DOI: 10.5455/msm.2017.29.196-200
Received: 17 June 2017; Accepted: 10 September 2017

ORIGINAL PAPER

Mater Sociomed. 2017 Sep; 29(3): 196-200

Prevalence of Pressure Ulcer and Nutritional Factors Affecting Wound Closure Success in Thailand

Supakrit Auiwattanakul[1], Winai Ungpinitpong[2], Surakrant Yutthakasemsunt[3], Supawan Buranapin[4], Kaweesak Chittawatanarat[5]

[1]Department of Surgery, Institute of Medicine, Suranaree University of Technology, Thailand

[2]Department of Surgery, Surin Hospital, Suring Province, Thailand

[3]Department of Surgery, Khon Kaen Hospital, Khon Kaen Province, Thailand

[4]Department of Medicine, Faculty of Medicine, Chiang Mai University, Thailand

[4]Department of Surgery, Faculty of Medicine, Chiang Mai University, Thailand

Corresponding author: Kaweesak Chittawatanarat, MD, PhD. Department of Surgery, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand.. E-mail address: kchittaw@gmail.com. ORCID ID: http://orcid.org/0000-0002-0285-6596

ABSTRACT

Introduction: The authors aimed to estimate the prevalence of pressure ulcers and to explore the nutritional effects of the prognostic factors on successful pressure ulcer closure in a public tertiary care hospital in Thailand. **Patients and Methods:** The study was a retrospective cohort analysis of seven-year census (2008 - 2014) at Surin hospital in Thailand. There were 424 of total 240,826 patients aged over than 15 years admitted to surgery, orthopedics and medicine wards during the study period with documented pressure ulcers (ICD 10TM). We analyzed four hundred and ten patients after excluding 14 patients with non-pressure ulcers (due to burning/ diabetic/ ischemic neuropathic ulcers, and less than 24 hours of admission) and loss medical record. We selected independent factors from demographic data, nutritional factors, pressure ulcer characteristics, and management data. The outcome of interest was successful pressure ulcer closure. The analysis method was the semi-parametric Cox regression model and reported as Hazard Ratios (HR) with 95% confidence interval (95% CI). **Results:** The total hospital admission was 240,826 patients between 2008 - 2014. 410 patients were developing pressure ulcers, of these, 7% (28/410) success in ulcer closure, and 77% (314/410) failure in closure requiring for additional procedures (excisional debridement). The rest of patients (16%, 68/410) was non-operative care. The prevalence of pressure ulcers was 1.7 per 1,000 person-year. The multivariable model found that only the Nottingham Hospital Screening Tool (NS) score was a statistically significant nutritional variable, and additional subgroup analysis of two models of sepsis and spinal cord co-morbidities was also significant. Adjusted hazard ratios (HR) for NS score = 0.355 (95%CI: 0.187, 0.674), p=0.002), for sepsis = 0.312 (95%CI: 0.140, 0.695), p=0.004), and for spinal cord co-morbidity = 0.420 (95%CI: 0.184, 0.958), p=0.039). **Conclusions:** The annual prevalence was 1.7 per 1,000 persons. NS score was strongly associated with ulcer closure success.

Keywords: Nottingham Hospital Screening Tool (NS), pressure ulcers prevalence, pressure ulcer closure, nutritional factors.

1. INTRODUCTION

The prevalence of hospitalized pressure ulcers varied between 1.25% and 18.5%, but the majority of studies revealed more than ten percent (1-4). About 10.3-76.6% of these were acquired in the hospital, and 36.3% of the patients had pressure ulcers at more than one site (1).

The malnutrition was a common problem in hospitals and a predictor of pressure ulcers (5-7). Subsequently, many screening tools were developed for detection of undernutrition or malnutrition status, for example, Nottingham Hospital Screening Tool (NS) (8). A tertiary hospital in Thailand used NS for screening and classified inpatients according to their nutrition status. Then, they prioritized malnourished patients for an appropriate nutritional care plan. Since many studies revealed, that supplemental nutrition could promote pressure ulcer healing (7, 9, 10). Then, the patients with pressure ulcers need nutrition-status monitor; for example, NS score.

This study conducted in a tertiary hospital because there were a large mixed population and few studies held near Thai-Cambodian border. The people in this area had low average income compared to another part of the country (11). Also, the patients with pressure ulcers need long term care and multidisciplinary approaches.

