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Original Article

RISK ASSESSMENT OF DECUBITUS ULCERS USING FOUR SCALES AMONG PATIENTS ADMITTED IN MEDICAL AND SURGICAL INTENSIVE CARE UNITS IN A TERTIARY CARE SET UP: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background and objectives: Pressure ulcers are the third most expensive disorder after cancer and cardiovascular diseases. For predicting the risk factors early among patients admitted in intensive care units , all critically ill patient should be screened for presence of all possible risk factors. There is no single specific tool for risk assessment which can predict almost all risk factors. Least studies have been done in Indian scenario to compare and suggest a better predictor of risk assessment for presence of pressure ulcers. The objectives of the present study was to assess & predict the risk for decubitus ulcer using Braden, Norton, Waterlow and Cubbin & Jackson scale as well as to compare better predictor score / tool among these four scales in patients admitted in M.I.C.U. & S.I.C.U. in Indian scenario**.**

Materials and Methodology: A total of one hundred fifty (150) subjects adult males and females admitted in I.C.U within 48 hours were included in the study. Braden scale, Norton scale, Waterlow scale and Cubbin & Jackson scale were administered by two physiotherapy interns.

Results: The data was analyzed using student's paired t test, Chi square test and single way ANOVA. Statistically significant differences were noted when the test scores were compared to age (58-77) years (p=0.0308) nutritional status(underweight & obesity) (p=0.0174), mechanical ventilation (p=0.00001), musculoskeletal problems (p=0.0333), type II Diabetes Mellitus (p=0.0003) that have shown to contribute higher risk for development of decubitus ulcers. Cubbin & Jackson scale have shown to be the best predictive value with 99.3% sensitivity and 55.5% specificity compared to other scores.

Conclusion: The present cross-sectional study concluded that the Cubbin and Jackson scale is a better predictor of risk of pressure ulcer in Indian scenario. In addition, Nutritional status, age group of 58-77 years, Type II diabetes mellitus and musculoskeletal problems have demonstrated to be risk factors for development of pressure ulcers in ICU admitted patients.

KEY WORDS: Decubitus ulcer, risk assessment, Braden scale, Norton scale, Waterlow scale, Cubbin and Jackson scale.

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INTRODUCTION

The pressure ulcer or decubitus ulcer have been recognized as a disease entity since ages. They have been found in Egyptian

mummies, some of which are more than 5,000 years old [1]. Hippocrates (460-370 B.C) had described pressure ulcer in association with paraplegia with bladder and bowel dysfunction [1]. Pressure ulcers are one of the most underrated conditions in critically ill patients [2]. Pressure sore development constitutes a major problems, which causes excessive pain and suffering in affected patients [3]. According to International NPUAP-EPUAP, a pressure ulcer is defined as a localized injury to the skin/ or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear. A number of associated contributing or confounding factors are also with pressure ulcers; the significance of these factors is yet to be elucidated [4].

A pressure ulcer can occur anywhere on the body where there is prolonged exposure to pressure. Prolonged pressure (from lying or sitting on a specific part of the body) will impede capillary blood supply to an area and thus limit the delivery of oxygen and nutrients to tissue, placing patients at risk for skin breakdown [5]. Expected capillary pressure ranges are between 10 and 30 mmHg [6]. Tissue hypo-perfusion occurs when the interface pressure exceeds capillary pressure thus increasing the likelihood of pressure ulcer development [7,8].

A lot of research has been undertaken to study the mechanism of tissue necrosis in case of decubitus ulcer . Many intrinsic and extrinsic factors have an impact on the level and extent of tissue trauma . Extrinsic factors remain the main causative factors or the primary factors with " pressure " heading the list while intrinsic factors also called secondary factors contribute to it . The dermal collagen fibers are also likely to protect against external pressure. Similarly the interstitial fluid acts as buffer and maintains the tissue hydrostatic pressure [9-18]. Intrinsic factors include altered consciousness, decreased or absent sensations, nutritional factors (under or over nutrition), anaemia, oedema, atherosclerosis, age-related changes, acute illness, sleep,medications, cardiovascular changes, emotional stress, smoking, Other factors like recurrence of pressure ulcer, prolong hospital stay, long duration of surgery, immobility. Extrinsic factors include undue prolonged pressure, shear, friction, moisture, abnormal posture, impaired mobility.

