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Risk Factors And Prevention Among Patients With Hospital-Acquired And Pre-Existing Pressure Ulcers In Hospital

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Abstract

Background: *Hospital-acquired pressure injuries (HAPUs) remain a significant patient safety threat. Worldwide, pressure ulcers (PUs) have been implicated in costing billions annually, with 60,000 deaths out of 2.5 million hospitalized patients resulting from complications related to PU. The prevention of PU reduces the incidence of other illnesses, decreases the financial costs, and improves the quality of life for patients. A contemporary understanding of the risk factors predicting pressure injury in hospitalized patients will inform pressure injury prevention.* ***This study aimed*** *to describe and identify risk factors associated with hospital-acquired pressure ulcers (HAPUs) among adults in an acute care hospital compared with patients with pre-existing pressure ulcers present on admission. A further aim was to identify the preventive measures performed with both groups respectively.* ***Method:*** *A cross-sectional survey design was conducted at Irada Mental Health Complex in Riyadh and Al-Noor specialist hospital AT Makkah. Data on 535 patients were recorded using a modified version of the protocol developed and tested by the Pressure Ulcer Advisory Panel, including the Braden scale for risk assessment.* ***Results:*** *The prevalence of pressure ulcers was 27% (95% confidence interval, 23– 31%). Higher age and a total Braden score below 17 were significantly associated with the presence of pressure ulcers. Among individual risk factors higher age, limited activity level and friction and shear while seated or lying[1] down were associated with HAPUs, whereas only higher age and friction and shear were associated with the presence of PUs in the overall sample. There was an overall sparse use of preventive measures to relieve pressure.* ***Conclusion:*** *The findings of the present study revealed that PUs and the insufficient use of preventive measure to relieve pressure is still a problem in acute care settings. A continued focus must be placed on staff training in identifying patients at risk for PUs development.* ***Implication to clinical practice:*** *Increasing the ability to identify patients who are at risk for pressure ulcer development can assist in preventing unnecessary complications and suffering as well as reduce costs.*

Keywords: *Hospital-acquired pressure injuries (HAPUs), Prevalence, Prevention, Risk Factors*

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Introduction:

Pressure ulcers remain a significant clinical problem despite extensive and consistent research findings directed at risk assessment and prevention. Pressure ulcers are a common and serious healthcare problem and costs for prevention and treatment are high. Pressure ulcer (PU) is a common medical problem that affects patients in healthcare settings worldwide [1]. A PU is also known as bedsore, pressure injury, pressure sore, or decubitus ulcer, and its defined as damage that is localized to the skin or/and underlying soft tissue, be it linked to a medical device or skin over a bony prominence. Pressure injuries may occur as an intact skin or as an open painful or painless ulcer, resulting from prolonged or/and intense pressure in combination with shear [2]. Crossways the Middle East, the prevalence of a PU is estimated to be 7-44.4% [3, 4]. Prior research has been conducted in a 144-bed governmental hospital in KSA, and they have found that the prevalence of hospital-acquired PU was 7.5% [5].

In fact, the prevalence of PU also defers long-term care, acute care, home care, and rehabilitative care by healthcare setting [3]. Patients in the intensive care unit (ICU) have a high risk of developing PU, with an estimated incidence between 3.3% and 52.9% [6, 7]. Globally, PU has been implicated in $11 billion in costs annually, and in the United States, 60,000 deaths out of 2.5 million hospitalized patients have resulted from complications related to PU, each year [8]. The cost to establish PU prevention to our patients at risk can tremendously affect the healthcare systems' resources [9] [9]. Prevention of PU by involving the patient and their families plays a major role in reducing the incidence of other illnesses, decrease the financial costs, and improve the quality of life for our patients [10, 11].