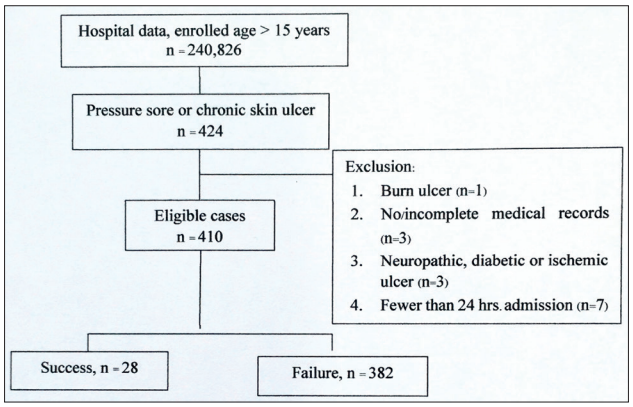

Figure 1. Data extraction (2008-2014)

2. AIM

Aim of study was to estimate the prevalence of pressure ulcers and the effects of nutritional factors on pressure ulcer closure.

3. PATIENTS AND METHODS

The retrospective study was conducted in a tertiary public hospital with 652 beds in the northeast region of Thailand. The hospital medical record census was reviewed for seven years (2008-2014) with subsequent data collection. Inclusion criteria were those patients over fifteen years, admission in the departments of Surgery, Orthopedics or Medicine. 424 patients had pressure ulcers (with ICD-10TM by codes or terms of "L-89 or (area, skin ulcer) or (necrosis (chronic) (skin)) or (sore (chronic) or ulcer (chronic))"). Concerning, missing medical charts (3), burn ulcers (1), neuropathic/diabetic (2) or ischemic ulcers (1) and admissions lasting fewer than twenty-four hours (7), these were exclusion. Finally, the eligible records for analysis were 410 patients. (Figure 1)

The study was retrospective cohort analytical design on the hospital database (see Study profile). The outcome of interest (dependent variable) was wound closure success. All cases had the standard wound care according to their nutritional and general status until they were fit to be discharged or referred to the community hospitals.

The independent variables were nutritional factors, basic characteristics of patients, and pressure ulcers. The nutritional factors were the duration of nutritional support, cumulative nothing per oral (NPO) days, cumulative caloric deficit, Nottingham Hospital Screening Tool (NS, see Appendix), and serum albumin. NS was the interesting variable in this study.

Patient baseline characteristic variables included age, gender, occupation, incontinence, sepsis, co-morbidities and Charlson Age-Comorbidity Index (CACI); additionally, microbial factors and chemistry variables comprised of a number of microbial resistant drugs, and hemoglobin. Moreover, the pressure ulcer variables incorporated the number, area, stage, and frequency of debridement of ulcers, and the Braden scale (Table 1). These variables were significant predictors for wound healing reported in many previous studies with operational definitions (12-14).

'Duration of nutritional support' was defined as the sum of the days during which patients had both an ordinary diet and an extraordinary diet by all feeding routes (oral (self-eat), enteral, parenteral).

'The cumulative caloric deficit' was reviewed from the medical record, for caloric balance. We calculated the formula as the sum of the daily caloric intake minus the predicted

