Turk J Intensive Care 2024;22:31-40
DOI: 10.4274/tybd.galenos.2023.37267

ORIGINAL RESEARCH / *ÖZGÜN ARAŞTIRMA*

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Main Factors Regarding Pressure Injury in Intensive Care Unit Patients and the Effects of Nursing Interventions

Yoğun Bakım Hastalarında Basınç Yaralanmalarını Etkileyen Temel Faktörler ve Hemşirelik Müdahalelerinin Etkileri

Received/Geliş Tarihi : 08.06.2022
Accepted/Kabul Tarihi : 09.02.2023

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ABSTRACT *Objective:* This study aims to determine the risk factors affecting the development of pressure injuries for inpatients in the intensive care unit, to determine the nursing interventions conducted to prevent pressure injuries, and to detect healing of the pressure injuries.
Materials and Methods: This follow up-longitudinal type study was conducted with 48 patients at an Intensive Care Unit in a public hospital between 01.09.2018 and 30.11.2018. Study data were collected using the Braden scale for predicting pressure injury risk, pressure injury assessment form, and pressure injury healing assessment form.
Results: Patients who had a hospitalization duration of 15 or more days, were supported with mechanical ventilators, were unconscious, were fed enterally, were immobile in bed, had an albumin level of 2.5 g/dL or below, or had a hemoglobin level of 10 g/dL or below had significantly more pressure injuries ($p<0.05$). No significant difference was found with nursing interventions (positioning, massaging, using barrier cream, moisturizing the skin, keeping the bed linen dry and stretched) performed in the clinic and the development of a pressure injury or healing of pressure injuries present during admission to the clinic ($p>0.05$).
Conclusion: The main risk factors for developing pressure injuries in inpatients in the intensive care units were enteral feeding, consciousness or unconsciousness, and level of hemoglobin. More pressure ulcers occurred on patients who were positioned and whose skin was moistened because nurses applied interventions to patients with a high risk of pressure ulcers. Additionally, there was no improvement in the healing of the compression injuries.
Keywords: Pressure injury, intensive care unit, nursing care, pressure injury risk factors

ÖZ *Amaç:* Bu araştırmada amaç yoğun bakım ünitelerinde yatan hastalarda bası yarası gelişimini etkileyen risk faktörleri saptamak, bası yaralarını önlemek için yapılan hemşirelik girişimlerini belirlemek, bası yaralarındaki iyileşme durumu tespit etmektir.
Gereç ve Yöntem: Bu araştırma izleme-uzamsal (follow-up longitidunal) tipte, 01.09.2018-30.11.2018 tarihlerinde bir ilde bulunan devlet hastanesindeki, yoğun bakım ünitesinde 48 hasta ile gerçekleştirilmiştir. Veriler Braden bası yarası değerlendirme ölçeği, bası yarası değerlendirme formu, bası yarası iyileşme değerlendirme formu ile toplanmıştır.
Bulgular: On beş gün ve üzeri yatış süresi olan, mekanik ventilatör ile desteklenen, bilinci kapalı, enteral beslenen, yatakta hareketsiz olan, albumin düzeyi 2,5 g/dL ve altında olan veya hemoglobin düzeyi 10 g/dL veya altı olan hastalarda bası yaralanmaları anlamlı olarak daha fazla olarak belirlenmiştir ($p<0,05$). Klinikte yapılan hemşirelik girişimleri (pozisyon verme, masaj yapma, bariyer krem kullanma, deriyi nemlendirme, çarşafları kuru ve gergin tutma) ile hastaneye başvuru sırasında mevcut olan bası yaralanması gelişimi veya bası yaralanmalarının iyileşmesi arasında anlamlı bir fark bulunamamıştır ($p>0,05$).
Sonuç: Yoğun bakımda yatan hastalarda bası yarası gelişimi için başlıca risk faktörleri enteral beslenme, bilinç veya bilinç kaybı ve hemoglobin düzeyidir. Hemşirelerin basınç yarası riski yüksek olan hastalara müdahale etmesi nedeniyle pozisyon verilen ve derisi nemli olan hastalarda daha fazla basınç yarası meydana gelmiştir. Ayrıca oluşan bası yaralanmalarının iyileşmesinde de bir gelişme olmamıştır.
Anahtar Kelimeler: Bası yarası, yoğun bakım ünitesi, hemşirelik bakımı, bası yarası risk faktörleri

