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Selver Gökdemir,
Manar Aslan

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

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Selver Gökdemir
Edirne Sultan Birinci Murat State Hospital, Edirne, Turkey

Manar Aslan
Trakya University Faculty of Health Sciences, Department of Nursing, Edirne, Turkey

Manar Aslan Assoc. Prof., (✉),
Trakya University Faculty of Health Sciences, Department of Nursing, Edirne, Turkey

E-mail : manaraslan@hotmail.com
Phone : +90 552 561 34 16
ORCID ID : orcid.org/0000-0003-0932-5816

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, and 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 tarihleri arasında bir ilde bulunan devlet hastanesindeki, Yoğun Bakım Ünitesi'nde 48 hasta ile gerçekleştirilmiştir. Veriler 'Braden Bası Yarası Değerlendirme Ölçeği' 'Bası Yarası Değerlendirme Formu', 'Bası yarası iyileşme değerlendirme formu' ile toplanmıştır.
Bulgular: 15 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, cildi 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 cildi nemli olan hastalarda daha fazla basınç yarası meydana gelmiştir. Ayrıca oluşan bası yaralanmalarının iyileşmesinde de bir gelişme olmamıştır.
Anahtar Kelimeler: Bası yarası, yoğun bakım, hemşirelik bakımı, bası yarası risk faktörleri

Introduction

Hospital-acquired pressure ulcers are undesirable in healthcare services.[1] Pressure ulcers develop in 3-34% of inpatients worldwide[2] and have a widespread prevalence and incidence in the healthcare environment.[3] Hospital-acquired pressure ulcers develop in 3-24% of the patients in the USA.[2] Its prevalence in Turkey ranges from 5.9% to 17.5%.[4-10] Gunningberg et al. found the pressure ulcer prevalence was 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 in Sweden. Pressure ulcer prevalence was set at between 24.2% and 28.2% in this study.[11]

Awareness in healthcare services has increased regarding the prevention of pressure ulcers; however, pressure ulcers continue to develop despite this increased awareness. The most effective method to decrease pressure ulcers is prevention interventions.[12] Correct determination of the risk factors for the development of a pressure ulcer is the first step in prevention. Pressure ulcer 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 pressure ulcers.[14] Ulcers do not develop because of one factor but result from the interaction of several factors. The biggest factor is pressure, but the determination of other factors causing the development of pressure ulcers is important to determine high-risk patients.[1] Hospital-acquired pressure ulcers are mostly acquired in the intensive care unit.[15] Inpatients in the intensive care unit have multiple risk factors such as being under sedation, consciousness changes, long-term bed rest, attachment to mechanical ventilation, changes in the hemodynamic balance, having a urinary catheter, not being repositioned frequently, hypotension, and inotrope support. Other risk factors are age, hospitalization duration in the intensive care unit, diastolic blood pressure, level of albumin, and incontinence.[1,15,16] The risk of pressure ulcers is higher in patients above 65 years and risk factors are higher in individuals above 51 years; pressure ulcer development risk increases with age.[17]

Nurses' responsibilities include the prevention and management of pressure ulcers and conducting the planned preventive interventions on time.[18] Preventive interventions include skin evaluation and care, nutrition assessment, positioning, and using supportive surface systems to reduce the pressure on the skin.[19] Early symptoms of pressure ulcers cannot be detected if nurses cannot correctly perform skin evaluations.[20] Workload, bed occupancy rate, the usability of the resources, nurse-patient ratio, and some characteristics (such as gender, age, and professional experience) of nurses are effective in the prevention and treatment of pressure ulcers.[18,20]

Nowadays, pressure ulcers are a well-known preventable patient safety problem in the world. To prevent pressure ulcers, it is necessary to know the factors affecting them and what needs to be done. 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 pressure ulcers for inpatients in intensive care units, to determine the nursing interventions conducted to prevent pressure ulcers, and to detect the healing status of the pressure ulcers.