Preventing PUs from occurrence is the key principles in its management. The multidisciplinary managing team should not only focus on the wound but also take a broad approach that needs the patient and their family [13]. PU represents interplay of a combination of factors contributing to its development from both the patient and the environment [14]. According to various prospective studies, factors such as low serum albumin level, age, mobilization, exercise, diabetes intake, and skin PU status have been found to increase the risk of developing PU [15, 16]. However, there has been no single factor that can determine the risk of PU development. There is limited information available concerning the most frequently used and effective strategies to prevent pressure ulcers. [17].

Therefore, this study aimed to describe and identify risk factors associated with HAPUs among adults in an acute care hospital compared with patients with pre-existing pressure ulcers present on admission. A further aim was to identify the preventive measures performed with both groups respectively.

Method

A cross-sectional survey design was conducted at Irada Mental Health Complex in Riyadh and Al-Noor specialist hospital AT Makkah. The hospital has about 878 inpatient beds, with 32,500 inpatient cases a year and provides apart from most medical specialties. A convenience sample for patients admitted to hospital from February to April 2023. The total population included 535 patients admitted to hospital wards during data collection. The included patients were recruited from the following disciplines: 106 patients (20%) in surgical care, 236 patients (44%) in medical care, 73 patients (14%) in orthopedic care, 23 patients (4%) in oncology care and 97 patients (18%) from other specialties.

Data collection protocol: A modified version of the one-page data collection protocol developed and tested by the Pressure Ulcer Advisory Panel, including the Braden scale for risk assessment (Gunningberg et al., 2006**)** [18] was used. This protocol consisted of eight areas: (1) hospital unit where the data were collected; (2) age, gender, expected

length of stay (categorized as less than six days, six days to one month and more than one month) and date of admission; (3) the Braden scale; (4) the incontinence item from the Norton scale; (5) skin observations where the location and grade of the most severe pressure ulcer was recorded according to the EUPAP classification; (6) recording of all existing pressure ulcers on a body map; (7) preventive measures used in beds and chairs and planned repositioning intervals; (8) recording of whether ulcers had been present at admission or developed during the hospital stay.

The Braden scale has six-item (activity, mobility, sensory, perception, nutrition, moisture and friction and shear) (Bergstrom et al., 1996) [19] was used to assess the risk of developing pressure ulcers. Each item is rated from 1 (least favorable) to 4 (most favorable) with the exception of friction and shear, which is rated from 1–3. The total score (range, 6–23) indicates the risk for pressure ulcer development, where lower scores represent higher risks. A total Braden score <17 has been suggested as a cut-off value for risk of pressure ulcer development (Bergstrom et al. 1987, Gunningberg 2005) [20, 21]. Because incontinence has been suggested to be associated with an increased risk for developing pressure ulcers (Vanderwee et al. 2007) [22] but is lacking in the Braden scale, the incontinence item from the Norton scale was used as well (Ek et al. 2007) [23]. This item is rated from 1 (no incontinence) to 4 (doubly incontinent). The degree of pressure ulcers was determined according to the EUPAP grading system [24]. According to this system, grade I represents non-blanchable erythema, grade II abrasion or blister, grade III a superficial ulcer and grade IV is a deep ulcer.

The study was performed on a predetermined according to the methodology developed by the EUPAP [21, 22]. Prior to the prevalence survey, the research coordinator informed about and discussed the study at meetings with hospital staff, especially the head nurses. Two weeks before the survey, all data collectors underwent training of pressure ulcer risk assessment and grading, including photograph based practice assessments [24]. The patients' skin was carefully inspected and, if some disagreement with the pressure ulcer grade arose, the researchers decided which grade should be recorded.

Data analysis: Due to violations of assumptions underlying the use of parametric statistics, the majority of variables were described and analyzed by means of non-parametric methods. For descriptive purposes, frequencies, percentages, means, standard deviations, medians and inter-quartile ranges were used. Comparisons regarding gender, age, location, Braden scores, incontinence, pressure ulcer grades and types of preventive measures used were made between patients with pressure ulcer present on admission and patients who developed pressure ulcers during their hospital stay using Mann– Whitney U and Chi-square tests.