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Introduction

In healthcare services, pressure ulcers (PUs) acquired in hospitals are not acceptable (1). PUs are common and frequently occur in the healthcare setting. They affect 3-34 percent of inpatients globally (2,3). Hospitalized patients suffer PUs in 3-24% of American cases (2). In Turkey, the frequency varies between 5.9% and 17.5% (4-10). PU prevalence in Sweden was found by Gunningberg et al. (11) to be 47.8% in 2011, 42.3% in 2012, 28.6% in 2013, 45.0% in 2014, 38.6% in 2015, and 15.4% in 2016. The prevalence of PUs was shown to be between 24.2% and 28.2% in this study (11).

Although there is a greater awareness in healthcare services about the prevention of PUs, PUs still arise. Preventive measures are the most efficient way to reduce the incidence of PUs (12). Correct determination of the risk factors for the development of a PU is the first step in prevention. PU treatment activities are costlier than prevention interventions (13).

Patients with limited mobility due to a physical or cognitive disorder have a higher risk of acquiring PUs (14). Ulcers do not develop because of one factor but result from the interaction of several factors. Although pressure is the primary factor, identifying other risk factors for PU development is crucial in identifying people who are at high risk (1). The critical care unit is where most hospital-acquired PUs originate (15). Many risk factors, including sedation, altered consciousness, prolonged bed rest, mechanical ventilation attachment, hemodynamic imbalance changes, urinary catheter use, infrequent repositioning, hypotension, and inotrope support, are associated with inpatients in the intensive care unit (ICU). Additional risk factors include incontinence, age, albumin level, diastolic blood pressure, and length of stay in the ICU (1,15,16). Patients over 65 have a higher risk of developing PUs, and those over 51 have higher risk factors; the risk of developing PUs rises with age (17).

The care and prevention of PUs, as well as the timely execution of scheduled preventive actions, are among the duties assigned to nurses (18). Preventive interventions include skin evaluation and care, nutrition assessment, positioning, and using supportive surface systems to reduce the pressure on the skin (19). If nurses are not able to perform proper skin inspections, it is impossible to detect the early symptoms of PUs (20). In order to prevent and treat PUs, nurses need consider factors including workload, bed occupancy rate, resource utilization, nurse-patient ratio, and certain personal traits like age, gender, and professional experience (18,20). These days, PUs are one of the most well-known avoidable patient safety issues worldwide. Understanding the causes of PUs and what needs to be done to prevent them is essential. This study was conducted to determine these factors.

Materials and Methods

Study Aim and Type

This follow-up longitudinal study was conducted to determine the risk factors affecting the development of PUs for inpatients in ICUs, to determine the nursing interventions conducted to prevent PUs, and to detect the healing status of the PUs.

Study Place and Time

Study data were collected from the ICU of a public hospital in Turkey between 01.09.2018 and 30.11.2018 after institutional permissions were obtained. A sampling method was not used in the study, how many patients were admitted to the ICU between the specified dates, and were these patients included in the sample? This study sample included 54 inpatients in the anesthesiology and reanimation ICU between 01.09.2018 and 30.11.2018; six patients did not agree to participate, or their relatives did not give permission. Thus, 48 patients were taken and followed up until they were sent to another service or discharged. The follow-up days of the patients are between 2 and 78 days [minimum-maximum: 2-78 days, $\bar{x}$ ± standard deviation (SD) (median): 14.25±15.42 (9.08)]. The ICU, where the study was conducted, has 9 beds, 3 nurses work on each shift, and a nurse takes care of 3 patients. In the ICU, the skin is evaluated every day to prevent pressure sores, lying on air beds, positioning every 4-6 hours, and skin moistening applications are performed once a day. There is no grouping of patients. The positioning times of the patients were grouped within themselves (2-8 hours).

