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Incidence of pressure ulcers in intensive care unit patients at risk according to the Waterlow scale and factors influencing the development of pressure ulcers

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Aims. To determine incidence of pressure ulcers in patients at risk according to the Waterlow scale in intensive care units and to evaluate the effects of risk factors in critically ill patients.

Background. Pressure ulcers continue to be an important health problem that increases the risk of illness and death, extends patients' length of hospital stay and increases healthcare expenses.

Design. The study was conducted as a descriptive and prospective study.

Method. The sample consisted of 140 patients. Data were collected using a data collection form, the skin assessment instrument and the Waterlow scale.

Results. The incidence of pressure ulcers in intensive care unit patients was found to be 14·3%. The majority of pressure ulcers (74%) were grade I. The mean length of time for pressure ulcer development was found to be 10·4 (SD 1·85) days. A statistically significant difference was found in the patients for pressure ulcer development according to their level of consciousness, activity, cooperation, length of stay, Waterlow scale score and C-reactive protein level. In the multiple stepwise logistic regression analysis, the most influential factors for pressure ulcer development were determined to be length of stay and activity level.

Conclusions. Extra care needs to be taken to prevent pressure ulcer development in intensive care unit patients who have an extended length of stay, are dependent for activities, have high Waterlow scores, are unconscious and are not cooperative.

Relevance to clinical practice. This study determined the incidence of and factors that can affect the development of pressure ulcers in intensive care unit patients who are in a high risk group for the development of pressure ulcers and presented the importance of having Turkish nurses implement interventions directed at these factors.

Key words: intensive care, nurses, nursing, pressure ulcer, risk assessment, Turkey

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Introduction

A scientific approach to pressure ulcers (PUs) began in the 19th century. Today they continue to be an important health problem that increases the risk of illness and death, extends patients' length of hospital stay and increases healthcare expenses (Kurtuluş & Pınar 2003).

Pressure ulcers occur in every setting, from homes to every department in the hospital (Rycroft-Malone 2000). Inpatient PU prevalence ranges from 3–6% (Kemp *et al.* 1990, Ek *et al.* 1991, Hoshowsky & Schramm 1994, Whitfield *et al.* 2000, Tannen *et al.* 2004). However, there have been limited studies to determine the prevalence and incidence of PUs in Turkey. Hug *et al.* (2001) found a 7·2% PU prevalence at a university hospital. Karadağ and Gümüşkaya (2005) also found a PU incidence of 54·8% in postoperative surgical patients. Critically ill patients are particularly susceptible to the development of PUs because of immobility and frequent exposure to PU risk factors (Theaker *et al.* 2005). Frantz *et al.* (2004) reported that the incidence of PU in acute care settings is between 7–38%. According to studies, 60% of patients who developed PUs did so in acute care settings (Gosnell *et al.* 1992, Smith *et al.* 1995). Kurtuluş and Pınar (2003) found a PU incidence of 18·3% in a neurology intensive care unit (ICU) in Turkey. No other studies were found to determine the PU incidence or prevalence in ICUs in Turkey.

Pressure ulcers cause pain and suffering, exudate, disturbance of body image, delayed healing and have a negative effect on patients' quality of life (Lindgren *et al.* 2000, Neil & Munjas 2000, Armstrong & Bartz 2001, Fox 2002, Moore & Price 2004, Lahmann *et al.* 2005). Because of PU's local and systemic effects, infections are more common, requiring extended hospitalisation (Stratton *et al.* 2003). Health services face increased expenditure for patients with severe PUs, as well as reduced availability of hospital beds (Hibbs 1988).