Multiple logistic regression analyses, with the absence or presence of pressure ulcers (coded as 0 and 1, respectively) as the dependent variable, were conducted to identify factors associated with pressure ulcers. Independent variables were age, gender (0 = male, 1 = female), expected length of stay (1 = < six days, 2 = six days to 1 month, 3 = >one month), incontinence, the total Braden score cut-off (0 = ≥17, 1 = <17) and individual Braden items. First, multiple logistic regression analysis (forward stepwise) was performed to determine factors associated with having a pressure ulcer either since before or developed during hospital stay. In the initial model, the total Braden cut-off score was used as independent variable and then, in a separate model, individual Braden item scores were used instead.

A second set of logistic regression analyses (forward stepwise) were then performed to determine factors associated with pressure ulcer development during the hospital stay. Again, two models were considered, one with the Braden cut-off score and

one with individual Braden item scores as independent variables. In these analyses, all Braden item scores were reversed and analyzed as dummy variables with the lowest scores (most favorable following score reversal) as reference categories. Due to relatively few observations in the two categories indicating most problems, these were collapsed for the activity, mobility, and sensory perception and moisture items. For the same reason, the incontinence item was collapsed into two categories (0 = no or occasional incontinence; 1 = common urinary or urinary and faecal incontinence). Data were analyzed using SPSS 28. P-values of <0.05 (two-tailed) were taken as statistically significant.

Ethical considerations: Patients and their relatives were informed about the study by posted notices at all the included wards, including the fact that participating was voluntary and that the information gathered would be treated with confidence. Patients with existing pressure ulcers at admission were asked specifically about consent to enable follow-up information from the patient records.

Results

Table (1) shows that patients included in the study were 535 patients, 55% were women and their mean (SD) age was 71.2 (16.4) years. The prevalence of pressure ulcers, including ulcers grade I, was 27% [95% confidence interval (CI), 23–31%; n = 144]. Among those with pressure ulcers, 73 (50.7%) had grade I ulcers, 52 (36.1%) grade II, 11 (7.6%) grade III and 8 (5.6%) had grade IV ulcers. Patients with pressure ulcers were significantly older ($p < 0.0001$) and were more frequently admitted at medical and orthopedic wards ($p = 0.02$) than patients without ulcers. Significantly higher (more favorable) Braden scores and lower (less incontinence) incontinence scores were seen in patients without pressure ulcers than those with ulcers.

Table (2) shows that 522 patients for whom total Braden scores could be computed, 126 (24.1%) had a Braden score below 17, indicating being at risk for developing pressure ulcers. Braden scores below 17 were observed among 56 (14.7%) of 381 patients without any identified pressure ulcers and among 70 (49.6%) of 141 patients with pressure ulcers and a computable total Braden score. In the group of patients with pressure ulcers, 53 (37%; 95% CI, 29–45%) patients had existing pressure ulcers at admission and 71 (49%; 95% CI, 41–57%) had developed pressure ulcers while in hospital. Insufficient documentation made it impossible to identify the time for pressure ulcer development in 20 (14%) patients and they were excluded from further analyses.

Moreover, table (2) shows patients who developed pressure ulcers during their stay in hospital were significantly older than patients with existing pressure ulcers but there were no significant differences in genders or medical disciplines. There were no significant differences in the total Braden score or the incontinence scores between the two groups although those with ulcers on admission tended ($p = 0.078$) to have more favorable scores. The difference was significant for the sensory perception, activity and nutrition item scores.

Table (3) shows that there was a significant difference in pressure ulcer severities ($p = 0.001$) between patients with pre-existing and those with hospital-acquired pressure ulcers. Grade I ulcers were more frequent (62% vs. 34%) in patients with HAPUs, while grades III and IV were more common among patients with ulcers at admission. Patients who developed ulcers during the hospital stay had fewer pressure ulcers but they were more often located in the sacrum.

