THE ASSESSMENT OF ENERGY AND PROTEIN NEEDS COVERAGE IN HOSPITALIZED PATIENTS

OCENA POKRITOSTI POTREB PO ENERGIJI IN BELJAKOVINAH MED HOSPITALIZIRANIMI BOLNIKI

Ruža PANDEL MIKUŠ[1*], Vid VIČIČ[1], Raja DAHMANE[1]

[1]University of Ljubljana, Faculty of Health Sciences, Nursing Department, Zdravstvena pot 5, 1000 Ljubljana, Slovenia

Received: May 15, 2015
Accepted: Dec 16, 2015

Original scientific article

ABSTRACT

Aim. Aiming at assessing sufficiency of energy/protein intake in hospitalized patients,the objective was to monitor and analyze actual food intake of patients hospitalized in three clinical wards of one of major Slovenian hospitals.

Methods. 53 patients were included in the study. Food intake was assessed 3 times daily from leftovers. Nutritional status was assessed with Nutritional Risk Screening tool 2002. The observed outcomes were percentage of energy coverage (PEC) and percentage of protein coverage (PPC). In PEC energy nutritional value of the menu (ENVM), and in PPC protein nutritional value of the menu (PNVM) were considered as the main modifiable risk factors. Data were analyzed univariately and multivariately by using logistic regression method.

Results. The patients did not cover energy needs (67.4±24.5%). Multivariate model for PEC was highly significant (R2=0.347; pmodel<0.001) with ENVM showing high strength of association (b=0.040; p=0.004). Patients also did not cover protein needs (84.0±40.2%). Multivariate model for PEC was highly significant (R2=0.477; pmodel<0.001) and PNVM showing high strength of association (b=0.937; p=0.002).

Conclusion. For successful prevention and early detection of malnutrition, food intake in hospitals is vital and should be constantly monitored. A simple method for monitoring is proposed. The menus provided to patients should also be adequate in terms of energy and protein content.

Keywords:
hospital settings, energy nutritional value of the menu, protein nutritional value of the menu, percentage of energy coverage, percentage of protein coverage

IZVLEČEK

Namen. *Namen raziskave je bil ugotoviti zadostnost vnosa energije in beljakovin pri hospitaliziranih bolnikih. Cilj je bilo sistematično spremljanje in analiza dejanskega vnosa hrane pri bolnikih, hospitaliziranih na treh kliničnih oddelkih v eni izmed večjih slovenskih bolnišnic.*

Metode. *V raziskavo je bilo vključenih 53 bolnikov. Vnos hrane je bil zabeležen in spremljan trikrat dnevno prek vrednotenja ostankov obroka na pladnju. Stanje prehranjenosti je bilo ocenjeno z orodjem Nutritional Risk Screening 2002. Opazovani izidi so bili delež pokritosti potreb po energiji (PEC) in delež pokritosti potreb po beljakovinah (PPC). Pri PEC (delež pokritosti potreb po energiji) je bil glavni dejavnik tveganja, na katerega je mogoče vplivati, energijska vrednost jedilnika (ENVM), pri PPC (delež pokritosti potreb po beljakovinah) je bila to beljakovinska prehranska vrednost jedilnika (PNVM). Podatki so bili analizirani univariantno in multivariantno, z logistično regresijsko metodo.*

Rezultati. *Bolniki niso pokrili energetskih potreb (67,4±24,5%). Multivariantni model za PEC je bil močno statistično značilen (R2=0,347; pmodel<0,001) in je pokazal visoko stopnjo povezanosti z ENVM (b=0,040; p=0,004).*
Prav tako bolniki niso zadostili potrebam po beljakovinah (84,0±40,2). Multivariantni model za PEC je bil ravno tako močno statistično značilen (R2=0,477; pmodel<0,001) in je pokazal visoko stopnjo povezanosti z PNVM (b=0,937; p=0,002).

Zaključek. *Uživanje hrane v bolnišnici je ključno za uspešno preprečevanje in zgodnje odkrivanje slabe prehranjenosti, zato bi moralo biti redno spremljano. Predlaga se spremljanje vnosa hrane s preprosto metodo. Bolnišnični jedilniki morajo pokrivati bolnikove potrebe po energiji in beljakovinah.*

Ključne besede:
hospitalizacija, energijska vrednost obroka, beljakovinska vrednost obroka, energijska pokritost, proteinska pokritost

***Corresponding author:** Tel: ++ 386 1300 11 33; E-mail: ruza.pandel@zf.uni-lj.si

1 INTRODUCTION

Malnutrition and cachexia are considered to be serious, life threatening and costly public health problems (1). The prevalence of malnutrition in hospitals worldwide is about 20-50% (2-4); in Slovenia, Trtnik (5) showed that around 40% of patients were at nutritional risk or malnourished.

The nutritional status decline is largely dependent on the nature of disease or injury and consequent stress and inflammatory response, which is exacerbated with low energy and protein intake (6, 7). However, in a large part of studies exploring malnutrition and cachexia, this aspect seems to be left out (8-12).