Pressure ulcers carry a significant economic burden. Armstrong and Bartz (2001) emphasised that, in the US every year, 1·6 million patients develop PUs, that its cost is $ 2·2–3·6 million, that PUs increase patients' length of stay (LOS) by an average of 4 days and second degree or worse PUs increase LOS by eight days. PUs also increase the workload of healthcare professionals because of the extra need for care required (Halfens *et al.* 2000). There have been no studies reported for the economic dimensions and total cost of PUs in our country (Hug *et al.* 2001). In addition to all of these negative effects of PUs, the presence of PU has been associated with a two- to fourfold increased risk of death in critically ill patients, especially older patients in the ICU (Clough 1994, Thomas *et al.* 1996). Allman *et al.* (1986) reported a four- to sixfold increase in risk of death.

The development of PUs is a very complex phenomenon, however and usually multidimensional with pressure, shear, friction, moisture and poor nutrition, contributing directly to the development of PUs (Garber & Rintala 2003). Pressure is the most important factor in the development of PUs. There is a positive correlation between PU and duration of pressure, intensity and tissue tolerance (Defloor 1999).

Friction that occurs with movement on the surface of tissue can cause damage to the upper layers of the epidermis and dermis. When friction combines with the effect of gravity, a shearing effect occurs that can tear deep tissues (Defloor 1999). These effects can easily cause PU in immobile patients, in particular. Immobility was found to be the most important risk factor for PUs (Lindgren *et al.* 2004). Critically ill patients are immobile and usually unable to change position. They cannot feel the discomfort prolonged pressure causes because of sedation (Ek *et al.* 1984).

Moisture is another PU causative factor. Maceration can occur first in the epidermis layer that is exposed to moisture for a long time, but later disturbance in the integrity of the skin can develop. For this reason, patients who are incontinent of urine or faeces or who perspire excessively are at greater risk for PU (Defloor 1999).

Nutrition also has an effect on PU development. Studies indicate that low body mass index (BMI), low serum albumin level, inadequate nutrition, activity and food intake are independent risk factors for PUs (Thomas 1997, 2001, Stratton *et al.* 2003, Harris & Fraser 2004). Malnutrition increases the PU risk (Thomas 2001) and has a negative effect on the healing process (Stratton *et al.* 2003, Harris & Fraser 2004).

There are contradictory findings on the effect of haematological factors on PU development. Haematological factors such as anaemia have been identified as significant PU risk factors (Stordeur *et al.* 1998, Williams *et al.* 2001). Other studies have determined that haematological factors, such as haemoglobin, white blood cells count and urea, do not have an effect on PU development (Holmes *et al.* 1987, Cullum & Clark 1992). Age has also been identified as a significant factor for PU development. Studies have shown that older individuals develop more PUs (Clough 1994, Thomas *et al.* 1996, Schumacher & Eveslage 1999, Williams *et al.* 2001, Lindgren *et al.* 2004). Gender has also been found to have an effect on PU development. PUs develop more often in women than in men (Gosnell *et al.* 1992, Lyder *et al.* 1999, Lindgren *et al.* 2005).

Reducing the risk for PUs is both complex and multifactorial (Theaker 2003). The most significant intervention to

decrease the incidence of PUs is determination of risk factors (Cox *et al.* 1998, Lindgren *et al.* 2002). It has become increasingly clear that the bedside nurse needs to evaluate patients for PU risk to plan preventive interventions and use a team approach to decrease the incidence of PU.

Prevention of PUs benefits both the patients, who may be spared a common, painful and debilitating condition and healthcare professionals, because of the reduction in work load and bed occupancy, as well as potential cost savings (Allman *et al.* 1999). However, because there are complex interactions of causative factors in PU etiology prevention is difficult.

Aims

To determine incidence and influential factors for PU development in ICU patients who are at risk for PU development according to the Waterlow scale (WS).

Method

Design and sample

The study was conducted as a descriptive, analytic and prospective study in the Reanimation, Surgical and Medical ICUs. Prior to beginning the study, the purpose and method of the study were explained to hospital administration and formal permission was obtained.