The incidence of pressure ulcers is different in each clinical setting . Incidence rates of as low as 0.4% to as high as 38% have been reported in the inpatient department while prevalence has been reported as 3.5% to 69% [19-22]. In long term care facilities, the reported incidence is between 2.2% to 23.9% while in home care setting the incidence varies from 0 to 17% [19].

The initiation of a valid tool to screen and predict skin breakdown would be useful in identifying patients who are at risk for development of pressure ulcers. In order to predict the risk factors early among patients admitted in intensive care units , all critically ill patient should be screened for presence of all possible risk factors. There is no single specific tool for risk assessment which can predict almost all risk factors. Different assessment tools include different domains and can be useful for early prediction. Most commonly used scales namely Breaden scale, Norton scale, Waterlow scale and Cubbin & Jackson scale were included in the study for comparision.

MATERIAL AND METHODS

1. Study Subjects: A total of one hundred fifty (150) subjects both adult male and female admitted in M.I.C.U and S.I.C.U, 48 hours prior only were included in the study. Subjects having pre-existing decubitus ulcer and age of below 18 years were excluded from the study.

2.Study design: This study was an observational cross-sectional study with convenience sampling technique method. Subjects were included in the study. Sample size was calculated to be 150 subjects with level of significance pd"0.005 [$n=4pq\div d^2$;(n= sample size, p= population at risk, q= population without risk and d=sampling error)].

3. Procedure: After obtaining the ethical approval for study from Institutional Ethical Committee all study subjects were screened for eligibility for inclusion criteria. An informed consent was taken

from Medical Officer / In-charge Intensivist / Physiotherapy Staff / Nursing In- charge. A detailed demographic data of each subject was noted from the patients record medical record at the time of admission to the ICU. After completion of the demographic data, administration of each scale namely Braden Scale, Norton Scale, Waterlow Scale and Cubbin and Jackson scale was done by two physiotherapy interns.

Fig. 1: Flow Chart of Methodology

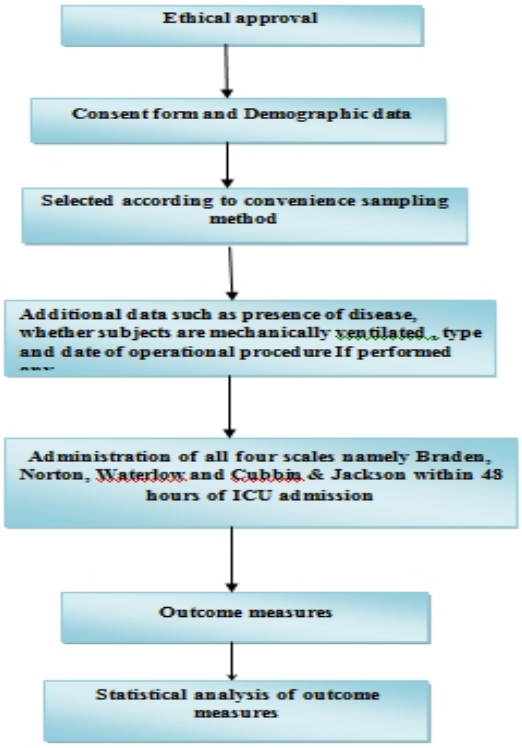
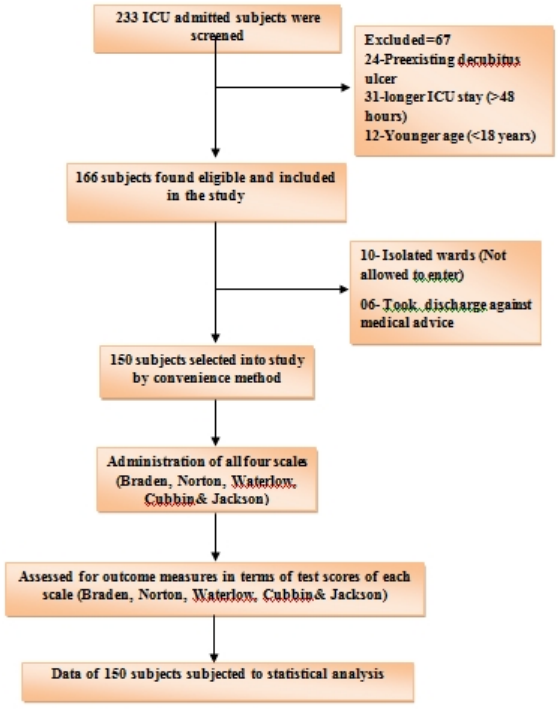


