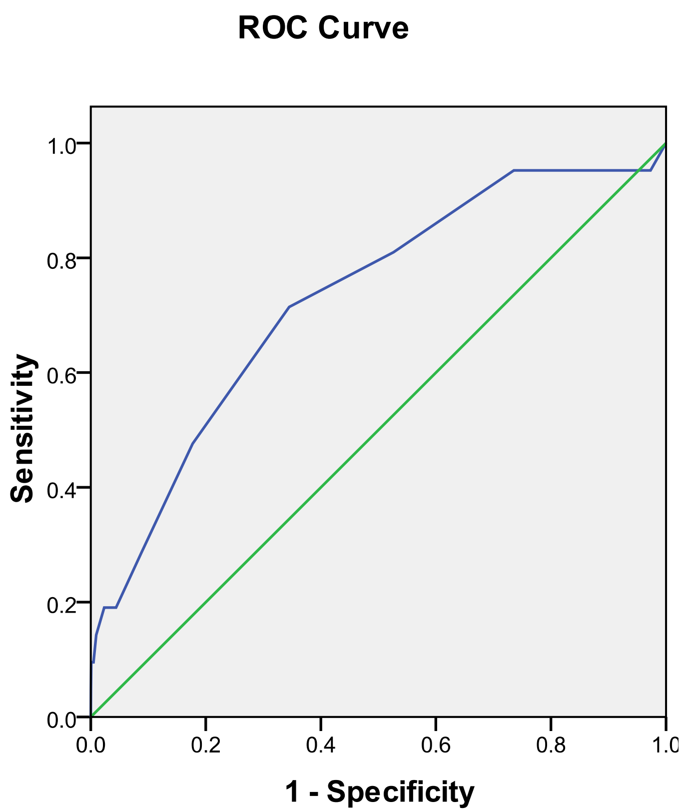


Figure 2 Receiver Operator Characteristic (n=2111)



The area under the curve represents those patients with a cutoff score of 18. The area is 0.727with a standard error of 0.057. The lower boundary is 0.615 and the upper boundary is 0.839 at a 95% Confidence Interval.

DISCUSSION

This study found that a Braden Scale score of 18 or less yielded the best balance between sensitivity 73.30% and 71.43% and specificity 65.50% and 65.50% for pressure ulcers among the patient sample that included pressure ulcers on admission and among the sample of patients that were pressure ulcer free on admission respectively. The cutoff score validity does not differ significantly between the two groups in this study; therefore, having an existing pressure ulcer did not modify the performance of the Braden Scale in this patient population. This study shows a cutoff score of 18 or less is the best indicator of pressure ulcer risk in elder home health care patients.

Results from the current study are more favorable than those by Bergquist and Frantz (2001) which found 61% sensitivity and 68% specificity with a cut off score of 19 or less. These results are less favorable than those reported by Ramundo (1995) which revealed a sensitivity of 100% and a specificity of 0% to 34% at a cutoff score of 18. While the sensitivity percentage is good, every patient in the study was indentified at risk because they were confined to a chair or bed. Therefore, that study was not a particularly strong study when trying to measure the validity of the Braden Scale. The sensitivity and specificity percentages were somewhat similar to those found in hospitalized and nursing home patients. The Bergstrom et al. study in 1987, conducted in an adult intensive care unit had a sensitivity of 83% and a specificity of 64% with a cut off score of 16. The Bergstrom & Braden study in1994, conducted in a skilled nursing facility found that a cut score of 18 simultaneously maximized sensitivity (75% to 79%) and specificity (64% to 75%). This study provided the rationale for the current study which took a new look at the validity of the Braden Scale in elder home health care patients. While the Braden Scale score is helpful in determining some patients at risk, it is not inclusive of all patients. The PVP found in this study was only 3.0%

Limitations

In this study, only 2120 out of the original 5395 patients admitted to the parent study had a documented Braden Scale Score which limits the generalizability of this study to a greater population. Additionally, the number of new ulcers in the sample of patients who were pressure ulcer free on admission was only 21.

CONCLUSION

Identification of pressure ulcer risk is important to reducing their occurrence and avoiding the high cost of caring for patients with pressure ulcers and the patient's own health and well being. This study found that the Braden Scale reasonably identified patients at pressure ulcer risk but did not predict their occurrence. Further studies are needed to guide home health care provider use of the Braden Scale for identifying elder patients at risk for pressure ulcer development in home health care and to determine whether there are additional criteria that need to be evaluated to determine risk factors prevalent in the elder home health care patient.

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