Data Collection Tools

The study data were collected using the Braden scale for predicting PU risk-Turkish form, and two assessment forms created by the researchers named PU assessment form and PU healing assessment form (21,22). The Braden scale has six subscales: sensory perception, moisture, activity, mobility, nutrition, and friction and shear. This study found that Cronbach's alpha value of the Braden scale for predicting

PU risk was 0.84. the PU assessment form had two sections with 23 questions in total. The first section included three questions regarding patients' PU evaluation during their admittance to the ICU (PU presence, area, and stage during the admission to service); the second section included 20 questions (patients' characteristics regarding health status, nursing prevention interventions, and evaluation of clinic-acquired PUs) in three subsections. The PU healing assessment form comprised three questions evaluating the depth, frequency of changing the medical dressing, and size of the ulcer.

Data Collection

Study data were collected from the inpatients who verbally agreed to participate in the study or those whose legal guardians permitted participation between September 2018 and November 2018 in a public hospital. The researcher collected data by going to the hospital every day, observing patient care, and reviewing the patient files.

In the first stage, patients who did not have a PU performed a risk evaluation using the Braden scale for predicting PU risk and PU assessment form. Patients' Glasgow coma scale (GCS) points were scored by the researcher and their body mass index and body surface area points were calculated through their height and weight, which were obtained from their files. In the second stage, a patient's ulcer evaluation was performed if an ulcer was present during their admission to intensive care, and the location, stage, size, and depth of the ulcer were recorded. The area and stage of the PUs were recorded by the researcher who personally participated in the patient care. The staging of the PU was evaluated based on the PU classification system developed by National PU Advisory Panel (23,24). The researcher observed which nursing interventions were performed and how frequently, nurses in the ICU were asked about the frequency of practices conducted during the ICU, and evaluations were done accordingly. The interventions of the nurses were observed by the observer at certain times of the day and recorded from the patient files during the rest of the day. The researcher is a 3-year intensive care nurse when the data were collected.

The PU healing status of the patients with a PU was followed up through the PU healing assessment form. Ulcer depth, frequency of medical dressing, and size were recorded by the researcher participating in the care. The size of the PU was measured using a disposable paper ruler.

Ethical Considerations

Ethical committee permission dated 04.06.2018 and numbered 2018/198 was obtained from the Scientific Research Ethical Committee of Trakya University before conducting the study (decision no: 10/21). The research protocol was signed with the institution to collect study data. Participation in the study was voluntary and the informed consent form was obtained from the legal guardians of the unconscious patients. Permissions were obtained from the scale owner of the Braden PU scale via e-mail.

Statistical Analysis

Data were evaluated using numbers and percentages for categorical data in descriptive statistics and mean and SD for numerical data. Pearson chi-square test, Yates corrected chi-square test, and Fisher Exact test was used in the comparison of PU status (rates) based on the descriptive and health status-related characteristics of the patients; when a difference was found in the multi-group variables, the adjusted p-value (Bonferroni method) was used in the further analysis where column rates were compared.

Independent variables that affected the development of PUs were evaluated using multiple logistic regression (Backward: Wald method) analysis in primary analyses. Autocorrelation between the independent variables was examined using Kendall Tau b correlation analysis and multicollinearity [variance inflation factor (VIF) and tolerance] statistics for logistic regression. The significance level was set at $p<0.05$.

Results

Patients' introductory and health-related characteristics are presented in Table 1. Of the patients, 87.5% were 60 years old and older, 68.8% were male, 77.1% had a chronic disease, 43.8% were supported by a mechanical ventilator, and 56.3% were conscious. Of the patients, 39.6% had recoverable brain damage (≥13) based on their GCS, 56.3% were high-risk (≤12 points) according to their Braden scale for predicting pressure, and 70.8% did not have an infection. The mean hospitalization duration was 16.15±16.19 days and 39.6% of the patients were in the ICU for 1 to 7 days. The patient's laboratory findings indicated that 68.8% of the patients had a level of albumin above 2.5 g/dL and 68.7% had a level of hemoglobin above 10 g/dL. The mean GCS score was 15.23±4.16, the mean Braden scale for PU risk

score was 12.34±3.31, mean albumin value was 2.84±.67 g/dL and the mean hemoglobin value was 11.36±1.95 g/dL (Table 1).