The Reanimation Unit is an 8-bed unit in which 13 nurses work and all of the beds used in the unit are 'decubitus beds', which are designed to prevent PUs. The decubitus beds are made of a visco-elastic, temperature sensitive open-cell material, which has unique pressure-relieving qualities. The majority of the patients in the unit require mechanical ventilation. The Surgical ICU is a 10-bed unit in which nine nurses work. The Medical ICU is an 11-bed unit in which nine nurses work. Air beds are used in these units based on patient needs.

Between 9 May–24 June 2005, 235 patients were admitted to these units. Within 1–2 hours after patients' admission to the ICUs, the WS was administered to determine PU risk and 140 patients were taken into the study, who were given scores that were within the 'at risk' and 'very high risk' limits.

Instruments

Data were collected using a data collection form, prepared by the researchers based on information in the literature, the skin assessment instrument and the WS.

Data collection form

The data collection form, which was prepared by us to determine risk factors for the development of PUs, was used for documenting sociodemographic characteristics and medical conditions that could be PU risk factors, including age, gender, hemiplegia, paraplegia, quadriplegia, mechanical ventilation, congenital deformity, contractures, lower extremity amputation, oedema, chronic disease, surgical operation and incontinence. The usage of some specific medications (steroids and diuretics) was assessed. The patients' level of consciousness (awake, apathetic, confused, stuporous, comatose and sedated), activity status (independent, partially dependent, dependent and sedated), level of cooperation (good, moderate, poor and sedated), method of nutrition (oral, nasogastric tube feeding and total parenteral nutrition) and BMI, type and characteristics of bed and mattress patient was using (air bed, orthopedic mattress and decubitus bed), previous history of PU and changes in patient's general condition were also recorded. The patient's laboratory findings from the day of admission to the unit, including total protein, albumin, urea, creatinine, leucocytes, haemoglobin, haematocrit and C-reactive protein (CRP) values were also recorded.

The skin assessment instrument

The skin assessment instrument includes a list of the most common sites for PUs: back of the head, scapula, iliac crest, trochanter, sacrum, ischium, lateral malleolus, lateral edge of the foot and the heel. The instrument also includes a PU staging system. PUs have been classified according to the standard staging system developed by European Pressure Ulcer Advisory Panel (EPUAP) Assessment of the severity of PUs using a four-stage grading system (Gould *et al.* 2000, Gunninberg *et al.* 2000, Bours *et al.* 2002, Theaker 2003, Fisher *et al.* 2004) grade I is non-blanchable erythema, with intact skin surface; grade II is epithelial damage, abrasion or blister; grade III is damage to the full thickness of the skin without a deep cavity and grade IV is damage to the full thickness of the skin with deep cavity (EPUAP 1999).

The Waterlow scale

The WS was used to identify patients at risk for PUs. We chose the WS for our study because the sensitivity and specificity of the WS has been shown to vary across different patient groups (Bridel 1993, Smith *et al.* 1995, Anthony & Barnes 1998, Pang & Wong 1998, Anthony *et al.* 2000, Papanikolaou *et al.* 2002). Papanikolaou *et al.* (2002) determined that the WS has satisfactory predictive ability. Similarly, the variables within the WS that have been found to be significant also vary across different patient groups

(Anthony & Barnes 1998, Weststrate *et al.* 1998, Anthony *et al.* 2000, Boyle & Green 2001).

The WS consists of 10 categories (build/weight and height, continence, skin type: visual risk area, mobility, sex/age, appetite, tissue malnutrition, neurological deficit, major surgery/trauma and medication), each containing several subscales. Each subscale is allocated a 'risk score' ranging from 0 (the most favourable) to 6/8 (the least favourable). To achieve the total risk score, first the category scores are obtained and then these are totaled. A patient is deemed 'at risk' if the total score is between 10–14, at 'high risk' if the total score is between 15–19 and at 'very high risk' if the total score is over 20.