Variables	Successful (n=28)	Non-successful (n=382)	P value
Age(years), median (IQR)	40(33, 49.5)	65(43, 79)	0.001
Male, n (male proportion, %)	22 (78.6)	226 (59.2)	0.046
Occupation, n (%)			0.002
Private	3 (37.5)	5 (62.5)	
Government officer	3 (25)	9 (75)	
Employee	4 (5.6)	68 (94.4)	
Farmers	13 (7.8)	154 (92.2)	
No income	5 (3.4)	142 (96.6)	
Primary diseases, n (%)			
Cardiovascular system	1(1.5)	65(98.5)	0.064
Respiratory system	1(4.4)	22(95.6)	1.000
Nervous system	1 (0.8)	123 (99.2)	0.001
Diabetes Mellitus	2 (4.3)	44 (95.7)	0.756
Spinal cord	19 (15.0)	108 (85)	0.001
Liver cirrhosis	1 (33.3)	2 (66.7)	0.192
Renal disorders	1(9.1)	10(90.9)	0.545
Orthopedics	1 (7.7)	12 (92.3)	0.607
Charlson Age-Comorbidity Index, median (IQR)[a]	2 (2, 3.5)	4(2, 5)	0.006
BMI (kg/m^2), median (IQR)	19.6(18.7, 20.9)	19(17.6, 20.8)	0.152
Braden score, median (IQR)	15(14, 16)	13(11, 15)	0.001
Number of pressure ulcers, median (IQR)	1 (1, 2)	1 (1, 2)	0.055
Maximum stage of pressure ulcers, median (IQR)	3 (3, 4)	3(3, 4)	0.887
Area of pressure ulcer (cm^2), median (IQR)	39.0(17.3, 78.5)	50.2(28.3, 93.5)	0.204
Number of debridement or excision (in OR), median (IQR)	1(0, 1)	1(1, 1)	0.696
Incontinence of feces and urine, n (%)	23 (6.8)	317 (93.2)	0.798
Sepsis, n (%)	19 (5.6)	320 (94.4)	0.040
Number of drug resistance by MDRS (multi-drug resistant organism), median (IQR)	0.5 (0, 4)	1 (0, 3)	0.653
Hb (g/dL), median (IQR)	9.9 (9.2, 11)	9.4 (8.2, 10.8)	0.175

Table 1. Baseline characteristics and univariable analysis between successful and non-successful pressure ulcer closures
[a] Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. J Clin Epidemiol. 1994; 47(11):1245-51.PMID: 7722560; P value estimated by Fisher's exact probability test

Nutrition Risk Screening	0	1	2
Body mass index (kg/m2)	>20	18-20	<18
Loss of weight over the last three months	No	<3 kg	>3 kg.
Decrease of food intake over last month	No	Yes	
Stress factors	None	Moderate	Severe
Total			
□ 0-2 = low risk □ 3-4 = moderate risk □ 5-7 = high risk			
Stress factors/ Severity of illness			
0 = none	2 = severe: multiple injuries, multiple fractures, deep pressure sore, severe sepsis, malignant disease, severe dysphagia or pancreatitis, major surgery, post-operative complications		
1 = moderate: minor surgery, chronic disease, minor pressure sore, CVA, inflammatory bowel disease, cirrhosis, renal failure, COPD, DM			

Appendix. Items of Nottingham Hospital Screening Tool (NS)

Nutritional factors	Successful (n=28)	Non-successful (n=382)	P value
Nottingham Hospital Screening Tool (NS), median (IQR)	2 (1,3)	3(1,5)	0.015
Cumulative NPO(days), median (IQR)	1(1, 2)	1(1, 2)	0.228
Caloric deficit per day(kcal), median (IQR)	-586 (-958, 20)	-394 (-746, -51)	0.684
Duration of nutritional support(days), median (IQR)	10(1, 33.5)	0(0, 3)	0.001
Albumin(g/dL),median (IQR)	2.5 (2.5, 3.1)	2.5 (2.3, 2.6)	0.046
Lymphocyte(cells/µL), median (IQR)	1,690 (1,159, 2,165)	1,337 (940, 1,860)	0.039

Table 2. Nutritional factors and univariable analysis between successful and non-successful pressure ulcer closure P value estimated by Fisher's exact probability test

Variables	HR (Hazard Ratio)	95%CI	P value
Nottingham Hospital Screening Tool (NS)[b]			
All	0.355	0.187, 0.674	0.002
Subgroup: sepsis	0.312	0.140, 0.695	0.004
Subgroup: spinal cord	0.420	0.184, 0.958	0.039
Cumulative NPO(days)[b]			
All	0.819	0.624, 1.075	0.151
Subgroup: sepsis	0.831	0.613, 1.127	0.233
Subgroup: spinal cord	0.932	0.685, 1.267	0.653
Duration of nutritional support(days)[b]			
All	0.995	0.980, 1.011	0.525
Subgroup: sepsis	0.993	0.975, 1.012	0.482
Subgroup: spinal cord	0.990	0.970, 1.012	0.368
Albumin(g/dL)[b]			
All	1.207	0.988, 1.473	0.065
Subgroup: sepsis	1.169	0.889, 1.538	0.293
Subgroup: spinal cord	0.904	0.334, 2.451	0.843

Table 3. Multi-variable analysis[a] for nutrition variables on pressure ulcer closure with subgroup analysis. a=Cox's regression; b = Adjusted by age, gender, Braden score and Charlson Age-Comorbidity Index (CACI)

total energy expenditure (TEE) in kilocalories. The predicted TEE was a weight-based formula or assuming 25 kcal/kg/day which was close to values from the predicted equations (15, 16). Nevertheless, patients were presumed to take all of the hospital diets completely.