Study Place and Time

Study data were collected from the intensive care unit 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 intensive care unit between the specified dates, and were these patients included in the sample? This study sample included 54 inpatients in the anesthesiology and reanimation intensive care unit 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 (Min-Max: 2-78 days, $\bar{x}$ **±SS [**Median]: 14.25±15.42[9.08]). The intensive care unit, where the study was conducted, has 9 beds, 3 nurses work on each shift, and a nurse takes care of 3 patients. In the intensive care unit, 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 Pressure Ulcer Risk -Turkish Form, and two

assessment forms created by the researchers named Pressure Ulcer Assessment Form and Pressure Ulcer 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 Pressure Ulcer Risk was 0.84. The Pressure Ulcer Assessment Form had two sections with 23 questions in total. The first section included three questions regarding patients' pressure ulcer evaluation during their admittance to the intensive care unit (pressure ulcer 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 pressure ulcers) in three subsections. The Pressure Ulcer 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 pressure ulcer performed a risk evaluation using the Braden Scale for Predicting Pressure Ulcer Risk and Pressure Ulcer Assessment Form. Patients' Glasgow Coma Scale (GCS) points were scored by the researcher and their Body Mass Index (BMI) and Body Surface Area (BSA) 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 pressure ulcers were recorded by the researcher who personally participated in the patient care. The staging of the pressure ulcer was evaluated based on the pressure ulcer classification system developed by NPUAP (National Pressure Ulcer 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 pressure ulcer healing status of the patients with a pressure ulcer was followed up through the Pressure Ulcer Healing Assessment Form. Ulcer depth, frequency of medical dressing, and size were recorded by the researcher participating in the care. The size of the pressure ulcer 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 a university before conducting the study. 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 Pressure Ulcer Scale via e-mail.

Data Evaluation

Data were evaluated using numbers and percentages for categorical data in descriptive statistics and mean and standard deviation for numerical data. Pearson Chi-square test, Yates corrected chi-square test, and Fisher exact test was used in the comparison of pressure ulcer 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 pressure ulcers 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 (VIF and tolerance) statistics for logistic regression. The significance level was set at $p<.05$.

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

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	**x̄ ± 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±,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)

recoverable brain damage (≥ 13) based on their Glasgow coma scale, 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 intensive care unit 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 Glasgow coma scale score was 15.23±4.16, the mean Braden Scale for pressure ulcer 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 pressure ulcers primarily developed were the sacrum, coccyx, and right and left trochanter in all patients included the study. In the classification of pressure ulcers, stage 2 pressure ulcers were mostly followed up. Clinic-acquired pressure ulcers developed during the 4th to 19th days of the patient's hospitalization. Eighteen of the patients already had pressure ulcers during admission to the clinic. The areas where pressure ulcers developed most were the sacrum, coccyx, left trochanter, and left scapula. In the classification of pressure ulcers, stage 2 pressure ulcers were present most frequently at the rate of 66.7%. Of these stage 2 pressure ulcers, 75% were in the sacrum area. Pressure ulcer stage, size, and width of the existing ulcers of the patients with a pressure ulcer during their admission to the unit (ICU) were followed; however, no recovery occurred in their ulcers.

Examining the pressure ulcer development status of the patients based on their hospitalization process, a highly significant difference was detected between groups (p<.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 pressure ulcers (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<.05).

The rate of pressure ulcer development in the patients attached to a ventilator (81%) was significantly higher than those not attached to a ventilator (22.2%) (p<.001, Table 2). The development rate of pressure ulcers in the unconscious patients (85.7%) was higher than that of the conscious patients (18.5%); the difference between groups was highly significant (p<.001, Table 2). The rate for the development of pressure ulcers in the patients who had edema (87.5%) was significantly higher than those who did not have edema (40%) (p<.05, Table 2).

Examining the development of pressure ulcers based on the nutrition status of the patients, the rate for the development of pressure ulcers in the patients who were fed enterally (80%) was higher compared to those fed with TPN and those who were not fed (13%); the difference between groups was highly significant (p<.001, Table 2). Examining the pressure ulcer development status based on GCS scores, a highly significant difference was detected between groups (p<.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 pressure ulcer development compared to those with 13 or

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*** **a<b**
8-14 days[a]	9	69.2	4	30.8		
≥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	**.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	**.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 (sd:3)	**0.001** **a<b**
Low risk (15-16 points)[a]	5	83.3	1	16.7		
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	**.016**[Y]
No	22	64.7	12	35.3		
Level of albumin						
≤2.5 g/dl	4	26.7	11	73.3	7.263	**.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	**.039**[Y]
>10 g/dL	21	63.6	12	36.4		
Moving in bed						
Mobile	15	88.2	2	11.8	11.633	**.001**[Y]
Immobile	10	32.3	21	67.7		

*Bonferroni adjusted p-value, Y: Chi-square test with Yates correction, sd: 1 (observed value < 25)., F: Fisher exact test (expected value <5).

more GCS score (recoverable brain damage) (10.5%); no significant difference was found between other dual groups (p>.05) (Table 2).

