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Development and progression of pressure ulcers in relation to the nutritional status of hospitalised overweight and obese patients older than 65 years: A longitudinal study

Rozwój i postęp odleżyn w zależności od stanu odżywienia hospitalizowanych pacjentów z nadwagą i otyłością w wieku powyżej 65 lat: badanie podłużne

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STRESZCZENIE

ROZWÓJ I POSTĘP ODLEŻYN W ZALEŻNOŚCI OD STANU ODŻYWIENIA HOSPITALIZOWANYCH PACJENTÓW Z NADWAGĄ I OTYŁOŚCIĄ W WIEKU POWYŻEJ 65 LAT: BADANIE PODŁUŻNE

Cel pracy. Badanie koncentruje się na związku między rozwojem odleżyn a wybranymi czynnikami ryzyka u pacjentów z nadwagą lub otyłością w wieku ≥ 65 lat.

Materiał i metody. W badaniu podłużnym uczestniczyło 102 pacjentów (59 mężczyzn, 43 kobiety; średni wiek 78,43±7,3 lat). Monitorowanie odbywało się przy przyjęciu do szpitala, przy wypisie oraz 5±1 tygodnia po zakończeniu hospitalizacji i obejmowało pomiar wskaźników somatometrycznych oraz zmiennych kliniczno-żywieniowych.

Wyniki. Częstość występowania odleżyn wynosiła od 31,37% do 43,13%, najczęściej rejestrowano odleżyny II stopnia w okolicy kości krzyżowej. Wiek i wskaźnik odżywienia okazały się najistotniejszymi predyktorami rozwoju odleżyn. Pozostałe czynniki w różnych fazach wykazywały pewne korelacje, lecz ich znaczenie było niejednolite. Skala Bradena okazała się narzędziem o wysokiej czułości.

Wnioski. Rozwój odleżyn u tych pacjentów warunkowany jest przez wiele czynników. Wyższy wiek, wskaźnik odżywienia oraz niski wynik w skali Bradena okazały się kluczowymi wskaźnikami. Wyniki badania mogą pomóc personelowi medycznemu we wczesnym identyfikowaniu pacjentów zagrożonych i przyczynić się do zmniejszenia częstości występowania odleżyn.

Słowa kluczowe: odleżyny, czynniki ryzyka, stan odżywienia, osoby starsze, otyłość

ABSTRACT

DEVELOPMENT AND PROGRESSION OF PRESSURE ULCERS IN RELATION TO THE NUTRITIONAL STATUS OF HOSPITALISED OVERWEIGHT AND OBESE PATIENTS OLDER THAN 65 YEARS: A LONGITUDINAL STUDY

Aim. The present study focuses on the connection between the development of pressure ulcers (PU) and selected risk factors in overweight or obese patients aged ≥ 65 years.

Material and methods. A longitudinal study included 102 patients (59 males, 43 females; mean age 78.43±7.3 years). The monitoring occurred at admission, discharge, and 5±1 weeks post-hospitalisation and included the measurement of somatometric indicators and clinical-nutritional variables.

Results. The prevalence of pressure ulcers ranged between 31.37% and 43.13%, and Stage 2 pressure ulcers in the area of the sacrum were recorded most frequently. Age and nutritional score have proved to be the most significant predictors of pressure ulcer development. The other factors analysed between the phases indicated some correlations but their significance has proved to be inconsistent. The Braden score has proved to be a highly sensitive tool.

Conclusions. The development of pressure ulcers in these patients is conditioned by multiple factors. Older age, the nutritional score and a low score of the Braden scale have proved to be the key indicators. The study results may help medical staff in identifying at-risk patients in a timely manner and contribute to reducing the prevalence of pressure ulcers.