The caloric intake was based on the routine hospital diet and supplemental diet by prescription. Types of the diet consisted of the regular diet, the soft diet, and the general formula blended diet providing energy of 1,800 kcal/day, 1,500 kcal/day, and 1 kcal/ml respectively, and the supper served in the morning and afternoon. The supplemental diet was delivered via three routes: oral (high protein or commercial diet), enteral, and parenteral (plus intravenous fluid).

Their nutritional status was assessed with the 'Nottingham Hospital Screening Tool (NS)'(17) which was used in all the inpatients of this setting. Regarding the multiple assessments, we chose the risk score at the first record for analysis. Because of a no NS record, that observation was deleted (The details of the scoring scheme was displayed in Appendix).

'Sepsis' was defined as a non-specific inflammatory response presenting signs of a microbial process. This study adopted two diagnostic criteria: documented or suspected infections and systemic inflammatory responses (SIRSs). SIRSs had the following clinical criteria: core temperature > 38.3°C or < 36.0°C, heart rate > 90 /min., tachypnea and altered mental status (18, 19).

The Charlson Age-Comorbidity Index was a score calculated by using the patient's comorbid medical conditions to predict health outcomes. It had sixteen comorbidity components and taking into account differences across age (20).

The Braden scale is a summated rating scale of six elements measuring functional capability. Its elements are sensory perception, moisture, activity, mobility, nutrition, friction, and shear. Each subscale has a score from 1 to 4, except the last item, which has a 1 - 3 range. The total scores range from 6 to 23. A low Braden Scale Score indicates low functioning and points to a high risk of pressure ulcer development (21).

The analysis was conducted using STATA (V.14). The repeated-measure variables were BMI, hemoglobin, albumin, blood urea nitrogen, creatinine, the Braden scale score, and NS. We specified the first data on admission. Missing data were replaced with median values.

To determine how much NS affects wound closure success, we first applied an empty model with no explanatory variables (Table 2). We selected 'Cox regression analysis' because of time-related, significant effect, and unknown post-hospital outcome. The proportional hazard assumption was assessed by a graph plot and statistical test. The time set was 'duration of wound preparation' (duration from NS measurement to outcome existing or censoring). The event set was 'ulcer closure or discharge. We selected the significant independent variables incorporated into the multivariable model based on theory and objectives. There were three sub-groups in each model: sepsis, comorbidities of the nervous system and spinal cord (Table 3). Finally, adjusted Hazard Ratios (HR) estimated the effect of NS, nutritional factors, and sepsis on wound closure success. The study protocol obtained approval from the ethical committee of Surin Hospital.

4. RESULTS

Prevalence of pressure ulcers in the departments of surgery, orthopedics, and medicine was 1.1 to 2.2/1,000 person-year, and the overall prevalence was 1.7/1,000 person-year (Table 4). The success of ulcer closure was 7% (28/410), and 77% (314/410) of non-closure patients required non-closure procedures or excision debridement in the operating room. The others (16%, 68/410) were no need for surgery. Patients' status improved by 87% (355/410) at discharge, while the crude death rate was 8% (34/410) and the rate of no improvement was 5% (21/410). Non-closure procedures had a frequency of none (96/410 = 23%), one time (265/410 = 65%) and two times (33/410 = 8%). Additionally, co-morbidity had

Years	Admitted patients [a]	Pressure ulcer	Annual prevalence (per 1,000)
2008	32,952	50	1.5
2009	34,560	47	1.4
2010	34,767	37	1.1
2011	33,150	55	1.7
2012	30,613	66	2.2
2013	37,614	78	2.1
2014	37,170	77	2.1
Total	240,826	410	1.7

Table 4. Prevalence of pressure ulcers by years. a = The department of Surgery, Orthopedics, and Medicine.

