ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

DOI: 10.5336/healthsci.2022-94178

Evaluation of Nutrition Related Risk Factors of Pressure Ulcers in the Home Care Patients: A Retrospective Cohort Study

Evde Sağlık Hizmeti Alan Hastalarda Bası Yaralarının Beslenme ile İlişkili Risk Faktörlerinin Değerlendirilmesi: Retrospektif Kohort Bir Çalışma

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ABSTRACT Objective: Pressure ulcers (PU) continue to be a common health problem, particularly among the physically disabled or bedridden patients who are followed either at home or in palliative care units. This study aimed to identify patient characteristics and to determine the nutrition related risk factors leading to PU in patients receiving home health care and to determine why PU occurred only in some, but not all, patients with similar health problems. **Material and Methods:** Medical records of 229 patients, who were under follow-up at the homecare unit between January 1, 2016, and December 31, 2019, were retrospectively evaluated. Patient demographics, comorbid conditions, laboratory data, and data regarding the nutritional status of the patients were collected and compared to determine the risk factors for PUs. Mini nutritional assessment was performed to diagnose or exclude malnutrition using the mini-nutritional assessment-short form (MNA-SF). **Results:** Initial and last laboratory values and nutritional status of patients who did not have PUs during this time (n=207) were compared with those who have had PUs (n=22). The patients who developed PUs had significantly lower serum albumin, worser nutritional scores and mobility status than those without PUs. **Conclusion:** Mobility status, serum albumin level, and nutritional status affect PUs development among home care patients. The fact that all elderly bedridden patients did not develop PUs suggests that adequate protein intake can prevent or delay their development.

Keywords: Pressure ulcer; malnutrition; aged; immobilization; home care services

ÖZET Amaç: Bası ülserleri (BÜ), evde sağlık birimlerince ya da palyatif bakım servislerinde takip edilmekte olan, fiziksel olarak sınırlı veya yatağa tamamen bağımlı yaşlılar arasında yaygın bir sağlık sorunu olmaya devam etmektedir. Bu çalışmadaki amacımız, BÜ'nün oluşumunda, hastalara ait özellikleri ve beslenme ile ilgili risk faktörlerini değerlendirmek, BÜ'nün benzer sağlık sorunlarına sahip olmalarına rağmen neden tüm hastalarda ortaya çıkmadığını incelemektir. **Gereç ve Yöntemler:** Evde sağlık biriminde 1 Ocak 2016 ve 31 Aralık 2019 arasında takip edilmekte olan 229 hastanın kayıt altındaki dosyaları retrospektif olarak incelenmiş, hastaların demografik bilgileri, eşlik eden kronik hastalıkları, bazı laboratuvar sonuçları ve beslenme durumları ile ilgili veriler toplanmış, değerlendirilmiş ve BÜ'nün oluşmasına etki ettiği düşünülen risk faktörleri karşılaştırılmıştır. Beslenme durumlarını değerlendirmek ve malnütrisyonu dışlamak amacıyla "Mini Nutritional Assessment-Short Form (MNA-SF)" kullanılmıştır. **Bulgular:** BÜ (n=22) olan ve BÜ (n=207) olmayan hastaların ilk ve son laboratuvar sonuçları ve beslenme durumları karşılaştırılmıştır. BÜ oluşan hastaların serum albumin düzeyleri ve beslenme skorları BÜ olmayanlara göre anlamlı şekilde daha düşüktür ve hareket edebilme açısından da daha yetersizdir. **Sonuç:** Hareketlilik durumu, serum albumin düzeyi ve beslenme durumları evde sağlık hastaları arasında BÜ'nün oluşmasına etki etmektedir. Tüm yaşlı ve yatağa bağımlı hastalarda BÜ gelişmemiş olduğu gerçeği, yeterli protein alımının, bunun oluşmasını engellediğini veya geciktirdiğini düşündürmektedir.

Anahtar Kelimeler: Bası ülser; malnütrisyon; yaşlı; immobilizasyon; evde bakım hizmetleri

Pressure ulcers (PUs) remain a common health problem, particularly among physically limited or bedridden elderly patients. The problem exists within the entire health framework and reduces the patient's quality of life.[1] Moreover, it can be life-threatening. For many elderly patients, PUs may become chronic

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Peer review under responsibility of Turkiye Klinikleri Journal of Health Sciences.