Data collection

The data were collected by the ICU nurses, which included the research team. Information meetings for the nurses were held on each unit with the following topics being covered: study procedure, grading system used for PUs, how to use the WS and the skin assessment instrument. Patients were classified according to the three WS risk categories: at risk (10–14), high risk (15–19) and very high risk (20+). Patients with a score of 10 or higher were evaluated as being in the group at risk for PU and were taken into the study. Patients, whose WS score was less than 10, were accepted as being in the group at 'no risk' and were not included in the study. The 140 patients who were over the risk limit (at risk) were monitored daily during their stay for PUs. The patient's skin condition was observed over the entire body, especially over bony prominences. All skin assessments were completed every day until discharge from the ICUs. Then an evaluation was conducted on the risk factors from the data collection form. In addition, the patients' laboratory findings from the day of admission to the unit, including total protein, albumin, urea, creatinine, leucocytes, haemoglobin, haematocrit and CRP values were also recorded.

In the literature, different recommendations can be found related to the frequency of use of a tool that evaluates risk (Ayello 1999). However, the shared viewpoint is that they can be used when the patient is first met and then repeated at regular intervals. Ayello (1999) determined that the use of tools for evaluation of risk vary according to the area where the nurse works and that patients were evaluated on admission to the ICU and repeated once every 48 hours afterwards or when there was a change in the general condition of the patient. For this reason, the patients in our study were evaluated with the WS once every 48 hours and when there was a change in their general condition. The evaluations were conducted in the morning during the day shift every 48 hours. A member of the research team (wound care nurse) visited the ICUs every day to recruit patients and to support the nurses during the data collection.

The evaluation of newly developed ulcers and changes, and treatment of current PUs was done in cooperation with the Plastic Surgery Department's wound care team. During the time, the research was conducted routine measures used to prevent the development of PUs in these patients (frequent position changes and use of air beds) continued. During this time, the other patients who were not in the risk group were monitored daily for PUs and care was given.

Data analysis

Data were analysed by percentage, mean values, median and SD. Student's *t*-test was used to determine a difference in PU development according to LOS, age, gender, scale score and mean laboratory findings. Chi-square test was used to determine the difference in PU development according to gender, presence of a chronic illness, surgical procedure, which ICU, etiology, level of consciousness, activity level, degree of cooperation, method of nutrition, BMI, incontinence, obstacle to position change, mattress used and previous history of PU. Those that achieved significance were then assessed further using multivariate analysis to derive coefficients. Survival analysis (the Kaplan–Meier test) was conducted to determine on which day PUs developed. For analysis, the SPSS 10·0 version for Windows was used (SPSS Inc., Chicago, IL, USA).

Ethical considerations

The study was approved by the appropriate ethics committee. Patients or family members were informed about the study by a member of the research team and their permission was received.

Results

Of the 235 patients who were admitted to the ICUs during the study period, 55·3% were at risk for PU according to the WS. The mean age of the 140 patients, who were at risk for PU according to the WS and were included in the study, was 58 (range 18–85) and 55·7% were male. The mean LOS was 7 days (range 2–30 days; Table 1). Of these patients, 39·3% were in the Reanimation Unit, 38·6% were in the Medical ICU and 22·1% were in the Surgical ICU.

As can be seen in Fig. 1, there were more patients at 'very high risk' for PU in the Reanimation and Medical ICUs than in the Surgical ICU. A statistically significant difference was

Table 1 Patients characteristics

Characteristic	Pressure ulcers		*p*-value
	Yes (n = 20)	No (n = 120)	
Age-years (mean)	61·30 ± 15·52	57·24 ± 17·59	> 0·05
Gender (n)			
Female	9	53	> 0·05
Male	11	67	> 0·05
Length of stay – days (mean)	14·05 ± 9·61	4·66 ± 4·44	< 0·05
Waterlow scale score (mean)	22·50 ± 6·63	16·21 ± 6·31	< 0·05

Age, length of stay and Waterlow scale score comparison using Students' *t*-test and gender comparison using chi-squared test.