Table (4) shows that factors associated with pressure ulcers in the total sample as identified in the multiple logistic regression analysis were age [odds ratio (OR): 1.05, 95% CI: 1.03–1.07, $p < 0.0001$] and a Braden score <17 (OR: 4.54, 95% CI: 2.86–7.19, $p < 0.0001$). When using the individual Braden item scores as independent variables instead,

significant associations were identified for one item. Having problems (OR: 12.07, 95% CI: 6.51–22.37, $p < 0.0001$) or potential problems (OR: 2.73, 95% CI: 1.60–4.67, $p < 0.0001$), compared with no apparent problem, according to the friction and shear item was significantly associated with having pressure ulcers.

In addition, age remained significantly associated with the presence of pressure ulcers (OR: 1.05, 95% CI: 1.03–1.07, $p < 0.0001$). When excluding patients with ulcers at admission, age (OR: 1.06, 95% CI: 1.04–1.09, $p < 0.0001$) and a Braden score <17 (OR: 4.87, 95% CI: 2.72–8.71, $p < 0.0001$) were significantly associated with hospital- acquired ulcer development. Entering Braden items into the logistic regression model instead of the cut-off score yielded a model where age, activity and friction and shear were significantly associated with pressure ulcer development. All regression models exhibited acceptable goodness-of-fit (Hosmer–Lemeshow test, $p > 0.05$).

Table (5) shows that preventive measures to relieve pressure in bed were used in 32 (60%) of the patients with existing pressure ulcers and in 47 (66%) of the patients who developed pressure ulcers in hospital; the difference was not significant. Measures to relieve pressure while sitting in a chair tended ($p = 0.07$) to be more frequently used among patients who developed pressure ulcers in hospital than among those with pre-existing ulcers (27 and 13%, respectively). Only one patient received regular change of positioning.

Table (1): Characteristics of patients with and without pressure ulcers

	Missing values	Patients without pressure ulcers (n = 390)	Patients with pressure ulcers (n = 144)	p-value
Age, m (SD)/md (IQR)*	1	68.4 (17.1)/ 72 (59, 82)	78.8 (11.2)/ 80 (74, 87)	<0.0001
Gender, %†				
Male/female	1	45/55	47/53	0.646
Hospital disciplines, %†				
Surgical	0	22	14	0.022
Medical	0	42	49	
Orthopedic	0	12	19	
Oncologic	0	4	5	
Other	0	20	13	
The Braden scale, md (IQR)*				
Sensory perception	0	4 (4, 4)	4 (3, 4)	<0.0001
Moisture	4	4 (4, 4)	4 (3, 4)	0.001
Activity	2	4 (3, 4)	2 (2, 3)	<0.0001
Mobility	2	4 (3, 4)	3 (2, 4)	<0.0001
Nutrition	3	2 (2, 3)	2 (2, 2)	<0.0001
Friction/shear	4	3 (3, 3)	2 (1, 3)	<0.0001
Total score	13	21 (18, 22)	17 (13, 20)	<0.0001

*Mann–Whitney U-test. †Chi-square test.

m, mean; SD, standard deviation; md, median; IQR, interquartile range (q1, q2).

Table (2): Characteristics of patients with pre-existing pressure ulcers present on admission compared to patients with HAPUs

	Missing values	Patients with pre-existing pressure ulcers (n = 53)	Patients with hospital-acquired pressure ulcers (n = 71)	p-value
Age, m (SD)/md (IQR)*		75 (11.3)/ 77 (71.84)	80 (11.1)/83 (76.89)	0.005
Gender, %†				
Male/female		56/44	45/55	0.024
Hospital disciplines, %†				
Surgical	0	9	13	0.19
Medical	0	53	51	
Orthopedic	0	11	24	
Oncologic	0	8	4	
Other	0	19	8	
The Braden scale, md (IQR)*				
Sensory perception	0	4 (3, 4)	3 (3, 4)	0.045
Moisture	2	4 (3, 4)	4 (4, 4)	0.139
Activity	0	3 (2, 3.5)	2 (2, 3)	0.032
Mobility	1	3 (2, 4)	3 (2, 3)	0.186
Nutrition	1	2 (2, 3)	2 (2, 2)	0.004
Friction/shear	1	2 (1, 3)	2 (1, 3)	0.231
Total score	3	17.5 (14, 20)	16 (13, 18.5)	0.078
Incontinence, md (IQR)*	1	1 (1, 3)	1 (1, 3)	0.540