Fig. 2: Study Flow Chart



RESULTS AND TABLES

Table 1: Comparison of various age groups with test scores by one way ANOVA among the subjects in the study.

Age groups	Braden score	Norton score	Waterlow score	Cubbin and jackson
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
18- 37yrs	13.86 ± 4.00	12.50 ± 3.17	16.23 ± 6.95	30.45 ± 4.24
38-57 yrs	13.46 ± 3.17	12.74 ± 2.64	18.42 ± 5.76	28.98 ± 4.23
58-77 yrs	13.58 ± 3.31	12.79 ± 3.20	20.12 ± 6.61	27.69 ± 4.09
78-97 yrs	12.09 ± 2.84	11.18 ± 2.86	24.18 ± 7.56	26.45 ± 3.21
Total	13.47 ± 3.34	12.61 ± 3.00	19.28 ± 6.68	28.43 ± 4.21
F-value	0.7497	0.955	4.4213	3.6685
P-value	0.5242	0.4158	0.0052*	0.0138*
18- 37yrs vs 38-57 yrs	p=0.9653	p=0.9894	p=0.5458	p=0.4963
18- 37yrs vs 58-77 yrs	p=0.9862	p=0.9791	p=0.0677	p=0.0308*
18- 37yrs vs 78-97 yrs	p=0.4775	p=0.6326	p=0.0047*	p=0.0413*
38-57 yrs vs 58-77 yrs	p=0.9974	p=0.9997	p=0.4945	p=0.3306
38-57 yrs vs 78-97 yrs	p=0.6085	p=0.4012	p=0.0372*	p=0.2507
58-77 yrs vs 78-97 yrs	p=0.5182	p=0.3504	p=0.2142	p=0.7925

Table 2: Comparison of BMI levels with different scores by one way ANOVA.

BMI groups	Braden score	Norton score	Waterlow score	Cubbin and jackson
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Underweight	16.57 ± 3.95	13.00 ± 6.22	14.86 ± 4.38	32.00 ± 4.24
Normal	13.32 ± 2.94	12.50 ± 2.54	18.42 ± 6.93	29.13 ± 4.02
Overweight	13.32 ± 3.48	12.67 ± 2.98	20.32 ± 6.45	27.59 ± 4.14
Total	13.47 ± 3.34	12.61 ± 3.00	19.28 ± 6.68	28.43 ± 4.21
F-value	3.2601	0.1141	3.1199	5.2539
P-value	0.0412*	0.8922	0.0471*	0.0063*
Underweight vs Normal	p=0.0352*	p=0.9090	p=0.3640	p=0.1840
Underweight vs Overweight	p=0.0324*	p=0.9575	p=0.0500*	p=0.0174*
Normal vs Overweight	p=0.9999	p=0.9425	p=0.2009	p=0.0674

*p<0.05

Table 3: Comparison of status of Diabetes Mellitus with different scores by t test.