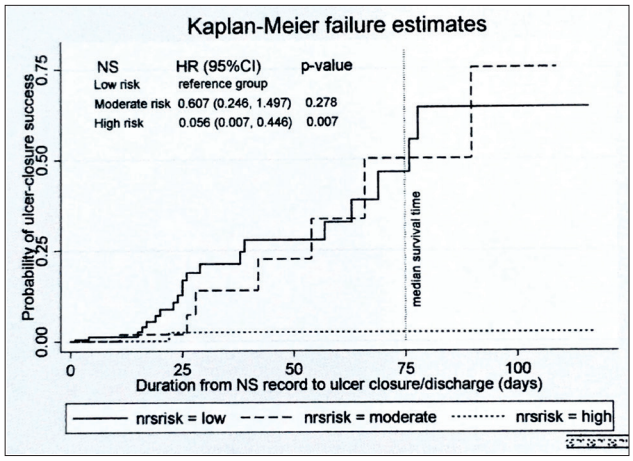

Figure 2. Kaplan-Meier failure curves for ulcer-closure success according to Nottingham Hospital Screening Tool (NS) risks; HR=Hazard Ratio

an element (paraplegia, hemiplegia, and quadriplegia) in the ulcer-closure group (63%) and the non-closure group (67%).

Compared to the ulcer-closure group, the non-closure ulcer group tended to be significantly older (60 vs. 41, p=0.001) and had a high percentage of farmers and individuals with no income (p=0.002). Moreover, the Charlson Age-Comorbidity Index and the Braden scale score were also significantly different (4 vs. 2, p=0.006 and 13 vs. 15, p=0.001).

The non-closure group had a higher proportion of multiple ulcers (46% vs. 29%, p = 0.078), but nutritional support was of shorter duration than the other group (0 vs. 10, p=0.001). Furthermore, the ulcer-closure group had a better nutritional status (NS score) (2 vs. 3, p=0.015). Nevertheless, cumulative NPO and caloric deficit were nonsignificant in both groups (1/1, p=0.228 and -2,338/-8,000, p=0.061).

Compared to the ulcer-closure group, non-closure ulcer group was found to have a significant wound sepsis (p=0.040), and more antibiotic resistance (1/0.5, p=0.653). Moreover, they had less hemoglobin and albumin in a non-closure ulcer (9.4/9.9, p=0.175 and 2.5/2.5, p=0.001, respectively). Lastly, they had more leukocytosis, but less lymphocyte count (11,300/9,370, p=0.016 and 1,337/1,690, p=0.039).

Kaplan-Meier estimates showed more than 50% probability of ulcer closure in low and moderate risks whereas few ulcers could be closure in high risk (Figure 2).

We ran the Cox regression in four main models and two sub-group analyses in each model. The final model of the main effect included NS score, cumulative NPO, duration of nutritional support, and serum albumin. The subpopulation were those who had sepsis and spinal cord co-morbidities (Table 3). All models were adjusted for age, gender, Braden score, and CACI.

Model 1: NS score and wound-closure success had an adjusted hazard ratio (HR) = 0.355 (95%CI: 0.187, 0.674, p=0.002). The significant subgroups were sepsis and spinal cord with adjusted HR=0.312 (95%CI: 0.140, 0.695, p=0.004) and 0.420 (95%CI: 0.184, 0.958, p=0.039). The other models resulted in insignificant effect.

5. DISCUSSION

The prevalence of pressure ulcers was quite low in our study comparing to the other studies (22-24). The possible reasons may be a meager incidence rate and different care setting among hospitals, home cares, and referral policy.

The nutritional factor is an establishing main predictor for pressure wound closure. Hence this study has explored this effect, and we found that only the NS score had a significant result by Cox's regression models. Ulcer-closure probability dropped 64% for each increased level of NS risk (p=0.002), while ulcer-closure probability increased by 21% for each one gm/dL of serum albumin rising (p=0.065).

Most of the patients were farmers and people who had no income. They presented with principal primary diseases of the nervous system (with CVA) and spinal cord. About sixty percent of participants had immobility factors, and then the Braden score was a dominant predictor in this study. Interestingly, outcomes of brain lesion (older age) and spinal cord lesion (younger age) were in contrast; the last outcomes were better than the other. Moreover, sepsis proved to be a critical factor in ulcer-closure success. As shown in subgroup analysis, sepsis and the spinal cord comorbid had a different effect and statistical significance on adjusted HR, therefore, these were evidentiary confounders (Table 3).