The areas where PUs primarily developed were the sacrum, coccyx, and right and left trochanter in all patients included the study. In the classification of PUs, stage 2 PUs were mostly followed up. Clinic-acquired PUs developed during the 4th to 19th days of the patient's hospitalization. Eighteen of the patients already had PUs during admission to the clinic. The areas where PUs developed most were the sacrum, coccyx, left trochanter, and left scapula. In the classification of PUs, stage 2 PUs were present most frequently at the rate of 66.7%. Of these stage 2 PUs, 75% were in the sacrum area. PU stage, size, and width of the existing ulcers of the patients with a PU during their admission to the unit (ICU) were followed; however, no recovery occurred in their ulcers.

Examining the PU development status of the patients based on their hospitalization process, a highly significant difference was detected between groups ($p<0.01$, Table 2). Further analysis (according to Bonferroni adjusted p-value) indicated that the inpatients staying in the clinic for 15 days or more had a significantly higher development rate of PUs (81.3%) compared to those inpatients staying in the clinic for 1 to 7 days (26.3%) and 8 to 14 days (30.8%) ($p<0.05$).

The rate of PU development in the patients attached to a ventilator (81%) was significantly higher than those not attached to a ventilator (22.2%) ($p<0.001$, Table 2). The development rate of PUs in the unconscious patients (85.7%) was higher than that of the conscious patients (18.5%); the difference between groups was highly significant ($p<0.001$, Table 2). The rate for the development of PUs in the patients who had edema (87.5%) was significantly higher than those who did not have edema (40%) ($p<0.05$, Table 2).

Examining the development of PUs based on the nutrition status of the patients, the rate for the development of PUs in the patients who were fed enterally (80%) was higher compared to those fed with total parenteral nutrition (TPN) and those who were not fed (13%); the difference between groups was highly significant ($p<0.001$, Table 2). Examining the PU development status based on GCS scores, a highly significant difference was detected between groups ($p<0.001$, Table 2). Further analysis found that patients who had a GCS score between 9 and 12 in addition to a moderate level of brain damage (61.5%) and patients who had a GCS score less than 9, a severe level of brain damage, and were in a deep coma (81.3%) had a significantly higher rate of PU

Table 1. Patients' introductory and health related characteristics

Characteristic	n	%
Age (years)		
≥60	42	87.5
<60	6	12.5
Gender		
Male	33	68.8
Female	15	31.3
Chronic disease		
Yes	37	77.1
No	11	22.9
Attached to a ventilator		
Yes	21	43.8
No	27	56.3
Consciousness		
Conscious	27	56.3
Unconscious	21	43.8
Nutrition method		
Oral	17	35.4
Enteral	25	52.1
TPN	2	4.2
No nutrition	4	8.3
Level of Glasgow coma scale		
Recoverable brain damage (≥13)	19	39.6
Moderate brain damage (9-12)	13	27.1
Severe brain damage (4-8)	13	27.1
Deep coma (≤3)	3	6.3
Braden scale for predicting pressure sore risk		
High risk (≤12 points)	27	56.3
Risky (13-14 points)	10	20.8
Low risk (15-16 points)	6	12.5
No risk (≥17 points)	5	10.4
Hospitalization duration		
1-7 days	19	39.6
8-14 days	13	27.1
≥15 days	16	33.3
Infection		
Yes (blood)	14	29.2
No	34	70.8
Albumin value (g/dL)		
≤2.5	15	31.3
>2.5	33	68.8

Table 1. Continued		
Characteristic	**n**	**%**
Hemoglobin value (g/dL)		
≤10	15	31.3
>10	33	68.7
	Min-max	**$\bar{X}$ ± SD (median)**
Age (years)	32-94	72.27±12.86
Glasgow total score	3-15	15.23±4.16
Total Braden scale for predicting pressure sore risk score	8-21	12.34±3.31
Albumin value (g/dL)	1.20-4.05	2.84±0.67
Hemoglobin value (g/dL)	7.85-16.65	11.36±1.95
Hospitalization duration (days)	2-78	16.15±16.19 (9.50)
Follow-up (days)	2-78	14.25±15.42 (9.0)

TPN: Total parenteral nutrition, SD: standard deviation, min-max: minimum-maximum

development compared to those with 13 or more GCS score (recoverable brain damage) (10.5%); no significant difference was found between other dual groups (p>0.05) (Table 2).