Examining the pressure ulcer development status based on the Braden Scale for pressure ulcer risk scores, a highly significant difference was detected between groups (p<.01, Table 2). The rate of pressure ulcer development in the high-risk group with 12 or less Braden Scale for Pressure Ulcer Risk scores (74.1%) was higher than those who did not have a pressure ulcer risk (no pressure ulcers were identified in the patients scoring 17 or more), had a low level of pressure ulcer risk (16.7% in those with 15-16 points), and had a pressure ulcer risk (20% in those with 13-14 points) (p<.05); no significant difference was found between the other dual groups (p>.05) (Table 2). The rate of pressure ulcer development in the intensive care unit patients with an infection (78.6%) was significantly higher than those who did not have an infection (35.3%) (p<.05, Table 2).

Patients with 2.5 g/dl or fewer albumin levels had a significantly higher rate of pressure ulcer development (73.3%) than those with albumin levels above 2.5 g/dl (36.4%) (p<.05, Table 2). In addition, patients with 10 g/dl or fewer hemoglobin levels had a significantly higher rate of pressure ulcer development (73.3%) than those with hemoglobin levels above 10 g/dl (36.4%) (p<.05, Table 2). The pressure ulcer development rate in the immobile patients (67.7%) was significantly higher than those who were mobile in bed (11.8%) (p<.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 pressure ulcers because they were mobile. Of the patients provided positioning every 2-4 hours, 53.3% acquired pressure ulcers and of the patients provided positioning every 6-8 hours, 68.2% acquired pressure ulcers. A highly significant difference was found between groups (p<.01, Table 3). No significant difference was found between the development of pressure ulcers in patients who were not given a massage (45%) and those who were given a massage (62.5%) (p>.05, Table 3). The pressure ulcer 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<.05); the difference between other dual groups was not significant (p>.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: .75, p<.001) and diet (r: .76, p<.001) (tolerance for being connected to a ventilator: .270, VIF: 3.699), GCS score level and being connected to a ventilator (r: .71, p<.001), state of consciousness (r: .71, p<.001), diet (r: .76, p<.001)), Braden pressure ulcer risk assessment scale score level (r:.76, p<.001) variables were found to be highly correlated (tolerance for GCS: .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 pressure ulcer risk assessment scale level, were found to be ineffective in the development of pressure ulcers in the intensive care unit patients and were excluded from the model sequentially (p. >.05).

The most significant variables (from the most effective to less effective) regarding pressure ulcer development were the mode of nutrition, consciousness, and level of hemoglobin (p<.05). The effect of these three independent variables on the pressure ulcer development risk of the inpatients in the intensive care unit was 72% (Table 4). The pressure ulcer development rate in the intensive care unit patients fed enterally was 19.32 times more than other patients (those fed orally, with TPN, and not fed orally). The pressure ulcer development rate was 14.04 times more in the unconscious patients compared to the conscious ones. The pressure ulcer development rate in the intensive care unit 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

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

Sores of patients with pressure ulcers 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. A retrospective study found that pressure ulcer healing in immobile patients is lower than in mobile patients.[27] A metabolic disorder is one of the essential factors delaying sore recovery.[28] Patients were immobile and 29.41% of the patients having pressure ulcers during admission to the clinic had diabetes; these factors might have caused a delay in recovery. Also, 41.17% of these patients had become exitus; so, the pressure ulcer could not be evaluated for a sufficient time. In the intensive care unit 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 pressure ulcer development increases, as well. The

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 Sore					
	No (n=25)		Yes (n=23)			
	n	%	n	%	χ^2	p
Frequency of repositioning						
Positioning not given[a]	11	100.0	-	-	13.911 (sd: 2)	**0.001 a<b**
Every 2-4 hours[b]	7	46.7	8	53.3		
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 (sd:2)	**0.009 a>b**
Sometimes/irregularly[a]	4	25.0	12	75.0		
No[b]	10	83.3	2	16.7		