*Mann–Whitney U-test. †Chi-square test.
m, mean; SD, standard deviation; md, median; IQR, interquartile range (q1, q2).

Table (3): Pressure ulcer grades, locations and numbers in patients with pre-existing PUs present on admission compared to patients with HAPUs

	Patients with pre-existing pressure ulcers (n = 53)	Patients with hospital-acquired pressure ulcers (n = 71)	p-value
Ulcer stage, n (%)*			
Grade I	18 (34)	44 (62)	0.001
Grade II	21 (40)	24 (34)	
Grade III	8 (15)	2 (3)	
Grade IV	6 (11)	1 (1)	
Location of most severe ulcer, n (%)[*,†]			
Heel	9 (17)	7 (10)	0.02
Sacrum	18 (35)	39 (55)	
Hip	1 (2)	6 (9)	
Other‡	24 (46)	19 (27)	
Number of ulcers, md	2 (1, 3)	1 (1, 2)	0.02

	Patients with pre-existing pressure ulcers (n = 53)	Patients with hospital-acquired pressure ulcers (n = 71)	p-value
(IQR)§			

*Chi-square test. †Missing data for one patient with pre-existing pressure ulcer. ‡ Head, trunk, shoulder, elbow, knee, tuber. §Mann–Whitney U-test. md, median; IQR, interquartile range (q1, q2).

Table (4): Variables associated with development of pressure ulcer during hospital stay as identified by multiple logistic regression analysis

Independent Variables*	Odds ratio	95% CI	p-value
Age	1.06	1.03-1.09	<0.0001
Activity			
Walks occasionally (vs. walks frequently)	3.01	1.17–7.77	0.022
Chair- or bedfast (vs. walks frequently)	4.27	1.45–12.59	0.008
Friction and shear			
Problem (vs. no apparent problem)	6.69	2.57–17.43	<0.0001

*Gender, expected length of stay, incontinence, mobility, sensory, perception, nutrition and moisture did not display any significant associations with ulcer development once age, activity and friction and shear had been taken into consideration.
CI: confidence interval.

Table (5): Measures made to prevent PUs in patients with pre-existing PUs present on admission compared to patients with HAPUs

	Patients with pre-existing pressure Ulcers (n = 53)	Patients with hospital-acquired pressure Ulcers (n = 71)	p-value*
Measures to relieve pressure in bed, n (%)	32 (60)	47 (66)	0.47
Regular change of position in bed, n (%)	2 (4)	4 (5)	
Measures to relieve pressure in chair, n (%)	7 (13)	19 (27)	0.07
Regular change of position in chair, n (%)	0 (0)	1 (1)	

Values are given as n (%). *Chi-square test.

Discussion

This study shows that pressure ulcers are a significant problem in acute hospital care with a prevalence of 27%. Higher age and a total Braden score below 17 were significantly associated with the presence of pressure ulcers in both the overall sample and among patients with HAPUs. When considering individual risk factors higher age, limited activity level and friction and shear while seated or lying down were associated with pressure ulcer development in hospital, whereas only higher age and friction and shear were associated with the presence of pressure ulcers in the overall sample. There was an overall infrequent use of preventive measures to relieve pressure in patients with pressure ulcers.