Examining the PU development status based on the Braden scale for PU risk scores, a highly significant difference was detected between groups (p<0.01, Table 2). The rate of PU development in the high-risk group with 12 or less Braden scale for PU risk scores (74.1%) was higher than those who did not have a PU risk (no PUs were identified in the patients scoring 17 or more), had a low level of PU risk (16.7% in those with 15-16 points), and had a PU risk (20% in those with 13-14 points) (p<0.05); no significant difference was found between the other dual groups (p>0.05) (Table 2). The rate of PU development in the ICU patients with an infection (78.6%) was significantly higher than those who did not have an infection (35.3%) (p<0.05, Table 2).

Patients with 2.5 g/dL or fewer albumin levels had a significantly higher rate of PU development (73.3%) than those with albumin levels above 2.5 g/dL (36.4%) (p<0.05, Table 2). In addition, patients with 10 g/dL or fewer hemoglobin levels had a significantly higher rate of PU development (73.3%) than those with hemoglobin levels above 10 g/dl (36.4%) (p<0.05, Table 2). The PU development rate in the immobile patients (67.7%) was significantly higher than those who were mobile in bed (11.8%) (p<0.01, Table 2).

58.3% of the patients included in the study were positioned, and the most frequent positioning frequency was between 6-8 hours (45.8%). 64.6% of these patients are inactive in bed, and generally, 83.3% of them are not massaged. Barrier cream is not used in 95.8%, 41.7% of them are moisturized, 97.9% of them are kept stretched and dry, and 91.7% of them lie on air beds. The patient group not provided with repositioning had no PUs because they were mobile. Of the patients provided positioning every 2-4 hours, 53.3% acquired PUs and of the patients provided positioning every 6-8 hours, 68.2% acquired PUs. A highly significant difference was found between groups (p<0.01, Table 3). No significant difference was found between the development of PUs in patients who were not given a massage (45%) and those who were given a massage (62.5%) (p>0.05, Table 3). The PU development rate of the patients whose skin was regularly moisturized (45%) and that of the patients whose skin was sometimes/irregularly moisturized (75%) were significantly higher than those whose skin was not moisturized (16.7%) (p<0.05); the difference between other dual groups was not significant (p>0.05) (Table 3).

For logistic regression, whether there is autocorrelation between independent variables was examined by Kendall Tau b correlation analysis and multicollinearity (VIF and tolerance) statistics. Among the independent variables, there was a high level of correlation between being dependent on a ventilator and consciousness status (r: 0.75, p<0.001) and diet (r: 0.76, p<0.001) (tolerance for being connected to a ventilator: 0.270, VIF: 3,699), GCS score level and being connected to a ventilator (r: 0.71, p<0.001), state of consciousness (r: 0.71, p<0.001), diet (r: 0.76, p<0.001), Braden PU risk assessment scale score level (r: 0.76, p<0.001) variables were found to be highly correlated (tolerance for GCS: 0.219, VIF: 4,567), as a result, there was an autocorrelation problem between independent variables. The variables of being connected to a ventilator and GCS level, which have autocorrelation problems with more than one variable, were not included in the logistic regression model, and 11 independent variables were analyzed. Eight independent variables, including positioning, edema, in-bed movement, skin moistening, length of stay, infection development, albumin level, and Braden PU risk assessment scale level, were found to be ineffective in the development of PUs in the ICU patients and were excluded from the model sequentially (p>0.05).