Insufficient food intake in hospitals is an important factor for the development of malnutrition (3, 13, 14). Food intake <25% of the received food is linked with 2-3-times greater mortality (13, 14). Malnutrition and low food intake are undoubtedly linked with higher costs due to longer hospitalization and frequent re-hospitalizations (1, 14-16). It is also more and more obvious that along the aging of populations, malnutrition (and cachexia) of aged plurimorbid patients, especially hospitalized (this is a highly vulnerable group), is a rising public health problem(17). Unfortunately, only a small number of these patients with very low food intake is recognized and receives nutritional support, artificial nutrition or oral supplements (13). The aim of our pilot study is to demonstrate the actual energy and protein intake of hospitalized patients from three clinical wards, at one of major Slovenian hospitals.

2 PATIENTS AND METHODS

2.1 Study Design

The design of this small pilot study was observational. It was a health examination survey in which quantitative, practical and inexpensive methods that can be easily incorporated into dietetic, medical and nursing practice were used. The study was conducted from 26. 5. 2014 to 20. 6. 2014.

2.2 Patients

In the study, patients from three different clinical wards of one of the major hospitals in Slovenia were enrolled. Two of them were internal medicine wards, while the third ward was a surgical one. 53 patients were included in the study: 15 men and 4 women from clinical ward 1, 15 men and 17 women from internal medicine wards 2, 16 men and 12 women from surgical wards 3.

The criteria for enrolment were, namely: (1) the ability of the patient to understand the course of the study and be able to sign the informed consent form by hand;(2) at least 5 days of expected stay on the ward; (3) terminal patients were excluded; (4) only patients that were eating exclusively per os were included (patients receiving enteral or parenteral nutrition were excluded).

All included patients received unaltered food prepared in the central kitchen. The appropriate menu was selected by a physician or registered nurse at admission. Some patients received oral nutritional supplements and supplemental food prescribed by nurses and/or dietetics.

2.3 The Measurement of Food Intake and Nutrition Status

2.3.1 Food Intake Monitoring

The study was conducted under the auspice of hospital food and dietetics service and in close collaboration with the head nurse of medical clinics, the head nurse of surgical clinics and with nursing staff on the selected wards. A method most useful in practice is simply writing down the ingested share (all, nothing, ¼, ½ and ¾) of all the food on the tray. For greater accuracy we separately assessed every single component of a meal (for example: soup, meat, side dish etc.). Patients received hospital food portioned by kitchen staff. In our calculations we assumed that the portion actually received is the same as stated on menu.

The food intake of the enrolled patients for at least 3 full days and up to 7 days was followed. Food intake was assessed visually from photographs of the leftovers. For the assessment of liquids a simple measuring tool – a plastic knife with marks - was used (Figure 1). For each component of a meal the remaining food from photographs to the nearest quarter (25%, 50%, 75% and 100%) was visually estimated (12). From these data, energy and protein intake was calculated. Food intake data were followed by using "Winpis" software.

Figure 1. Food assessment with improvised measures for liquids (12).

2.3.2 The Measurement of Nutritional Status

We measured the height and weight of the patients, and completed the Nutritional Risk Screening 2002 (NRS 2002), which takes into account the parameters, such as the presence of illnesses or injuries, body mass index (BMI), involuntary weight loss and food intake in the last week (18-20). Its purpose is to detect not only developed malnutrition but also the risk for developing malnutrition in the hospital setting (20).

Energy needs were estimated using Harris-Benedict equation (21) with appropriate stress and activity factors summarized by Ferrie and Ward (22). The protein needs of the patients were estimated and adjusted for illness, injury and renal function, using the recommendations summarized by Ferrie, et al. (23). Energy and protein needs were estimated using actual or corrected (when BMI >30 kg/m2) body weight (15). Ideal body weight by Devine equation (24) was used in 4 patients in which weight was not obtainable. These patients were also underweight.

2.4 Methods

2.4.1 Observed Outcomes

We observed the actual intake (the amount of energy and protein the patients actually ingested) in the form of the actual energy intake (kcal per day) and actual protein intake (g of ingested protein per day).We compared these values with the estimated energy and protein needs (what patients should have ingested). We expressed these values as relative values: percentage of energy coverage (PEC) and percentage of protein coverage (PPC). We also followed the theoretical intake – the energy and protein content of the received meals (ENVM and PNVM) (the amount of energy and protein that patients received on their plates, but were not necessarily eaten).

Finally, two main observed outcomes, percentage of energy coverage (PEC) and percentage of protein coverage (PPC), were determined.

2.4.2 Explanatory Factors

Energy nutritional value of the menu (ENVM) was considered as the main modifiable factor in the analysis of PEC. Protein nutritional value of the menu (PNVM) was considered as the main modifiable risk factor in the analysis of PPC.

2.4.3 Confounding Factors

As potential confounding factors, medical ward (1=internal medicine ward 1, 2=internal medicine ward 2, 3=surgical ward), age (years), and sex (1=male, 2=female) were considered.