Key words: pressure ulcers, risk factors, nutritional status, elderly, obesity

INTRODUCTION

Pressure ulcers (PU) are localised damage to the skin and underlying tissue that develops mainly in areas over bony prominences. In spite of preventive measures, education of medical staff and technological advancement, PU remain a significant global problem [1]. They are a serious complication that negatively affects the quality of patients' life, extends the length of hospitalisation and increases the economic burden on medical facilities [2]. The prevention of PU involves the timely identification of at-risk groups and the use of scoring tools, with the Braden scale being the most frequently used [3]. The prevention also involves systematic assessment of the skin condition and nutritional screening. The latter makes it possible to identify malnutrition and commence timely intervention [4]. Malnutrition represents a frequent clinical complication in senior patients that is connected with a loss of muscle mass and a decrease in muscle strength (sarcopenia). Moreover, the ageing process is characterised by a loss of collagen and the thinning of individual skin layers, which increases the risk of PU development [5]. The risk of malnutrition is not limited only to patients with a low body mass index (BMI), but it also afflicts obese individuals, in the case of whom diagnosing malnutrition is more complicated [6]. Nutritional screening involves the examination of the basic somatometric parameters, which include mid-arm circumference (MAC) [7] and the triceps skin fold (TSF) [8], complemented by a laboratory examination and the use of standardised assessment tools [9]. In view of differing conclusions of studies conducted to date regarding the impact of malnutrition on pressure ulcer development, this longitudinal survey was conducted [5,10-12].

AIM

The aim of the study was to analyse and evaluate the connection between PU development, progression and selected risk factors in overweight or obese patients aged 65 years and older at the beginning and at the end of hospitalisation in an internal department and thereafter in aftercare beds.

MATERIALS AND METHODS

Study design and setting: The study was designed as a quantitative longitudinal survey conducted according to the recommendations of The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) [13] and in the period from 5 January to 6 June 2025 in an internal department and in aftercare beds in a hospital in the Czech Republic. The longitudinal monitoring included three phases: initial measurement on admission, exit measurement of termination of hospitalisation (minimum of 5, maximum of 9 days; M = 6.71, SD = 1.13) and a check measurement in aftercare beds after 5±1 weeks.

Participants: A total of 102 patients (59 males, 43 females) meeting the set criteria: age ≥ 65 years, BMI ≥ 25 kg/m^2, and signing an informed consent were included in the study. Of the approximately 950 hospitalised patients, more than 350 persons were identified as overweight or obese, 102 of whom met the criteria for inclusion in the study.

Anthropometric measurements: All measurements were performed by a single author to minimise potential measurement bias. The initial, exit and check measurements were done according to methods of standardised anthropometry and included the determination of body height using an A226 anthropometer, body weight using an InBody 120 scale, skin fold thickness (triceps, biceps, subscapular) measured with a BEST II K-501 calliper and mid-arm circumference with a tape measure [14]. Based on these data, the BMI and percentage representation of body fat were calculated [15].

Pressure ulcers assessment: The assessment also included the skin condition and an assessment of the risk of pressure ulcer development by means of the Braden scale [3]. In the European context, the Braden scale shows a consistently good inherent reliability, with the value of Cronbach's alpha ranging from 0.72 to 0.84 [16], which confirms its suitability for clinical practice in the Czech Republic. PU detected were classified based on the International Pressure Ulcer Classification System [1].

Nutritional assessment: The nutritional state was assessed by means of a Nottingham Screening Questionnaire, with a score of 3–4 points indicating a risk of malnutrition [17]. Furthermore, laboratory determination of the serum level of albumin was conducted with a reference range of 37–52 g/l. Albumin serves not only for indicative determination of malnutrition, but it is also used to calculate the Nutritional Risk Index (NRI), with a value of < 83.5 signalling severe malnutrition [18].

Ethical considerations: The study was approved by the Ethics Committee of the Faculty of Health Sciences of Palacký University in Olomouc (UPOL – 3312/1030S-2024), and it took place in accordance with the Helsinki Declaration [19].