The most significant variables (from the most effective to less effective) regarding PU development were the mode of nutrition, consciousness, and level of hemoglobin (p<0.05). The effect of these three independent variables on the PU

Table 2. Risk factors affecting pressure sore development and comparison of pressure sore development based on health status						
Factor	Pressure sore development					
	No (n=25)		Yes (n=23)			
	n	%	n	%	χ^2	p
Hospitalization duration						
1-7 days[a]	13	73.7	6	26.3	12,188	**0.002***
8-14 days[a]	9	69.2	4	30.8		**a<b**
≥15 days[b]	3	18.8	13	81.3		
Attached to a ventilator						
Yes	4	19.0	17	81.0	14,057	**0.000[Y]**
No	21	77.8	6	22.2		
Consciousness						
Conscious	22	81.5	5	18.5	18,764	**0.000[Y]**
Unconscious	3	14.3	18	85.7		
Edema						
Yes	1	12.5	7	87.5		**0.020[F]**
No	24	60.0	16	40.0		
Nutrition						
Enteral	5	20.0	20	80.0	18,920	**0.000[Y]**
Orally + TPN + not receiving oral*	20	87.0	3	13.0		
Glasgow coma scale						
Recoverable brain damage (≥13 points)[a]	17	89.5	2	10.5	18,734	**0.000**
Moderate brain damage (9-12 points)[b]	5	38.5	8	61.5	(SD: 2)	**a<b**
Severe brain damage/deep coma (≤8 points)[b]	3	18.8	13	81.3		
Braden scale for predicting pressure sore risk						
No risk (≥17 points)[a]	5	100.0	-	-	17,473	**0.001**
Low risk (15-16 points)[a]	5	83.3	1	16.7	(SD: 3)	**a<b**
Risky (13-14 points)[a]	8	80.0	2	20.0		
High risk (≤12 points)[b]	7	25.9	20	74.1		
Infection						
Yes (blood)	3	21.4	11	78.6	5,809	**0.016[Y]**
No	22	64.7	12	35.3		
Level of albumin						
≤2.5 g/dl	4	26.7	11	73.3	7,263	**0.039[Y]**
>2.5 g/dL	21	63.6	12	36.4		
Level of hemoglobin						
≤10 g/dL	4	26.7	11	73.3	4,263	**0.039[Y]**
>10 g/dL	21	63.6	12	36.4		
Moving in bed						
Mobile	15	88.2	2	11.8	11,633	**0.001[Y]**
Immobile	10	32.3	21	67.7		

TPN: Total parenteral nutrition, SD: standard deviation, *Bonferroni adjusted p-value, [Y]chi-square test with Yates correction, SD: 1 (observed value <25), [F]Fisher Exact test (expected value <5).

development risk of the inpatients in the ICU was 72% (Table 4). The PU development rate in the ICU patients fed enterally was 19.32 times more than other patients (those fed orally, with TPN, and not fed orally). The PU development rate was 14.04 times more in the unconscious patients compared to the conscious ones. The PU development rate in the ICU patients with 10 g/dL or less hemoglobin was 22.89 times more than those with a hemoglobin level above 10 g/dL (Table 4).

Discussion

Table 3. Comparison of pressure sore development based on the nursing interventions performed on the patients in the intensive care unit (n=48)

Characteristic	Pressure score					
	No (n=25)		Yes (n=23)			
	n	%	n	%	χ^2	p
Frequency of repositioning						
Positioning not given[a]	11	100.0	-	-	13,911	**0.001**
Every 2-4 hours[b]	7	46.7	8	53.3	(SD: 2)	**a<b**
Every 6-8 hours[b]	7	31.8	15	68.2		
Massage						
No	22	55.0	18	45.0	-	0.454[F]
Sometimes/ irregularly	3	37.5	5	62.5		
Skin moisturizing						
Yes[a]	11	55.0	9	45.0	9,466	**0.009**
Sometimes/ irregularly[a]	4	25.0	12	75.0	(SD: 2)	**a>b**
No[b]	10	83.3	2	16.7		

[F]Fisher Exact test, SD: standard deviation

The areas where PUs were mostly seen were the sacrum and coccyx in this study followed by the trochanters and scapula. Deng et al. (15) stated PUs develop most in the sacrum, calx, and dorsum areas. Cooper (1) detected PU development mostly on the sacrum, gluteal area, calx, and ears. In the classification of PUs, most of the PUs were stage two PUs, and of these ulcers, 75% were sacrum area PUs. González-Mendez et al. (25) found that 59.4% of participants had stage two PUs, primarily in the sacrum. Similarly, Apostolopoulou et al. (26) found that stage two PUs were mostly detected in the sacrum.