Interestingly, the caloric deficit per day revealed higher success in ulcer-closure but non-statistical significant effect. This finding could be accounting for other factors: younger, less chronic diseases/sepsis and more mobility (Braden scores) together with the positive healing effect (25-28).

Moreover, chronic wounds increase metabolic demands due to metabolic response to injury. These patients need both energy and protein to maintain lean body mass, especially no intake (NPO) or low intake in elderly. Then, nutritional support was a crucial factor to promote wound healing (10, 27).

Limitation of the study was a low event rate which may have resulted from infrequent prevalence. Also, we did not follow up with patients after they were discharged from hospital because this is a retrospective study. Nevertheless, we used survival analysis to analyze all cases. According to the low outcome, the meager event rate in high-risk NS and cardiovascular co-morbidity resulted in a statistical limitation (Table 3).

Moreover, this study could not measure NS score and laboratory values regularly, and surgeons had a variety of treatment regimes, which may alter management and timeframe.

The strength of this study is a census from single center including large sample size. The hospital has a typical setting of the common public hospital with the special team for nutritional surveillance and standard clinical management.

Whereas the weakness of the study is a gateway for nutritional data collection, and this study was in a period of hospital software transition.

6. CONCLUSION:

The average prevalence of pressure ulcers in Thailand was 1.7/1,000 persons-year. The significant independent variables were age, gender, occupation, nervous system and spinal cord co-morbidities, CACI, Braden score, sepsis, and nutritional factors (NS score, duration of nutritional support, and serum albumin). According to the multivariable analysis of nutritional factors, only NS risk showed a significant effect on ulcer-closure success. The confounders were sepsis and spinal cord co-morbidity.

- **Acknowledgements:** The authors wish to thank the Ethical Committee of Surin hospital, and Mr. Woratep Woottisil included the computer & IT center of Surin Hospital for permission to use data for analysis.
- **Author Contributions:** Conception and design: SP, WU, SY, SB, and KC. Statistical analysis: SP, SY, and KC. Writing of the manuscript: SP, SY, and KC. Interpretation of study results and proofreading of the manuscript: SP, and KC. Final approval of the manuscript: SP, SY, and KC.
- **Conflict of Interest:** The authors declare no conflict of interest. This study publicly funded by the research fund "Dr. Prasert Prasardthong-O-Sod" and the Medical Association of Thailand.