Received: 04 Nov 2022 ***Received in revised form:*** 17 Jun 2023 ***Accepted:*** 31 Jul 2023 ***Available online:*** 21 Sep 2023

for no apparent reason and remain for prolonged periods, even life-long.[1,2]

A PU is "localized damage to the skin and underlying soft tissue usually over a bony prominence as a result of intense or prolonged pressure".[3] The most common locations in adults are the bony prominences of the sacral and hip regions, although the lower extremities are affected in up to 25% of cases.[4]

It has been hypothesized that external pressure impairs the blood flow and results in local tissue hypoxia. In addition, sustained external pressure above a threshold causes prolonged ischemia and facilitates necrosis. Reperfusion injury has also been proposed as a source of tissue damage leading to PUs. Reperfusion of ischemic tissue may cause increased formation of reactive oxygen species and trigger an inflammatory response. The risk of tissue damage is initially most significant in muscle, followed by subcutaneous tissue and skin. Thus, at the point when skin ulceration is observed, extensive deep tissue injury is likely to have already occurred.[4] It was reported that factors such as aging, malnutrition, chronic diseases, immobility, incontinence, immunosuppression, and impaired cognition increase the risk of Pus.[1,4-6] Notably, 70% of PUs occur in people aged over 70. Age-related skin changes are indicated by flattening in the dermo-epithelial junction and slow turnover of skin cells, loss of elasticity, thinning of subcutaneous layers, and reduction of overall muscle mass (i.e., sarcopenia), and decreased intradermal vascular perfusion and oxygenation.[1,7] In addition, medications used to treat chronic diseases may have adverse effects such as bladder dysfunction, reduced blood pressure, rigidity, sedation, confusion, drowsiness, and constipation and thus amplify the risk of Pus.[1,5,7]

As in the rest of the world, the life expectancy of people in our country is getting longer and the elderly population is increasing.[8] According to the World Health Organization data, the number of people over the age of 60 is 1 billion in 2019. This number is expected to increase to 1.4 billion in 2030 and to 2.1 billion in 2050.[9] It is reported that fragility rates and related risks of falls, fractures, disability and hospitalization increase in aging people.[10-12] PUs continue to be the subject of research, with the addition of malnutrition to various chronic diseases and physical disabilities in these people.[13,14] Because, although the risk factors are well known, it is not always possible to put these known ones into daily practice in the field of application, in home health or palliative care services, in secondary and tertiary health institutions, and to get positive results.

"Home Health Service" units, which started to serve in our country in 2015, are becoming more widespread and are rapidly advancing towards becoming more effective and high quality.

Correct diagnosis and treatment of preventable and correctable problems such as malnutrition and/or vitamin and mineral deficiencies and prevention of PUs are extremely important in terms of both increasing the quality of life of patients and contributing to the country's economy. In this study, we aimed to contribute to this important issue, to share our experience with our patient group and to determine the nutrition related risk factors leading to PU in patients receiving home health care. We also sought the answer to the question of why PU did not occur in all physically disabled or bedridden patients.

MATERIAL AND METHODS

This study was approved by the Local Ethical Review Committee of University of Health Sciences Dışkapı Yıldırım Beyazıt Training and Research hospital (date: January 7, 2019; no: 58/15). This study was designed and conducted in accordance with the principles stated by the Declaration of Helsinki of 1975, as revised in 2013. After taking approval from the same hospital's local data of these patients were retrospectively reviewed.

In this retrospective cohort study, the medical records of 600 patients who were followed up for the first time in the Home Health Care Unit of University of Health Sciences Dışkapı Yıldırım Beyazıt Training and Research Hospital between January 1, 2016 and December 31, 2017 were reviewed. Those who did not have a PU during this time were re-assessed after 2 years in 2019. These patients were phoned and asked whether they could walk, had chronic diseases, urinary incontinence, and developed

a PU. Also, the mini-nutritional assessment-short form (MNA-SF) was applied to evaluate nutritional status and to diagnose malnutrition. Of the 600 patients, 203 patients died as of 2019, 3 patients were excluded from the study because of data loss and 31 patients were excluded from the study due to PUs as of the date of follow-up. There were 80 patients who were excluded from the study due to unreachable or change of address or follow-up in different hospitals. Of the remaining 283 patients, 50 were excluded from the study because no current blood test results for 2019 were available and 4 patients were under 18 years of age. As a result of the data cleaning, 229 patient's data were included in the study. Initial (in 2016 or 2017) and last laboratory values (in 2019) and nutritional status of patients diagnosed with PUs (n=22) during the three years follow-up period were compared with those who did not have PUs (n=207).

THE EVALUATION OF NUTRITIONAL STATUS

Mini Nutritional Assessment was performed to diagnose or exclude malnutrition using the MNA-SF in our follow up period.[15] Those with a test score of ≤17 were considered to be malnourished, those with a test score between 17 and 24 were at risk, and ≥24 were considered normal.