[F]Fisher Exact test

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: >10g/dL, 1: ≤10)	3.13	1.38	5.13	0.024	22.89	1.52	344.07

x2: 36.952, sd: 3, p=0.000, Nagelkerke R^2: 0.72, Hosmer and Lemeshow χ^2: 6.521 p=0.089

relationship between hospitalization duration and pressure ulcer development in previous studies complied with the findings of this study.[29-32] Patients receiving ventilation support acquired pressure ulcers compared to those who did not receive this support. Ventilation support increases the development of pressure ulcers[15,33] and Cox et al. stated that 81% of the patients receiving mechanical ventilation support for more than 72 hours acquired pressure ulcers.[30] More pressure ulcers developed in unconscious patients than in conscious patients. The study conducted by Mendez also supports this result.[25] Edema also affects pressure ulcer formation. Previous similar studies support this result.[25,34,35]

Considering the method of nutrition and pressure ulcer status, patients who were fed in an enteral way had a higher risk of pressure ulcers 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 pressure ulcers used various methods such as lab findings or daily calorie intake to evaluate nutrition.[8,30] Some studies examining the effect of enteral and parenteral nutrition on the development of pressure ulcers found that the method of nutrition does not impact the development of pressure ulcers.[35,36]

Patients with low GCS scores had a higher rate of pressure ulcer development. Similarly, previous studies indicated that patients with lower GCS scores acquire pressure ulcers.[37,38] Patients with 12 or lower scores on the Braden Scale for Predicting Pressure Ulcer Risk had more pressure ulcers. Similarly, patients with <12 Braden scale scores had a pressure ulcer development incidence of 28.6%.[39] As the Braden Scale for pressure ulcer score decreases, pressure ulcer formation increases.[15,40]

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

Patients who were repositioned and immobile had more pressure ulcer development. Karayurt et al. also found that patients who were repositioned acquired more pressure ulcers.[35] The characteristics of the patients acquiring pressure ulcers were high-risk for pressure ulcer development and had long hospitalization periods. The general status of the patients who did not acquire pressure ulcers was low-risk, conscious, and mobile patients who did not need to be repositioned. Patients who were repositioned acquired more pressure ulcers 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 pressure ulcers, and longer immobilization duration is one of the most significant factors affecting pressure ulcer development.[25,42] Previous studies indicated that patients whose skin is moisturized have fewer pressure ulcers.[43] Patients whose skin was moisturized in this study had more pressure ulcers. Patients' sores did not recover despite skin moisturizing.

Nurses' increased workload due to patient density in the intensive care unit, 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 pressure ulcers. The excessive workload in the intensive care unit affects the quality of care and mortality rate. As the quality of care decreases, patient falls, the development of pressure ulcers, infection, and other adverse events increase.[44] Neuraz et al. conducted a study in the intensive care unit 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 found that the risk of mortality increases by 3.5 times when the patient-per-nurse ratio is above 2.5.[45] Kelly et al. found that pressure ulcer development increases as the nurse workload increases. However, most pressure ulcers were considered to have preventable side effects based on structural factors such as nursing workload.[46]

This study conducted logistic regression analysis for the determination of independent variables affecting pressure ulcers 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 pressure ulcer development by 19.32 times compared to other types of nutrition. Similarly, inadequate nutrition is the most significant factor in the formation of pressure ulcers and increases pressure ulcer

formation by 11.5%. However, the nutrition method was not mentioned in this study.[47] Alderden et al. conducted a retrospective study with 89% of participants as intensive care unit patients and found that vasopressor medication infusion, spinal cord injuries, and patients above 40 were the three most effective factors.[48] Unconscious patients' possibility to acquire pressure ulcers 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 pressure ulcer (PU) risk scale are high-risk.[26] The pressure ulcer risk of patients with a level of hemoglobin under 10 g/dl increased by 22.89. Similarly, Ayazoğlu et al. stated that patients with a low level of hemoglobin (8.02±0.78) have a higher risk of acquiring pressure ulcers.[42]

Study Limitations

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 intensive care unit performed interventions for the patients they considered at risk of pressure ulcers; 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 pressure ulcers. In addition, pressure ulcers 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 pressure ulcer for inpatients in the intensive care unit and to determine the nursing interventions conducted to prevent pressure ulcers. It is possible to reduce pressure sores by increasing the knowledge level of nurses on pressure ulcer 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.

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.

Peer-review: Externally peer-reviewed.

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.

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Kaynak

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