Variable	Diabetic	n	Mean ± SD	t-value	p-value
Braden score	Absent	86	13.55 ± 3.71	0.3104	0.7567
	Present	64	13.38 ± 2.79		
Norton score	Absent	86	12.66 ± 3.12	0.2336	0.8156
	Present	64	12.55 ± 2.85		
Waterlow score	Absent	86	17.60 ± 6.64	-3.7108	0.0003*
	Present	64	21.53 ± 6.09		
Cubbin and jackson	Absent	86	28.86 ± 4.52	1.4451	0.1505
	Present	64	27.86 ± 3.71		

Table 4: Comparison of status of Musculoskeletal Problems with different scores by t test.

Variable	Musculoskeletal Problems	n	Mean ±SD	t-value	p-value
Braden score	Absent	118	13.71 ± 3.39	1.6915	0.0928
	Present	32	12.59 ± 3.00		
Norton score	Absent	118	12.77 ± 3.10	1.2413	0.2164
	Present	32	12.03 ± 2.53		
Waterlow score	Absent	118	18.42 ± 6.48	-3.134	0.0021*
	Present	32	22.47 ± 6.52		
Cubbin and jackson	Absent	118	28.81 ± 4.31	2.1489	0.0333*
	Present	32	27.03 ± 3.53		

Table 5: Comparison of test scores (scales) among (Mechanical Ventilated and Non Ventilated) subjects in the study.

Variable	Ventilated / Non-ventilated	n	Mean ±SD	t-value	p-value
Braden score	Mechanical ventilator	43	10.84 ± 2.63	-7.0695	0.00001*
	Non ventilator	107	14.53 ± 2.99		
Norton score	Mechanical ventilator	43	10.30 ± 2.02	-6.8494	0.00001*
	Non ventilator	107	13.54 ± 2.82		
Waterlow score	Mechanical ventilator	43	22.51 ± 6.79	3.9351	0.0001*
	Non ventilator	107	17.98 ± 6.21		
Cubbin and jackson	Mechanical ventilator	43	24.07 ± 2.76	-10.6594	0.00001*
	Non ventilator	107	30.19 ± 3.33		

Table 6: Specificity & Sensitivity of Cubbin & Jackson scale.

		Cubbbin & Jackson score			
Braden score		At risk	No risk	Total	k = 0.650 p<<0.001
	At risk	140	1	14%	
	No risk	4	5	9	
	Total	144	6	150	

Table 7: Percentage distribution of subjects according to test scores.

SCALE	SCORES	No. of respondent	Percentage distribution
Braden Scale			
No risk	{≥19}	9	-6%
At risk	{15-18}	44	-29.30%
Moderate risk	{13-14}	36	-24%
High risk	{10-12}	42	-28%
Very high risk	{≤9}	19	-12.70%
Norton Scale			
Low risk	{>18}	3	-12%
Medium risk	{14-18}	57	-38%
High risk	{10-14}	67	-44.70%
Very high risk	{≤9}	23	-15.30%
Waterlow Scale			
No risk	{≤9}	6	-4%
At risk	{10-14}	30	-20%
High risk	{15-19}	56	-37.70%
Very high risk	{≥20}	58	-38.70%
Cubin & Jackson Scale			
No risk	{36-40}	6	-4%
At risk	{31-35}	47	-31.30%
High Risk	{25-30}	72	-48%
Very high risk	{≤24}	25	-16.70%