Sores of patients with PUs during their admission to the clinic did not recover. Examining the characteristics of these patients, they generally had a bad status, were immobile, and had diabetes. PU healing is less common in immobile individuals than in mobile ones, according to a retrospective research (27). One of the main things holding up painful recovery is a metabolic issue (28). The fact that patients were immobile and that diabetes affected 29.41% of those with PUs when they were admitted to the clinic may have contributed to the delay in their recovery. Also, 41.17% of these patients had become exitus; so, the PU could not be evaluated for a sufficient time. In the ICU where the study was conducted, nurses worked in full capacity with three patients per nurse during night/day shifts. Thus, an excessive workload in the provision of care may indicate some inadequacies.

As the patients' hospitalization duration increases, the rate of PU development increases, as well. Previous research has shown a correlation between the length of hospital stay and the development of PUs, which aligns with the results of this investigation (29-32). PUs were more common in patients receiving ventilator support than in those not receiving it. PUs are more likely to form while a patient is receiving ventilation

Table 4. Independent variables' effect on pressure sore development in the patients in the intensive care unit: multivariate logistic regression analysis (n=48)

Independent variables	B	S. error	Wald	p	Exp (β)	95% confidence interval for EXP (B)	
Invariant	-3.72	1.21	9.45	0.002	0.024		
Nutrition method (0: other, 1: enteral)	2.96	1.22	5.87	0.015	19.32	1.76	212.08
Consciousness (0: conscious, 1: unconscious)	2.64	1.11	5.66	0.017	14.04	1.59	123.87
Level of hemoglobin (0: >10 g/dL, 1: ≤10)	3.13	1.38	5.13	0.024	22.89	1.52	344.07

S. error: Standard error, SD: standard deviation, x^2: 36.952, SD: 3, p=0.000, Nagelkerke R^2: 0.72, Hosmer and Lemeshow x^2: 6.521, p=0.089

support (15,33), according to Cox et al. (30), 81% of patients who received mechanical breathing support for longer than 72 hours had PUs. More PUs developed in unconscious patients than in conscious patients. The study conducted by González-Mendez et al. (25) also supports this result. Edema also affects PU formation. Previous similar studies support this result (25,34,35).

Considering the method of nutrition and PU status, patients who were fed in an enteral way had a higher risk of PUs compared to those who were fed another way. No study in the literature supports this study result. Studies examining the method of nutrition and risk of acquiring PUs used various methods such as lab findings or daily calorie intake to evaluate nutrition (8,30). Several research looking at the relationship between enteral and parenteral nutrition and the occurrence of PUs discovered no relationship between the two feeding techniques and PU development (35,36).

Patients who scored low on the GCS developed PUs more frequently. In a similar vein, earlier research found that patients with lower GCS scores develop PUs (37,38). PUs were more common in patients who scored 12 or lower on the Braden scale for predicting PU risk. Similarly, the incidence of PU development was 28.6% in individuals with a Braden scale score of less than twelve (39). As the Braden scale for PU score decreases, PU formation increases (15,40).

Patients with infections had more PUs. Similar studies reveal the relationship between having an infection and PUs (26,41). Patients with albumin levels under 2.5 g/dL acquired more PUs. Similarly, Deng et al. (15) found that patients with albumin levels below 3.5 g/dL acquire more PUs. Previous studies also indicated that low levels of albumin affect PU development (34,42). Patients with a hemoglobin level below 10 g/dL had more PUs. Similarly, Deng et al. (15) found that a low level of hemoglobin affects PU formation.

Patients who were repositioned and immobile had more PU development. Karayurt et al. (35) also found that patients who were repositioned acquired more PUs. The characteristics of the patients acquiring PUs were high-risk for PU development and had long hospitalization periods. The general status of the patients who did not acquire PUs was low-risk, conscious, and mobile patients who did not need to be repositioned. Patients who were repositioned acquired more PUs suggesting nurses tended to reposition these patients more.