REFERENCES

1. Gallagher P, Barry P, Hartigan I, McCluskey P, O'Connor K, O'Connor M. Prevalence of pressure ulcers in three university teaching hospitals in Ireland. Journal of tissue viability. 2008; 17(4): 103-9.
2. Kroger K, Niebel W, Maier I, Stausberg J, Gerber V, Schwarzkopf A. Prevalence of pressure ulcers in hospitalized patients in Germany in 2005: data from the Federal Statistical Office. Gerontology. 2009; 55(3): 281-7.
3. Lyder CH, Preston J, Grady JN, Scinto J, Allman R, Bergstrom N, et al. Quality of care for hospitalized Medicare patients at risk for pressure ulcers. Archives of internal medicine. 2001; 161(12): 1549-54.
4. Perneger TV, Heliot C, Rae AC, Borst F, Gaspoz JM. Hospital-acquired pressure ulcers: risk factors and use of preventive devices. Arch Intern Med. 1998; 158(17): 1940-5.
5. Litchford MD, Dorner B, Posthauer ME. Malnutrition as a Precursor of Pressure Ulcers. Adv Wound Care (New Rochelle). 2014; 3(1): 54-63.
6. Correia M, Perman MI, Waitzberg DL. Hospital malnutrition in Latin America: A systematic review. Clinical nutrition (Edinburgh, Scotland). 2017; 36(4): 958-67.
7. Neloska L, Damevska K, Nikolchev A, Pavleska L, Petreska-Zovic B, Kostov M. The Association between Malnutrition and Pressure Ulcers in Elderly in Long-Term Care Facility. Open access Macedonian journal of medical sciences. 2016; 4(3): 423-7.
8. van Bokhorst-de van der Schueren MA, Guaitoli PR, Jansma EP, de Vet HC. Nutrition screening tools: does one size fit all? A systematic review of screening tools for the hospital setting. Clinical nutrition (Edinburgh, Scotland). 2014; 33(1): 39-58.
9. Horn SD, Barrett RS, Fife CE, Thomson B. A predictive model for pressure ulcer outcome: the Wound Healing Index. Advances in skin & wound care. 2015; 28(12): 560-72; quiz 73-4.
10. Cereda E, Neyens JCL, Caccialanza R, Rondanelli M, Schols J. Efficacy of a Disease-Specific Nutritional Support for Pressure Ulcer Healing: A Systematic Review and Meta-Analysis. The journal of nutrition, health & aging. 2017; 21(6): 655-61.
11. Gross Regional and Provincial Product, 2013 Edition. Office of the National Economic and Social Development Board (NESDB); 2013: 60.
12. Bergstrom N, Braden B, Kemp M, Champagne M, Ruby E. Predicting pressure ulcer risk: a multisite study of the predictive validity of the Braden Scale. Nursing research. 1998; 47(5): 261-9.
13. Ohura T, Nakajo T, Okada S, Omura K, Adachi K, Oishi S. [Effects of nutrition intervention for pressure ulcer patients - healing rate and speed of wound size and nutrition]. Nihon Ronen Igakkai Zasshi Japanese journal of geriatrics. 2013; 50(3): 377-83.
14. Ohura T, Nakajo T, Okada S, Omura K, Adachi K. Evaluation of effects of nutrition intervention on the healing of pressure ulcers and nutritional states (randomized controlled trial). Wound repair and regeneration: official publication of the Wound Healing Society [and] the European Tissue Repair Society. 2011; 19(3): 330-6.
15. Dambach B, Salle A, Marteau C, Mouzet JB, Ghali A, Favreau AM, et al. Energy requirements are not greater in elderly patients suffering from pressure ulcers. J Am Geriatr Soc. 2005; 53(3): 478-82.
16. Boullata J, Williams J, Cottrell F, Hudson L, Compher C. Accurate determination of energy needs in hospitalized patients. Journal of the American Dietetic Association. 2007; 107(3): 393-401.
17. Barendregt K, Soeters P, Allison SP. Diagnosis of malnutrition. Screening and assessment.: Galen, Prague, 2000.
18. Lever A, Mackenzie I. Sepsis: definition, epidemiology, and diagnosis. BMJ. 2007; 335(7625): 879-83.
19. Levy MM, Fink MP, Marshall JC, Abraham E, Angus D, Cook D, et al. 2001 SCCM/ESICM/ACCP/ATS/SIS International Sepsis Definitions Conference. Intensive Care Med. 2003; 29(4): 530-8.
20. Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. J Clin Epidemiol. 1994; 47(11): 1245-51.
21. Parikh HG, Miller A, Chapman M, Moran JL, Peake SL. Calorie delivery and clinical outcomes in the critically ill: a systematic review and meta-analysis. Critical care and resuscitation: journal of the Australasian Academy of Critical Care Medicine. 2016; 18(1): 17-24.
22. Shahin ES, Dassen T, Halfens RJ. Pressure ulcer prevalence and incidence in intensive care patients: a literature review. Nursing in critical care. 2008; 13(2): 71-9.
23. Shafipour V, Ramezanpour E, Gorji MA, Moosazadeh M. Prevalence of postoperative pressure ulcer: A systematic review and meta-analysis. Electronic physician. 2016; 8(11): 3170-6.
24. Beal ME, Smith K. Inpatient Pressure Ulcer Prevalence in an Acute Care Hospital Using Evidence-Based Practice. Worldviews on evidence-based nursing. 2016; 13(2): 112-7.
25. Russell L. The importance of patients' nutritional status in wound healing. British journal of nursing (Mark Allen Publishing). 2001; 10(6 Suppl): S42, s4-9.
26. Evans C. Malnutrition in the Elderly: A Multifactorial Failure to Thrive. The Permanente Journal. 2005; 9(3): 38-41.
27. Molnar JA, Underdown MJ, Clark WA. Nutrition and Chronic Wounds. Advances in Wound Care. 2014; 3(11): 663-81.
28. Byrne DW, Salzberg CA. Major risk factors for pressure ulcers in the spinal cord disabled: a literature review. Spinal cord. 1996; 34(5): 255-63.