44.67% of subjects were in age group of 58-77 years Waterlow scale and Cubbin & Jackson scale showed statistical difference with (p=0.0052) for Waterlow & (p=0.0138) in Cubbin & Jackson score respectively. BMI levels also demonstrated statistical difference when compared with test scores of Braden, Waterlow and Cubbin & Jackson with (p=0.0412, p=0.0471 & p=0.0063) respectively. The study demonstrated statistical significance (p=0.0003) when compared between status of type II diabetes mellitus & Waterlow score, similarly Waterlow and Cubbin & Jackson score showed statistical significant differences (p=0.0021, 0.0333) respectively when compared to subjects with musculoskeletal problems. Maximum (n=107) subjects were non ventilated & remaining (n=43) were ventilated; all four scales (Braden, Norton, Waterlow and Cubbin & Jackson) showed statistical significant difference between ventilated and non ventilated subjects with (p<0.05) for each scale. On percentage distribution of subjects was done with each scale scores, cut off value of Braden scale showed 6% of subjects with no risk, 29.3% at risk, 24% had moderate risk, 28% suspected for high risk & 12.7% predicted very high risk. Norton scale showed that 12% subjects at low risk, 38% at medium risk, 44.7% at high risk & 15.3% at very high risk. According to cut off values of Waterlow scale 4% of subjects had no risk, 20% subjects were at risk, 37.7% showed high risk & 38.7% suspected to have very high risk. The Cubbin & Jackson scale predicted 4% subjects as having no risk, 31.3% at risk, 48% having high risk & 16.7% subjects having very high risk.

DISCUSSION

The present study was aimed to assess and predict risk of decubitus ulcers using Braden scale, Norton scale, Waterlow scale and Cubbin and Jackson scale. It also aimed to compare better predictive score among four scales, in patients admitted in medical and surgical intensive care unit in Indian scenario. The study undertaken included a total of 150 subject admitted in medical and surgical intensive care unit.

Previous study performed to assess factors associated with pressure ulcers in patients in a surgical intensive care unit. Low Braden Scale score, age >70 years and a diagnosis of diabetes may represent clinically relevant pressure ulcer risk factors in the surgical intensive care population and that patients with these factors may benefit from more aggressive preventive care [23]. Present study also showed presence of increased risk of pressure ulcer in patients aging 58-77 years and patients with Type II Diabetes Mellitus.

A small but significant proportion of elderly emergently admitted hospital patients acquire pressure ulcers soon after their admission [24]. Present study also showed the risk of pressure ulcer in the elderly age group of 58-77 years. Advanced age decreases subcutaneous fat hence decreasing protection from pressure effects. Sensory deficits decreases cues to change position. Nutrition is another identified criterion for pressure ulcer risk. Patients who are malnourished have more bony prominence and are therefore at greater risk for pressure ulcers [25]. Result of present study also suggested that elderly subjects (58-77 years) and subjects who were underweight are also at risk of developing pressure ulcers.

The previous study done to find incidence of pressure ulcers in a neurologic intensive care unit using Braden score concluded that pressure ulcers may develop within the first week of hospitalization in the intensive care unit. Patients at risk have Braden scores of d"16 and are more likely to be underweight. These results suggest that aggressive preventive care should be focused on those patients with Braden scores of d"13 and/or a low body mass index at admission.[26] Present study also suggested that patient admitted in intensive care units with neurological disorders show risk of development of pressure ulcers within 48 hours of admission; and also shows significant risk in patients with low BMI.

As in other studies [27-28] low BMI was strongly and significantly associated with the incidence of hospital-acquired pressure ulcers. It may be that low BMI is a marker for disease-associated cachexia and poor health [29]. Present study also showed that low BMI (under weight) is one of the risk factor for pressure ulcer the role of nutrition in pressure ulcer prevention and treatment stated that nutrition plays vital role in preventing pressure ulcer. Similarly this study also concluded that poor nutrition is an risk factor for development of pressure ulcer [30]. Though underweight and obesity both are considered as risk factors for developing pressure ulcer, it is suggested that extra body fat reduces the risk of pressure ulcer (PU) in elderly hospitalized patients [25], but the present study showed the risk of development of pressure is high in both underweight as well as overweight patients. The exact percentage difference between which category (underweight /obese) of patients had more risk could not be found since the data was not sufficient and number of patients and each category were unequal.