Also, patients' ulcers did not recover even if they were repositioned. The reason for this was that the number of patients per nurse was above standards; therefore, nurses' workload increased, and risky patients did not receive sufficient care. Immobile patients acquire more PUs, and longer immobilization duration is one of the most significant factors affecting PU development (25,42). Previous studies indicated that patients whose skin is moisturized have fewer PUs (43). Patients whose skin was moisturized in this study had more PUs. Patients' sores did not recover despite skin moisturizing.

Nurses' increased workload due to patient density in the ICU, lack of nurses, and an insufficient level of patient care may be the reason for this situation, causing skin moisturizing administrations to occur after the development of PUs. The excessive workload in the ICU affects the quality of care and mortality rate. As the quality of care decreases, patient falls, the development of PUs, infection, and other adverse events increase (44). Neuraz et al. (45) conducted a study in the ICU and detected that care was provided on an optimal level when nurses work 12 hours shifts and the mean patient number per nurse is 1.8 at night and during the day. They discovered that when the patient-to-nurse ratio is higher than 2.5, the risk of mortality rises by a factor of 3.5 (45). According to Strazzieri-Pulido et al. (46), the development of PUs rises with an increase in a nurse's workload. However, based on structural factors like nursing workload, the majority of PUs were thought to have preventable side consequences (46).

This study conducted logistic regression analysis for the determination of independent variables affecting PUs and found the most effective variable was the method of nutrition. The most important second and third variables were consciousness and level of hemoglobin. Enteral nutrition increased PU development by 19.32 times compared to other types of nutrition. Similarly, inadequate nutrition is the most significant factor in the formation of PUs and increases PU formation by 11.5%. However, the nutrition method was not mentioned in this study (47). Alderden et al. (48) conducted a retrospective study with 89% of participants as ICU patients and found that vasopressor medication infusion, spinal cord injuries, and patients above 40 were the three most effective factors. Unconscious patients' possibility to acquire PUs increased by 14.04 times. Apostolopoulo stated that patients under mechanical ventilation support for more than 20 days and patients receiving 29 points or less from Jackson/Cubbin PU risk scale are high-risk (26). The PU risk of patients with a level of hemoglobin under 10 g/dL increased by 22.89. Similarly, Ayazoğlu et al. (42) stated

that patients with a low level of hemoglobin (8.02±0.78) have a higher risk of acquiring PUs.

The patient's laboratory results were recorded for the days in which blood analysis was done based on hospital procedure; therefore, no continuity was obtained in the laboratory results. Nurses in the ICU performed interventions for the patients they considered at risk of PUs; and for the other patients, they performed fewer or no interventions.

Conclusion

Accordingly, patients who had a longer duration of hospitalization, were unconscious, required ventilation support, had edema, were fed enterally, had a lower GCS score, an infection, an albumin level less than 2.5 g/dL, a hemoglobin level less than 10 g/dL, and were immobile acquired more PUs. In addition, PUs did not recover despite repositioning and skin moisturizing, indicating that nurses missed providing care due to the excessive ratio of patients/nurses. This study was conducted to determine the risk factors affecting the development of a PU for inpatients in the ICU and to determine the nursing interventions conducted to prevent PUs. It is possible to reduce pressure sores by increasing the knowledge level of nurses on PU prevention and healing. It is recommended that to carry out regular in-service training to prevent and heal pressure sores and to follow current guidelines and to be repeated studies with different research designs and with a larger population of patients.

*This article was produced from the master's thesis titled 'Evaluation of pressure sores as a quality indicator in adult intensive care patients'. Thesis authors: Selver Gökdemir, Manar Aslan.

Ethics

Ethics Committee Approval: Ethical committee permission dated 04.06.2018 and protocol numbered 2018/198 was obtained from the Trakya University Scientific Research Ethical Committee of a university before conducting the study (decision no: 10/21).

Informed Consent: Participation in the study was voluntary and the informed consent form was obtained from the legal guardians of the unconscious patients.

Authorship Contributions

Concept: M.A., Design: M.A., Data Collection and Process: S.G., Analysis or Interpretation: S.G., M.A., Literature Search: S.G., Writing: S.G., M.A.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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