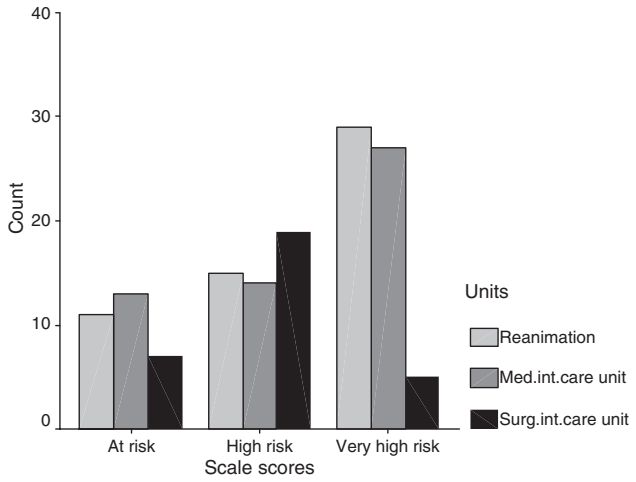

Figure 1 Waterlow scale scores according to unit where patient is located.

found between the WS scores for patients at risk for PU in the ICUs ($p < 0·05$).

In this study, 4·3% of the patients were receiving steroids and 5% were receiving diuretics. Half of the patients (47·9%) had a chronic illness and 27·9% were postoperative.

In the examination of other PU risk factors, it was seen that 26·4% of the patients were on mechanical ventilation, 5·7% were apathetic, 11·4% confused, 9·3% in a stupor and 21·4% in a coma or sedated. The activities for 50% of the patients were dependent, 40·7% were partially dependent, 23·6% were moderately cooperative, 41·4% were uncooperative or sedated, 32·1% had a BMI above normal, 9·3% were obese and 4·3% were cachectic, 46·4% were receiving total parenteral nutrition, 3·6% were receiving nasogastric tube feedings, 66·4% had a urinary drainage catheter, 72·1% were incontinent, 57·9% were on an air bed, 39·3% were on a decubitus bed, 2·8% were on an orthopedic mattress and 94·3% had not had a previous PU. Thirty per cent of the patients could not change their position (traction, trauma and lack of patient cooperation). The majority of the patients (96·4%) did not have a change in their general condition during the study.

Table 2 Pressure ulcer location and staging

Location	Number of patients (n = 20)	Stage*	
		Grade I	Grade II
Shoulder	7	6	1
Sacrum	6	4	2
Shoulder + sacrum	1	2	–
Sacrum + heel	1	1	1
Shoulder + heel	1	2	–
Elbow + heel	1	2	–
Sacrum + elbow	1	2	–
Heel + malleolus	1	2	–
Ischium + malleolus	1	2	–

*In the 20 patients with diagnosed PU there were 27 PUs.

A new PU was diagnosed in 14·3% of the study patients. The mean length of time for development of PU in these patients was 10·4 (SD 1·85) days and the median was six days. In the 20 patients with diagnosed PU, there were 27 PUs, of these 23 were grade I and four were grade II. Six patients' PUs were on the sacrum, seven patients' PUs were on the back and they were in more than one place in seven patients (Table 2).

At discharge, transfer to other wards, or at the end of the study period, 12 patients had PUs. Ten of the patients with new PU were in the Reanimation Unit, six in the Surgical ICU and four in the Medical ICU. There was no statistically significant difference found between the ICUs for PU development ($p > 0·05$). In the evaluation of WS scores of the patients who developed PUs, it was determined that nine patients were in the 'high risk' group and 11 were in the 'very high risk' group and a statistically significant difference was found in the scale scores for PU development (Table 1; $p < 0·05$). No statistically significant difference was found for PU development according to patients' age and gender. There was a statistically significant difference for PU development according to LOS ($p < 0·05$). In addition, there were statistically significant differences found for PU development according to level of consciousness, activity and cooperation (Table 3). C-reactive protein was the only laboratory finding that was found to have a statistically significant relationship with PU development (Table 4). In the multiple stepwise logistic regression analysis performed on variables, LOS and activity level were determined to be the most important factors for PU development ($p < 0·05$; Table 5). During the study, none of the patients developed a PU who were not found to be at risk according to the WS.