Statistical analysis

The basic descriptive statistics were calculated separately for individual genders and phases of measurement. The normality of the data was verified through the Shapiro-Wilk test. Differences in mean values of somatometric and nutritional parameters were analysed by means of a repeated-measures ANOVA with a follow-up post-hoc Scheffe's test and a t-test for independent samples. Non-parametric tests – Cochran's Q test and a chi-squared test with Bonferroni correction were used to compare changes in the number of patients between the phases of measurement. Binary logistic regression using the Enter method was applied to identify independent predictors of pressure ulcer development. Statistical significance was determined at the level of $p < 0.05$ and $p < 0.01$. The analyses were conducted in the STATISTICA Cz 14 program.

RESULTS

The study involved 59 males (57.84%) and 43 females (42.16%). The average age of the males was 76.24 years (SD = 7.37), and 80.61 years (SD = 7.23) of the females.

■ Tab. 1. Longitudinal changes in selected somatometric and clinical-nutritional predictors in patients (n = 102)

Predictor	Phase 1	Phase 2	Phase 3
Body height (cm)	**M (SD)**	**M (SD)**	**M (SD)**
Males	172.94 (7.86) n.s.	173.13 (7.78) n.s.	173.13 (7.78) n.s.
Females	160.73 (6.58) n.s.	160.80 (6.61) n.s.	160.76 (6.60) n.s.
Weight (kg)			
Males	96.33 (19.03) n.s.	96.74 (19.05) n.s.	97.03 (17.64) n.s.
Females	82.09 (14.52) n.s.	82.33 (14.51) n.s.	83.29 (14.18)*
BMI (kg/m²)			
Males	32.16 (5.73) n.s.	32.21 (5.67) n.s.	32.33 (5.25) n.s.
Females	31.74 (5.22) n.s.	31.80 (5.20) n.s.	32.21 (5.14)*
MAC (cm)			
Males	28.46 (5.53) n.s.	28.44 (5.51) n.s.	28.45 (5.47) n.s.
Females	27.90 (4.56) n.s.	27.88 (4.63) n.s.	27.85 (4.60) n.s.
TSF (mm)			
Males	27.00 (10.50) n.s.	27.20 (10.70) n.s.	27.80 (9.50) n.s.
Females	28.70 (8.20) n.s.	28.90 (8.10) n.s.	28.80 (7.90) n.s.
Body fat (%)			
Males	33.52 (7.31) n.s.	34.47 (8.59) n.s.	34.04 (6.54) n.s.
Females	35.45 (6.31) n.s.	35.61 (6.45) n.s.	35.04 (6.34) n.s.
Braden score			
Males	13.44 (4.47)*	14.27 (5.06) n.s.	13.85 (4.81) n.s.
Females	12.91 (4.23)*	13.53 (4.75) n.s.	12.84 (4.45) n.s.
Nutritional score			
Males	2.49 (1.52) n.s.	2.68 (1.85) n.s.	2.83 (1.77) n.s.
Females	2.91 (2.11) n.s.	3.09 (2.33) n.s.	3.26 (2.09) n.s.
NRI			
Males	111.40 (14.72) n.s.	110.55 (16.57)*	116.84 (16.19)**
Females	109.79 (14.80)*	107.77 (13.72)**	114.67 (13.40)**
Albumin (g/l)			
Males	35.35 (6.70) n.s.	34.71 (8.95)*	38.68 (9.23)**
Females	32.76 (6.38)*	31.34 (5.61)*	35.40 (6.30)**

M – mean, SD – standard deviation, BMI – body mass index, MAC – mid-arm circumference, TSF – triceps skin fold, NRI – nutritional risk index, * – statistically significant ($p < 0.05$), ** – statistically significant ($p < 0.01$), n.s. – statistically not significant

The analysis of somatometric indicators has shown that body height was stable for both genders in all the phases. The body weight of the males manifested a slight increase, which was not statistically significant, whereas with respect to females the differences between the phases were relatively small; nevertheless, the analysis confirmed a significant difference in phase 3 ($p = 0.038$).