Recorded hemoglobin (Hb), fasting blood glucose, and serum albumin levels were extracted from medical records. Diagnosis of anemia was based on the World Health Organization definition based on Hb values (Hb<12 mg/dL for women, Hb<13 mg/dL for men).[16] In addition, their PUs was staged according to the Revised National Pressure Ulcer Advisory Panel Pressure Injury Staging System.[17]

STATISTICAL ANALYSIS

All statistical analyses were performed using IBM SPSS Statistics 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) First, the conformity of the data to a normal distribution for age was examined with the Shapiro-Wilks 4 test. Next, the median (minimum-maximum) and number (percentage) were given for age and categorical variables, respectively. Subsequently, differences in variables predicted as risk factors in groups with and without PU were evaluated with the Pearson chi-square, continuity corrected chi-square, and Fisher's exact chi-square tests. The multiple logistic regression model (Forward: LR method) was used for the variables predicted to impact PU development. In each step, the entry probability was taken as 0.05 and the removal probability as 0.1. The odds ratio (OR) and 95% confidence intervals (CI) obtained from the model were given. A value of $p<0.05$ was considered statistically significant.

RESULTS

A total of 229 patients were included in this study. The median patient age was 78 years (range: 19-96 years). The descriptive data of the patients according to groups are displayed in Table 1.

PU stages of those 22 patients were Stage 1 in 68.2% (n=15), Stage 2 in 27.3% (n=6), and Stage 3 in 4.5% (n=1). The 2 groups did not differ regarding the rates of anemia based on the Hb levels (p=0.668). Anemia was present in 40.9% (n=9) of patients with PU and 33.8% (n=70) of those without PU. Serum albumin level was low in 50% of patients with PU and 21.3% of those without PU. The comparison of these 2 groups concerning albumin values revealed that the patients with PU had a significantly lower serum albumin level than those without PU. On the other hand, serum glucose levels were similar between the 2 groups. 69.9% of the patients had systemic comorbidities. Among the patients with at least one comorbidity, 65% had 1, 32% had 2, and 2.5% had 3 systemic comorbidities.

The results of univariate and multiple logistic regression analysis on the predicted variables affecting PU development are given in Table 2.

When the other variables were omitted, the effect of mobility, serum albumin level, and malnutrition variables was statistically significant on PU development ($p<0.05$). As a result of multiple logistic regression analyses performed with the clinical variables predicted to be effective, the model with mobility, albumin, and malnutrition variables was found to be significant. When the albumin and malnutrition variables in the model were kept constant, the rate of PU was 2,91 times higher in patients who are "completely bedridden" than those who can

TABLE 1: Comparison of clinical and laboratory characteristics of study groups.

	Pressure ulcer		
Variables	**No (n=207)**	**Yes (n=22)**	**p value**
Age (years±SD)	72.28±16.33	76.86±14.35	0.172
Gender (men/women)	70/137	9/13	0.328
Initial physical competence			
To be able to move with help	156 (75.4%)	16 (72.7%)	0.765
Completely immobile	51 (24.6%)	6 (27.3%)	
Last physical competence			
To be able to move with help	150 (72.5%)	9 (40.0%)	**0.002**
Completely immobile	57 (27.5%)	13 (59.1%)	
Initial malnutrition score			
No malnutrition (≥24)	150 (72.5%)	15 (68.2%)	0.229
At risk (18-23)	26 (12.6%)	1 (4.5%)	
Malnourished (≤17)	31 (14.9%)	6 (27.3%)	
Last malnutrition score			
No malnutrition (≥24)	163 (78.7%)	10 (45.5%)	**<0.001**
At risk (18-23)	24 (11.6%)	3 (13.6%)	
Malnourished (≤17)	20 (9.7%)	9 (40.9%)	
Initial hemoglobin (g/dL)	12.65±1.83	12.43±1.89	0.612
Last hemoglobin (g/dL)	12.63±1.99	12.75±1.88	0.787
Initial albumin (g/dL)	3.77±0.42	3.70±0.42	0.459
Last albumin (g/dL)	3.78±0.39	3.41±0.51	**0.000**
Initial fasting blood glucose (mg/dL)	122.81±70.60	111.72±42.86	0.39
Last fasting blood glucose (mg/dL)	119.75±57.72	119.64±43.6	0.991

SD: Standard deviation.

TABLE 2: Multiple logistic regression analysis results of variables predicted to have an impact on pressure ulcer* (n=229).