Immobility, dry skin and decreased body weight are independent and significant risk factors for pressure ulcers in hospitalized patients whose activity is limited to bed or chair.[31] The present study also showed statistical significance and risk of pressure ulcer in patients with musculoskeletal problems leading to immobility and also in patients having low body mass index leading to poor nutrition. Immobility is also a major risk factor for development of pressure ulcer among adult hospitalized patients. A prospective study by Margareta Lindgren et.al confirmed that immobility is a risk factor of major importance for pressure ulcer development among adult hospitalized patients [32]. The present study also suggested that Waterlow score and Cubbin and Jackson score demonstrated statistically significant difference (p=0.0021, p=0.00333) respectively when compared to the subjects having musculoskeletal problem which was leading to the immobility.

A previous study conducted by Santuran L et al. that aimed to find the relationship among pressure ulcers, oxygenation, and perfusion in mechanically ventilated patients in an intensive care unit suggested that mechanically ventilated patients who develop pressure ulcers were more likely to have significantly higher blood glucose levels, significantly lower diastolic blood pressure values, and significantly higher serum pH values than the patients who remained free of pressure ulcers [33]. The present did not aim to find the relationship between the risk of pressure ulcers and mechanical ventilators, however the risk of pressure ulcers was high in Type II diabetes mellitus (DM).

Pressure ulcer development appears to be associated with an increase in mortality among patient requiring mechanical ventilator for 24 hours and longer within the limitations of the single centre approach [34]. The present study

also showed all the four scale's test score to be statistical significance difference between mechanically ventilated and non ventilated subjects maximum subjects (n=107) were non ventilated compare to ventilated subject (n=43) subjects. Duration of mechanical ventilation is may be associated with increased risk of pressure ulcer development [25]. However present study could not differentiate the risk of pressure ulcers in mechanical ventilated and non ventilated patients.

The previously done clinical practice in Spain to find effectiveness of scales concluded that the Braden and Norton scales are valid and effective for assessing the risk of developing pressure ulcers and Braden and Cubbin & Jackson are valid scales for measuring the risk in patients admitted to intensive care units [35]. The present study also showed that Cubbin & Jackson scale is better predictor of risk in patients admitted in ICU.

The reusability of Electronic Medical Records (EMR) for application of risk assessment of Cubbin & Jackson scale in critically ill patients have demonstrated that Cubbin & Jackson scale performed slightly better than the Braden scale to predict pressure ulcer development and also stated that if the Cubbin & Jackson scale is a part of EMR assessment form, it would help nurses perform tasks to effectively prevent pressure ulcers with an EMR alert for high risk patients.[15] The present study has also shown that Cubbin & Jackson scale was most effective risk assessment tool to predict risk of decubitus ulcers in patients admitted in ICU with sensitivity of 99.3% and specificity of 55.5%.

Though multiple risk factor scales have been developed, but they do not reflect the additional risk factors present in the ICU. The most common risk scales used in the United States are the Braden Scale and the Norton Scale. These 2 pressure ulcer risk scales are recommended by the Agency for Health Care Policy and Research [35]. The most common pressure ulcer risk scales used in Britain are the Waterlow and Braden Scales [36]. The Jackson Cubbin Risk Assessment Score is a pressure ulcer risk tool specific to European critical care units. The present study also consists of these four commonly used scale for screening of risk assessment of pressure ulcer in Indian tertiary care set-up.

The results of the research prior done showed that the Cubbin and Jackson scale was most effective in predicting pressure ulcer risk compared to the other two scales (Braden and song and choi scale) in the SICU [37]. Present study also suggested Cubbin and Jackson scale is the better risk predictor of pressure ulcers with sensitivity 99.3% and specificity 55.5%.

Different studies performed in different clinical setups have proven number of risk factors like old age, underweight, obesity, nutritional status, mechanical ventilation, incontinence, duration of hospital stay, diseases like musculoskeletal problems, Type II Diabetes Mellitus, neurological problems ; but there is no single tool which contains all the domains therefore there is further need of development of a scale which will include all risk factors and domains and which can administered easily in short period of time.

Conflicts of interest: None

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