Table 3 Distribution of pressure ulcer development according to risk factors

Risk factors	Pressure ulcer		*p*-value
	Yes (n = 20)	No (n = 120)	
Consciousness			
Awake	5	68	$p < 0{\cdot}05$
Confused	2	22	
Stuporous	5	8	
Comatose	1	1	
Sedated	7	21	
Activity			
Independent	1	12	$p < 0{\cdot}05$
Partially dependent	2	55	
Dependent	17	53	
Cooperation			
Good	2	47	$p < 0{\cdot}05$
Moderate	3	30	
Poor	8	22	
Sedated	7	21	

Table 4 Distribution of pressure ulcer development according to laboratory findings

Laboratory findings	Pressure ulcers				*p*-value
	Yes (n = 20)		No (n = 120)		
	X	SD	X	SD	
Albumin	2·91	1·91	2·81	2·20	> 0·05
Total protein	5·70	2·92	5·89	3·30	> 0·05
Urea	55·10	34·52	59·16	63·29	> 0·05
Creatinine	1·01	0·54	3·43	0·67	> 0·05
C-reactive protein	138·69	86·16	75·97	102·95	< 0·05
Leucocytes	13·75	8328·90	11·61	7474·70	> 0·05
Haemoglobin	10·79	1·93	10·88	4·64	> 0·05
Haematocrit	31·67	22·63	31·52	28·57	> 0·05

Table 5 Pressure ulcer risk factors identified by multiple stepwise logistic regression analysis

Risk factors	Odds ratio	95% Confidence interval	*p*-value
Length of stay	1·20	1·11–1·30	0·000
Activity level	0·34	0·16–0·73	0·005

Discussion

During our study, only 55·3% of the patients admitted to the ICUs were found to be at risk for PU according to the WS. This value seems to be low when we consider the characteristics of patients admitted to the ICU. The reason for this may be the high turnover of patients, particularly in the Surgical ICU. Most of these patients are only kept in the Surgical ICU postoperatively until they are haemodynamically stable. The majority are kept in the ICU for 1–2 days. The majority of these patients were not found to be at risk for PU.

The incidence of PUs in patients at risk for PU according to the WS in ICUs in our study was found to be 14·3%. In the majority of studies conducted to determine the PU incidence in ICUs, the incidence was determined based on the total population. However, in our study, the evaluation was only conducted with the population evaluated to be at risk for PU. For the total group (235 patients), PU incidence was 8·5%. Pressure ulcer incidence is low compared with studies in other countries in which the incidence of PU in ICU patients has been reported to be between 3–33% (Bours *et al.* 2001, Theaker *et al.* 2005). In this study, all PUs may not have been detected because of shorter LOS in the ICU. In addition, the average hospital LOS was seven days, whereas PUs developed in 10·4 days.

All of the patients who were diagnosed with PUs were patients at 'high risk' or 'very high risk' according to the WS. For this reason, we can say that the WS was a good instrument for risk evaluation. This is also supported by our finding that none of the patients in the 'no risk' group developed a PU. Similarly, Boyle and Green (2001) found the mean WS score of patients developing a PU that, according to the WS classification, indicates 'very high risk'. Papanikolaou *et al.* (2002) reported that the WS has satisfactory predictive ability. In addition, Weststrate *et al.* (1998) stated that the WS has been shown to have predictive ability for patients in an ICU.

There were 27 PUs, which developed in a total of 20 patients in our study, 23 of the total were grade I (74%) and four were grade II (26%). During the study, there was no change in the PUs that developed and interventions recommended by the wound care team were implemented to prevent worsening of these PUs. Having the majority of the PUs to be grade I and not worsening is assumed to be due to the effect of the PU preventive measures implemented in the ICUs. In addition, the ICUs here have younger patients (mean age 58 years), higher nurse/patient ratios, more advanced technology and shorter LOS, which may also have had an effect on outcome. In other studies, the more severe PUs were reported to be in hospitals, of which 25–45% were grade III or grade IV (Dealey 1991, Clark & Cullum 1992) and 24% were grade I in hospitals (Clark & Cullum 1992).