	Univariate		Multiple logistic regression*				
	OR (95% CI						For OR 95% CI
Variable	**Lower limit, upper limit)**	**p value**	**Coefficient β (SE)**	**Wald**	**p value**	**OR**	**Lower limit, upper limit**
Age (19-65/>65)	1.63 (0.53-5.02)	0.392					
Gender (F/M)	1.36 (0.55-3.32)	0.668					
Physical competence	3.80 (1.54-9.38)	**0.002**	1.07 (0.49)	4.808	**0.028**	2.91	1.12-7.58
Albumin	3.71 (1.51-9.11)	**0.003**	1.12 (0.49)	5.281	**0.022**	3.07	1.18-7.97
Nutritional status	6.47 (2.46-17.02)	**<0.001**	1.55 (0.52)	8.878	**0.004**	4.73	1.70-13.14

*Forward: Likelihood ratio method was used. /-2loglikelihood: 121.63, Hosmer and Lemeshow p=0.550, sensitivity: 9.1%, accuracy: 89.5% OR: Odds ratio; CI: Confidence interval; SE: Standard error.

"move with help" (OR=2.91, 95% CI=1.12-7.58; p=0.028). Similarly, when mobility status and albumin variables were kept constant, the risk of PU was 4,73 times higher in patients with malnutrition than in non-malnourished patients.

The same steps were taken for 70 patients who were bedridden in 2019. The results of univariate logistic regression analyses over other variables that are predicted to affect the development of PU in these patients are displayed in Table 3.

This analysis revealed that the effect of albumin was significant (p=0.038). Also, in the multiple logistic regression analysis performed in 2019 with variables predicted to have an impact on the devel-

TABLE 3: Univariate logistic regression analysis results of variables predicted to have an impact on pressure ulcer formation in bedridden patients in 2019* (n=70).

	Univariate	
Variable	OR (95% CI lower-upper limit)	p value
Age (19-65/>65)	3.46 (0.70-17.09)	0.112
Gender (F/M)	0.48 (0.12-1.93)	0.292
Hemoglobin	1.92 (0.54-6.83)	0.309
Albumin	3.58 (1.03-12.46)	**0.038**
Nutritional status	2.94 (0.79-10.88)	0.097

*OR: Odds ratio, CI: Confidence interval, , β (SE): Coefficient (Standard error).

opment of PU in bedridden patients, the effect of only albumin variables was significant [p=0.038, OR (%95 CI): 3.58 (1.03; 12.46)].

DISCUSSION

Our study found that the incidence of PU was 9.6% in homecare patients. It was previously reported that the rate of PU varied between 1.3% and 12.8% in acute and long-term care environments (community-acquired pressure injuries).[18] A study evaluating 19,363 patients hospitalized in intensive care units in Spain reported that the PU rate ranged from 3% to 39%.[5] The prevalence of PUs in hospitalized patients in the United States has been estimated to range from 5% to 15% but may be significantly higher in intensive care units and specific long-term care settings.[4] Corbett et al. worked on the present-on-admission pressure injuries in community-dwelling adults admitted to acute care and noted that the rate of PU was 7.4%.[19] Bauer et al. reported that PU occurred in up to 23% of patients in long-term and rehabilitation facilities, and its incidence ranged between 10% and 41% in intensive care unit patients in the United States.[7] In a systematic review of 1,037 articles in the United Kingdom, the overall prevalence and incidence of PU in patients receiving palliative care were calculated as 12.4% and 11.7%, respectively.[20] The rate of PU we found in our study was similar to the rates reported by other centers.[4,5,7,18-20] In our study, 74% (n=170) of our patients were over 65, and the median age of the 22 patients with PU was 79.5 years. It was reported in various studies that the risk of PU increased with aging due to reasons such as reduced activity or mobility, diminished tissue tolerance, pain perception, or an increased rate of comorbidities.[1,5,7,18,20]