The use of the rigorous methodology developed by the EPUAP strengthens the present study. This method has been used previously across several European countries (Vander- wee et al. 2007) [22], which increase the possibility to compare and illuminate the pressure ulcer problem in an international perspective. However, since prevalence studies usually are snapshots of a particular problem at a specific time and place they need to be interpreted with some caution and should not be taken as absolute measures of quality of care [19]. The present study included 84% of all eligible patients, which must be considered high. This increases the confidence of the reported findings. There is always a risk of inconsistency in ratings and assessments performed by different people, who may yield biased and potentially misleading results.

Similar to other prevalence studies [21, 25-27], about half of the PUs were classified as grade I (a non-blanchable erythema of intact skin), which is known to be difficult to diagnose (Halfens et al. 2001). This problem was investigated by Bhattacharya and Mishra, (2015) [28] who showed that the prevalence of stage I ulcers were reduced by almost 50% by a second assessment on the same day at least four hours after the first one. This implies that grade I pressure ulcers either were incorrectly identified or resolved during the day. In the present study no reassessments were made. It could, therefore, be argued that grade I ulcers should be excluded.

However, a study by Shi et al., (2020) [29] demonstrated significant increased risk of pressure ulcer development associated with non-blanching erythema. In this study, grade I ulcers were more frequent in patients who developed pressure ulcers than in patients with pre-existing ulcers, who had more severe ulcers (grades III and IV). Similarly, Pieper et al., (1998) [30] found that patients admitted with pressure ulcers tended to have more stage III or IV ulcers (58%) compared with those who later developed ulcers (13%). Because stage I ulcers thus appear as preludes to more advance ulcers, thereby acting as important warning signs that call for nursing interventions, they are important to consider.

Pressure ulcer development is a complex phenomenon and contributing factors can be related both to the patients' condition and to extrinsic factors derived from the environment. The absence of complementary data such as preadmission status, diagnosis, medication, body mass index, oxygen saturation and blood pressure precludes conclusions about associations between such risk factors and pressure ulcer development. The Braden cut-off value <17 was chosen according to the EPUAP recommendations [31]. However, only about half of the patients with pressure ulcers were identified to be at risk according to this criterion. This is in agreement with a methodological review of pressure ulcer risk assessment scales that found insufficient predictive validity for the Braden and other tools and it was suggested that health care units should locally determine their own cut-off point to reflect the special need of the patient populations of interest [32].

Since patients with pressure ulcers in this study were older it is possible that a total Braden score of in geriatric care where all chair-fast patients were provided with seat

cushions and repositioning. Li et al., (2020) [33] investigated the influence of body posture on the pressure at the seat surface and to what extent different seat cushions could reduce pressure. They found that sliding down and slouching caused the highest maximum pressure and that the sitting-back posture with the lower legs on a rest gave the lowest maximum pressure. This emphasizes the importance of regular checking the posture in combination with use of pressure relieving cushions. It is obvious that development and implementation of evidence based clinical guidelines is needed so nurses can be supported in taking the most effective preventive measures. However, further research is also needed to understand strategies for successful implementation as well as to evaluate compliance to guidelines.

Conclusion

This study revealed that pressure ulcers and sparse use of preventive measure to relieve pressure continues to be a problem in acute care hospital settings. It is, therefore, paramount to pay more attention to develop and implement clinical pressure ulcer care guidelines. With the current strive towards cost-effective care and shortening lengths of stay in hospitals, standardized risk assessments and preventive interventions should probably be initiated already at admission. A further finding was that HAPUs were associated with older patients who had a limited activity level and was sensitive for friction and shear.

Therefore, a continued focus must be placed on staff training in identifying patients at risk for pressure ulcer developments. A systematic approach is needed to change health care professionals thinking and acting with regard to pressure ulcer risk assessment and prevention. This study has served as a baseline for and the implementation of activities to improve the prevention and treatment of pressure ulcers at the surveyed hospital. Further work has been undertaken to develop a standardized care plan and an educational program directed to all registered and enrolled nurses. It is important to continue conducting prevalence studies to evaluate such interventions and to avoid attention moving away from this topic, which may lead to deterioration in the quality of pressure ulcer care and an increase in hospital care costs.

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