The majority of the PUs that developed were on the sacrum (nine PUs) and on the shoulder (nine PU's; Table 2). The reasons for this may be the fact that the majority of patients are kept in a semi-fowler's position, which puts more pressure on the sacrum and shoulder and because of an

increase in friction and shearing from incorrect lifting techniques. Other studies have reported that 60–90% of all PUs develop below the waist, with the sacrum the most common location followed by the heels (Dealey 1991, Clark & Cullum 1992, Oot-Giromini 1993, Thoroddsen *et al.* 1999, Nixon *et al.* 2000, Lindgren *et al.* 2004, Theaker *et al.* 2005). Karadağ and Gümüşkaya (2005) determined that the PU localisation in postoperative patients was, respectively, gluteal area, scapula, iliac-trochanter area, sacrum, elbow and others. Lindgren *et al.* (2004) found that 77·4% of patients developed one PU and 22·6% of patients two or more PUs. Knowing the site where PUs develop can give valuable information regarding cause and prevention.

Age was not a PU risk factor in our study. The mean age for patients who developed PUs was 61 years, but was 57·2 years for those who did not develop PU. The difference, however, was not found to be statistically significant. Most older adults tend to have decreased activity and mobility, diminished tissue tolerance and increased risk of comorbidities (Braden & Bergstrom 1987). For example, 41% of cardiovascular patients, 21% of acute neurologic patients and 15% of patients with orthopedic injuries may develop PUs (Meehan 1994).

The majority of studies have reported that the risk for PU is higher in patients over 65 (Burd *et al.* 1992, Gosnell *et al.* 1992, Williams *et al.* 2001, Lindgren *et al.* 2004). Hoshowsky and Schramm (1994) found that age (> 40 years) was a significant predictor. There are also findings in other studies, which were similar to our findings in not finding age to have an effect on PU development (Nixon *et al.* 2000, Theaker *et al.* 2005).

There are conflicting findings in the literature regarding gender as a PU risk factor. In contrast to studies, which determined that there were more PUs in women than in men (Meehan 1990, Gosnell *et al.* 1992, Lyder *et al.* 1999, Lindgren *et al.* 2005), gender was not found to be a factor affecting PU development in our study. The men and women in our study having similar risk factors for PU (age, health condition and immobility) may have affected this result. Our findings are consistent with others reported in the literature (Anthony *et al.* 2000, Lindgren *et al.* 2004, Theaker *et al.* 2005). It may be important for gender to be evaluated together with other risk factors.

The level of consciousness of 13 of the patients who developed PUs was stupor, comatose or sedated, 17 were dependent for activities or sedated and 15 were uncooperative or sedated. As can be seen, in general, the patients who developed PUs were sedated and immobile patients. Because of sedation patients may not feel discomfort from an extended period of pressure and because they are unable to change their positions, they have an increased risk for PU (Kemp *et al.* 1990). Immobilisation has a negative effect on many organs and systems in the body, which increases the risk for PU (Allman *et al.* 1995b, Bergstrom *et al.* 1996).

Although there were differences in the Medical, Surgical and Reanimation ICUs that affect the development of PUs in addition to immobility, no statistically significant differences were found between the ICUs for incidence of PU. There were 10 patients who developed PUs in the Reanimation Unit, six in the Surgical ICU and four in the Medical ICU. The factors that could have caused more patients in the Reanimation Unit to develop PUs may be because of the higher number of patients on mechanical ventilation whose position changes were limited or not possible at all and because of their sedation, which decreased or prevented their ability to move. In the Surgical ICU, one of the surgery-related risk factors is having an extended period of pressure during the surgical procedure, remaining wet, metabolic and circulatory changes related to the surgical procedure and anaesthesia (Armstrong & Bartz 2001).