Malnutrition is one of the most critical risk factors for PU development.[7] Our study found that the patients with PU were significantly malnourished, and serum albumin levels were also significantly low. As shown in a pilot retrospective cohort study, additional nutrition-related risk factors associated with increased risk of PU include low body mass index, reduced food intake, and impaired ability to eat independently.[7] Adequate nutrition may reverse the underfed state unless an underlying wasting disease is present and reduce the risk of PU as per several cross-sectional and prospective observational studies.[21-23] Another study stated that nutritional deprivation and insufficient dietary intake were the critical risk factors for PU and impaired wound healing.[24] The adverse effects of malnutrition include organ dysfunction, compromised collagen synthesis that reduces the stretchability of skin, weakness of the immune system, decreased activity of antioxidant mechanisms leading to accumulation of free radicals, and increased risk of infection. It is also known that the high rate of several systemic chronic illnesses contributes to the risk of PU in elderly patients.[25,26] Our findings were compatible with those previous reports. In our study, 69.9% of the patients had systemic comorbidities. The common age-related chronic diseases such as cardiovascular disease, diabetes mellitus, pulmonary, renal, musculoskeletal, and neurodegenerative diseases and complicating factors can facilitate the development of PU in community settings, hospitals, and nursing facilities.[27] Ding et al. reported that diabetes mellitus was significantly associated with PU.[28] According to the previously published data, immobility is the most significant risk factor for PU.[1,2,4-7,18-24,27-30] In our study, 59% of the patients with PU were bedridden. Our comparative analysis between the patients who developed PUs with those who did not have PUs revealed that the only significant difference was detected in the ambulatory skills. The ambulatory capacity of 46.2% of our patients with PU remained unchanged for 2 years; the status of those who could move with help did not change, and there was no change in those who were utterly bedridden. How-

ever, 53.8% (n=13) of the patients with PU were able to move with help in 2017, but they became utterly bedridden in 2019. These results are the consistent with the suggestion that immobility is the most crucial risk factor for PU. Notably, while 57 of the 229 patients were utterly bedridden in 2017, 70 were bedridden in 2019, and only 13 of these 70 patients developed PUs. This finding suggests that immobilization is not a risk factor alone. Since serum albumin levels were statistically significantly lower in patients with PU than in those without PU, it can be suggested that serum albumin level could be viewed as a biomarker or risk factor for development of PU. This finding also aligns with the literature.[1,5,7,19-30]

Home care patients at risk of or with malnutrition as well as patients with PU should be referred to a registered dietitian nutritionist to conduct an in-depth nutrition assessment. Once the patient's nutrition diagnosis has been identified, an individualized care plan should be developed and communicated to all members of the interprofessional team.[31] *The 2019 Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline* provides specific and general nutrition recommendations.[3]

The strength of this study is that only 22 of 70 completely bedridden patients developed PUs within 2 to 3 years, and malnutrition and albumin deficiency were identified as the cause of this. So being malnourished is more risky than being bedridden. The second important point we should emphasize is that this is a problem that can be easily and mostly corrected (unless there is an underlying malignancy or another devastating co-morbidity). The present study has some important limitations. First, the number of patients was limited because the "Home Care Service Unit" where registered patients were followed up, was transferred to another hospital at the beginning of 2020. The data analysis in this study was affected by the fact that one third of the patients had died during the study period. Employee and environmental or administrative factors were not examined in this study; the authors focused on patient-related factors. Additional prospective and larger scale studies examining all factors that may affect PU healing, as well their relationships to each other are needed.

CONCLUSION

This study showed that PU was a common problem in which multiple risk factors play a role. Although a combination of immobility, malnutrition, decreased serum albumin levels, old age, and the presence of more than one chronic disease increase the risk of PU, it is not always possible to establish a direct cause-effect relationship. The fact that all elderly bedridden patients did not develop PUs suggests that adequate protein intake can prevent or delay their development. Health professionals working in home healthcare units or palliative care clinics should be aware of the risk of PU, particularly in immobile and malnourished patients with advanced age. It is thought that it would be very beneficial to include a dietitian in the team that visits and evaluates patients in units providing home healthcare services, and to monitor patients' nutritional deficiencies more closely.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Canan Emiroğlu, Süleyman Görpelioğlu, Pervin Demir, Cenk Aypak;* ***Design:*** *Canan Emiroğlu, Süleyman Görpelioğlu, Pervin Demir, Cenk Aypak;* ***Control/Supervision:*** *Canan Emiroğlu, Süleyman Görpelioğlu, Pervin Demir, Cenk Aypak;* ***Data Collection and/or Processing:*** *Canan Emiroğlu, Süleyman Görpelioğlu, Cenk Aypak;* ***Analysis and/or Interpretation:*** *Canan Emiroğlu, Süleyman Görpelioğlu, Pervin Demir, Cenk Aypak;* ***Literature Review:*** *Canan Emiroğlu, Süleyman Görpelioğlu, Cenk Aypak;* ***Writing the Article:*** *Canan Emiroğlu, Süleyman Görpelioğlu, Pervin Demir, Cenk Aypak;* ***Critical Review:*** *Canan Emiroğlu, Süleyman Görpelioğlu, Pervin Demir, Cenk Aypak;* ***References and Fundings:*** *Canan Emiroğlu, Süleyman Görpelioğlu, Pervin Demir, Cenk Aypak;* ***Materials:*** *Canan Emiroğlu, Süleyman Görpelioğlu, Pervin Demir, Cenk Aypak;*

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