The BMI of the males remained stable, but in the case of females a slight increase was observed in phase 3, with the change being statistically significant. The values of the percentage of body fat, MAC and TSF did not change significantly between the phases with respect to both genders (Table 1). In the field of clinical-nutritional predictors, the Braden score was the lowest in phase 1 for both genders and differences compared to the other phases were statistically significant. Nevertheless, the patients remained at medium to high risk of pressure ulcer development throughout the period monitored. The albumin level and the related NRI showed statistically significant changes during the monitoring, except phase 1 in the case of males. Changes in the nutritional score were not statistically significant. The nutritional score and albumin level indicated a risk of malnutrition, whereas NRI indicated a good state of nutrition. In comparison of the individual predictors between the genders during all the three phases, a statistically significant difference in favour of males was found in body height and weight ($p < 0.001$) and in the albumin level ($p = 0.019$) compared to the group of females.

The study participants were divided into two groups (with a PU and without PU) irrespective of their gender, which made it possible to analyse the differences in selected variables. Overall, the PU prevalence ranged from 31.37% to 43.13%. A Stage 2 pressure ulcer was the most frequent (45.23%), with predominance in the area of the sacrum (38.64%) and heels (22.73%). The group with pressure ulcers manifested a higher risk according to the Braden scale, an inferior nutritional state and lower BMI levels. Nevertheless, both groups fell within the obesity

■ Tab. 2. Comparison of the parameters monitored in patients in the group with pressure ulcers and in the group without pressure ulcers in the individual phases of the measurement (n = 102)

	Phase 1		Phase 2		Phase 3	
Variables	**PU (n = 32)**	**WPU (n = 70)**	**PU (n = 44)**	**WPU (n = 58)**	**PU (n = 42)**	**WPU (n = 60)**
Gender	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Males	15 (46.88) n.s.	44 (62.86) n.s.	24 (54.55) n.s.	35 (60.34) n.s.	13 (30.95) n.s.	47 (78.33) n.s.
Females	17 (53.13) n.s.	26 (37.14) n.s.	20 (45.45) n.s.	23 (39.66) n.s.	29 (69.05) n.s.	13 (21.67) n.s.
	M (SD)	**M (SD)**	**M (SD)**	**M (SD)**	**M (SD)**	**M (SD)**
Braden score	10.00 (2.56)**	14.69 (4.24)**	10.32 (2.51)**	16.72 (4.53)**	9.71 (2.39)**	16.02 (4.11)**
Nutritional score	3.44 (1.98)*	2.31 (1.60)*	4.02 (2.03)**	2.97 (1.62)**	4.26 (1.77)**	2.13 (1.52)**
BMI (kg/m²)	31.16 (4.23) n.s.	32.36 (5.99) n.s.	30.39 (3.86) n.s.	32.79 (5.92) n.s.	31.18 (4.28) n.s.	33.05 (5.60) n.s.
Albumin (g/l)	33.02 (6.03) n.s.	34.82 (6.89) n.s.	31.64 (9.17) n.s.	34.53 (6.51) n.s.	35.74 (8.33) n.s.	38.39 (8.03) n.s.
NRI	107.76 (12.51) n.s.	112.07 (15.52) n.s.	104.94 (16.18)*	112.76 (13.92)*	111.70 (13.97) n.s.	118.90 (15.11) n.s.
MAC (cm)	26.73 (5.00)*	28.91 (5.07)*	26.94 (4.52)*	29.17 (5.30)*	27.49 (4.79) n.s.	28.70 (5.41) n.s.
TSF (mm)	27.80 (10.40) n.s.	27.70 (9.30) n.s.	27.30 (9.80) n.s.	28.40 (9.60) n.s.	27.50 (9.60) n.s.	28.70 (8.20) n.s.
Body fat (%)	32.89 (6.50) n.s.	34.99 (6.98) n.s.	33.83 (6.93) n.s.	35.46 (7.21) n.s.	33.49 (6.36) n.s.	35.11 (6.47) n.s.