No statistically significant differences were found in PU and total protein and serum albumin levels, which provide information about a patient's nutritional status. Prospective studies of serum albumin have shown conflicting results (Thomas 1997). In some studies, serum albumin has been found to be a positive predictive factor in PU development (Holmes *et al.* 1987, Cullum & Clark 1992, Anthony *et al.* 2000), but other studies show no predictive value (Bergstrom & Braden 1992, Allman *et al.* 1995a, Kurtuluş & Pınar 2003). Protein deficiency could play a role in the development of PUs (Allman *et al.* 1986, Ek *et al.* 1989). Long-term protein deficiency causes oedema as a result of hypoalbuminemia. This oedema decreases oxygen supply to the tissue (Goode & Allman 1989).

Another parameter that shows patients' nutritional status is the haemoglobin level. Anaemia has been shown to have an effect on PU development (Williams *et al.* 2001). However, in contrast, there are studies that have not found anaemia to have an effect on PU development (Phillips 1999, Kurtuluş & Pınar 2003). In our study, also, anaemia was not found to have an effect on PU development. In other studies with results similar to ours, haematological factors, such as haemoglobin, white blood cells and urea, were not found to be PU risk factors (Holmes *et al.* 1987, Cullum & Clark 1992). Although there are studies, which have found obesity and cachexia to be PU risk factors (Phillips 1999, Russell 2000), in our study BMI was not found to be a factor in PU development.

In our study, there was no significant relationship determined between incontinence and PU development. In

contrast to our findings, Goldstone and Goldstone (1982) reported that faecal incontinence was significant in the development of PUs in the critically ill patients. When a layer of epidermis is exposed to moisture from incontinence for a long period of time, first maceration occurs and later disturbance in skin integrity can occur (Ribbe & Van Marum 1993).

The CRP levels of patients who developed PUs were higher than other patients and the difference was found to be statistically significant. It can be important in the determination of the duration and intensity of inflammation (Frost *et al.* 2005). There are some limitations for this study. Not all variables were measured adequately. For example, patients were on bedrest and could not be weighed. Their BMI was calculated from previous weight measurements.

Although many risk factors were identified that had an influence on PU development, PUs cannot be completely prevented. This is supported by the literature reports of preventive measures decreasing PUs but not completely preventing them (Bale *et al.* 1995, Bergstrom *et al.* 1995, Regan *et al.* 1995). Some factors (chronic illnesses and long-term steroid use) that cannot be controlled may have an effect on this situation. Many standard routines implemented with an individualised approach are another factor that affects PU development. Standard procedures may remain limited to turning and changing patients' position every two hours. However, in ICUs, even these standard procedures may not be accomplished. If the nurse has a heavy work load, if there are not enough assistant personnel, if the patient is not haemodynamically stable or because of the surgical procedure the patient has undergone (for example major orthopedic and cardiovascular surgical procedures), these preventive measures may not be carried out and the patient is at greater risk for PU development. Gould *et al.* (2000) also stated that the effectiveness of different schedules of manual repositioning have not yet been examined adequately. There is also insufficient evidence about the effectiveness of equipment used for preventing PUs. Gould *et al.* (2000) also stated that there is little evidence in terms of clinical effectiveness or cost effectiveness to enable practitioners to select equipment at all.

A multidisciplinary team approach is essential because PU development is both complex and multifactorial. The determination of risk factors is important for the identification of appropriate interventions.

Conclusions

In line with the multidisciplinary team approach, care needs to be taken to prevent PU development in ICU patients who have an extended LOS, have high WS scores, are unconscious, are dependent for activities and have poor cooperation. In addition, the finding that only patients found to be at risk for PU according to the WS developed PUs suggests that the scale can be used in ICUs as a tool for assessing PU risk.

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Contributions

Study design: SS, FD, SY, ND; data collection and analysis: ST, HD, AE, SS, SY, BT, FD and manuscript preparation: SY, SS, FD.

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