PU – pressure ulcers, WPU – without pressure ulcers, N (%) – absolute count and relative frequency in per cent, M – mean, SD – standard deviation, BMI – body mass index, MAC – mid-arm circumference, TSF – triceps skin fold, NRI – nutritional risk index, * - statistically significant ($p < 0.05$), ** - statistically significant ($p < 0.01$), n.s. – statistically not significant

Tab. 3. Results of logistic regression between pressure ulcer development and selected independent predictors in the study patients (n = 102)

Predictor	Phase 1			Phase 2			Phase 3		
	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI
Age (years)	0.009**	1.069	(1.017; 1.124)	0.462 n.s.	0.981	(0.933; 1.033)	0.007**	1.086	(1.023;1.546)
Gender	0.596 n.s.	1.230	(0.573; 2.638)	0.628 n.s.	0.949	(0.764; 1.177)	0.441 n.s.	0.980	(0.932; 1.032)
BMI (kg/m^2)	0.021*	0.366	(0.156; 0.857)	0.858 n.s.	1.073	(0.496; 2.320)	0.571 n.s.	1.271	(0.554; 2.918)
Nutritional score	0.016*	2.633	(1.195; 5.806)	0.001**	4.846	(2.241; 7.451)	0.001**	5.853	(2.713; 12.619)
Albumin (g/l)	0.121 n.s.	1.908	(0.842; 4.317)	0.445 n.s.	0.727	(0.320; 1.648)	0.059 n.s.	0.840	(0.698; 1.011)
NRI	0.979 n.s.	0.985	(0.320; 3.034)	0.978 n.s.	2.447	(1.065; 5.693)	0.032*	1.657	(0.478; 5.751)
MAC (cm)	0.011*	3.238	(1.305; 8.038)	0.064 n.s.	2.600	(0.946; 7.144)	0.377 n.s.	1.618	(0.556; 4.710)
TSF (mm)	0.128 n.s.	0.117	(0.007; 1.855)	0.380 n.s.	0.286	(0.018; 1.720)	0.847 n.s.	1.379	(0.054; 35.597)
Body fat (%)	0.090 n.s.	0.815	(0.643; 1.033)	0.065 n.s.	1.224	(0.987; 1.516)	0.293 n.s.	1.146	(0.894; 1.469)

BMI – body mass index, MAC – mid-arm circumference, TSF – triceps skin fold, NRI – nutritional risk index, p – value of statistical significance, OR – odds ratio, CI – confidence interval, * – statistically significant ($p < 0.05$), ** – statistically significant ($p < 0.01$), n.s. – statistically not significant

zone with a similar relative amount of body fat. Statistically significant differences were ascertained mainly in the Braden score, nutritional score and MAC, which corroborates a correlation of the risk of PU development with the patient's overall condition. With respect to the other monitored parameters, no statistically significant differences were found in the course of the three phases (Table 2).

The next phase of the assessment involved the identification of variables relating to PU development in the individual phases of measurement. The variable "Braden score" was not included in the assessment as no patient classified as free from the risk of PU had developed a pressure ulcer. The results of the logistic regression during the monitoring of the three phases show that the risk of PU development was statistically significantly connected with several selected predictors, with the nutritional score being the strongest and a very stable predictor in all the phases. It has been demonstrated that an inferior nutritional state increases the risk of pressure ulcers up to five times (phase 3: $p = 0.001$, OR = 5.853). Another significant predictor was the patients' age, which increased the risk of pressure ulcer development. In phase 1, the BMI appeared to be a significant protective factor against pressure ulcers, but in phases 2 and 3 its protective effect gradually decreased owing to the impact of other factors. The other monitored predictors manifested only certain correlations or were not entirely consistent and did not demonstrate a significant impact on pressure ulcer development (Table 3).

DISCUSSION

A higher prevalence of PU was registered in females in all the monitored phases (55.88%), but gender has not proved to be statistically significant. In contrast, the study [20] reported a higher occurrence of PU in males. Our analysis has identified age as a statistically significant predictor of pressure ulcer development in phases 1 and 3 of the measurement. This outcome corresponds to the findings in the studies, which consistently refer to age as a significant risk factor for PU development [11,20,21]. The heightened prevalence of PU in our sample, compared e.g. with patients from retirement homes, may be affected not only by the nature of the disease but also by factors of hospitalisation stress and change in the settings [21]. The most frequent location where pressure ulcers developed was the area of the sacrum (38.64%), which corresponds to the findings of the study, where this site was affected nearly in half the patients (49.1%) [10]. The second most frequent location was heels (22.73%), which is also confirmed by the study [10]. No case of more than two pressure ulcers per patient was recorded in our sample, which differs from the results presented in the study [10]. Stage 2 was the most frequent PU stage (45.23%), followed by Stage 1 (26.21%), which is in keeping with the results of the study [11]. The nutritional score has proved to be one of the strongest and most stable predictors of PU development in all the phases of measurement. The risk of malnutrition has been identified in 44.67% of the patients, while the studies mention a deteriorated nutrition in almost 50% of the patients, and another study states that malnutrition afflicts up to 30% of retirement home clients and 63% of them are at risk of developing it [10,21]. These findings underline the importance of regular nutritional screening and targeted interventions in the prevention of pressure ulcers. According to the data, an insufficient intake of nutrients and a low body weight not only increase the risk of PU but also adversely impact the healing process [5].

BMI has proved to be a statistically significant protective predictor of pressure ulcer development only in phase 1 of the measurement ($p = 0.021$). In the following phases, this effect gradually diminished as other predictors were included, which is in accordance with the results of the study, where no protective impact of individual patients' BMI was proved in BMI categories [20]. The analysis of other predictors has demonstrated the statistical significance of MAC in phase 1 and of NRI in phase 3 of measurement. The Braden score was markedly lower with respect to the patients with PU (10.01±2.49) compared to patients without pressure ulcers (15.81±4.29), which confirms its robustness as a tool to estimate the risk of PU development. The nutritional score was higher, indicating a greater risk in patients with pressure ulcers (3.91±1.93) compared to the patients without pressure ulcers (2.47±1.58). Similar results are presented in the study, where patients with a high risk of PU development

(10.84±1.34) also had a higher nutritional score (4±2.25) [12]. This phenomenon may reflect the fact that the patients with a higher risk were monitored more interventionally. The level of serum albumin in the patients with a pressure ulcer was lower (33.47±7.84 g/l) but without statistical significance. Statistical significance was not confirmed in the study, and paradoxically lower albumin levels were observed in patients without a pressure ulcer (by 2.1±0.2 g/l) [12].

CONCLUSIONS

This longitudinal study shows that older age and impaired nutritional status are the main risk factors for pressure ulcer development in hospitalised patients. In overweight or obese seniors, PU occurrence is influenced by a combination of somatometric and clinical-nutritional factors, with the Braden score proving to be the strongest predictor. Age and nutritional status remained significant risk factors across all measurement phases, while other factors showed only weak or phase-dependent effects. Patients with PU were older, had lower Braden scores and worse nutritional status compared to patients without PU.

These findings highlight that a comprehensive nutritional assessment is more clinically relevant than BMI alone, which is a less reliable long-term predictor of PU. The systematic use of the Braden scale combined with nutritional screening enables timely identification of at-risk patients and supports effective preventive measures. Targeted interventions, particularly early nutritional support and individualised nursing care, may improve care quality and reduce PU incidence in this vulnerable population.

Limitations of the study

The study has several limitations that need to be taken into account when interpreting the results. The research was conducted only in one hospital, which limits the possibility of generalisability of the conclusions to a broader population of seniors. The survey concentrated solely on overweight and obese patients, without the inclusion of other BMI categories, which limits the possibility of comparison across categories. However, it is necessary to take into consideration the fact that it was a longitudinal survey with high logistical demands. The study results and findings will continue to be used for further screening of the occurrence of pressure ulcers and for assessing the nutritional state of elderly patients and for supporting the development of more efficacious preventive strategies.

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