2.4.4 Statistical Methods

The association between the outcomes and their main modifiable factors, as well as potential confounders (sex, age, hospital ward), was firstly assessed univariately. A simple linear regression method was used for assessing the relationship between PEC and ENVM, age and sex, and PPC and PNVM, age and sex, while multiple linear regression was used for assessing the relationship between PEC or PPC and a ward. The dummy variables were created using a simple method for coding dummies (one group was assigned as the reference group).

Afterwards, multiple linear regression method was performed to adjust the estimates of the association between PEC and ENVM, and PPC and PNVM, for potential confounders. Again, the dummy variables were created using a simple method for coding dummies (one group was assigned as the reference group).

P-value of 0.05 or less was considered significant. The SPSS statistical package for Windows (Version 21.0, SPSS Inc., Chicago, IL, USA) (License: University of Ljubljana, Slovenia) was used as a tool for the analysis.

2.5 Ethical Considerations

All the enrolled patients handedly signed the informed consent form. The study was approved by The Republic of Slovenia National Medical Ethics Committee and was conducted in accordance with the declaration of Helsinki and Oviedo convention.

3 RESULTS

3.1 Study Group Characteristics

In the study 53 patients were included. 15 patients (28.3%) were coming from internal medicine ward 1, 23 patients (43.4%) from internal medicine ward 2, and 15 patients (28.3%) from surgical ward 3. Among them there were 22 women (41.5%) and 31 men (58.5%). The mean age was 69.7±11.4 years (internal medicine ward 1: 66.7±16.4; internal medicine ward 2: 71.3±9.2; surgical ward: 73.3±9.0). The mean value of BMI was 27.5±6.3 (internal medicine ward 1: 26.1±5.3; internal medicine ward 2: 29.9±6.9; surgical ward: 25.2±4.9). 31/53 (58.5%) of patients had NRS 2002 scores ≥3 (internal medicine ward 1: 11/15, 73.3%; internal medicine ward 2: 6/23, 26.1%; surgical ward: 14/15, 93.3%).

On average, estimated daily energy needs were assessed to 2064±467kcal (internal medicine ward 1: 2179±472 kcal; internal medicine ward 2: 1849±349 kcal, and surgical ward: 2278±506 kcal), and estimated daily protein needs were assessed to 86.4±24.3 g (internal medicine ward 1: 88.6±17.4 g; internal medicine ward 2: 68.6±13.2 g, and surgical ward: 111.4±20.6 g).

3.2 Food Intake Characteristics

On average, 3.8% of patients ate less than 25% of offered food, 18.9% ate 25-50% of offered food, 45.3% ate 50-75% of offered food and 32.1% ate 75-100% of offered food.

3.2.1 Energy Intake Characteristics

Mean daily energy intake on all wards was low. On average, daily energy intake was 1327±418 kcal (internal medicine ward 1: 1430±560 kcal; internal medicine ward 2: 1346±341 kcal, and surgical ward: 1194±348 kcal).

The average value of ENVM daily was 1932±240 kcal (internal medicine ward 1: 2052±315 kcal; internal medicine ward 2: 1818±117 kcal; surgical ward: 1987±230 kcal).

3.2.2 Protein Intake Characteristics

Mean daily protein intake on all wards was low as well. On average, daily protein intake was 65.9±23.2 g (internal medicine ward 1: 64.8±33.4 g; internal medicine ward 2: 71.3±16.4 g, and surgical ward: 58.8±18.7 g).

The average value of PNVM daily was 95.4±15.4 g (internal medicine ward 1: 94.2±25.9 g; internal medicine ward 2: 95.1±3.7 g; surgical ward: 97.2±13.9 g).

3.3 The Analysis of Percentage of Energy Coverage

It was possible to establish PEC in all 53 patients enrolled in the study.

On average patients did not cover their relative energy needs: the average value of PEC was 67.4±24.5% (min: 17.2%; max: 127.3%) (internal medicine ward 1: 67.5±25.4%; internal medicine ward 2: 76.0±24.8%; surgical ward: 53.9±17.7%).

The results of univariate analysis of association between PEC and ENVM showed that, in this model, ENVM did not show statistically significant association with PEC, and only 2.8% of variability of PEC could be explained by the fact that the model consisted solely of ENVM (Table 1). All other results are presented in Table 1.

All data necessary to perform multiple logistic regression analysis of association between PEC and ENVM were present in all 53 patients enrolled in the study as well. The results are presented in Table 2. The model was highly statistically significant (pmodel< 0.001), and in total 37.4% of variability of PEC could be explained by this model. In comparison to the results of univariate analysis ENVM in multivariate model showed increased strength of association with PEC that was statistically highly significant (Table 1), and also the percentage of variability of PEC that could be explained by ENVM increased to 15.4%. The strength of association increased also between PEC and all considered potential confounding factors, except sex (Table 2).

Table 1. The results of simple linear regression analysis of the association between percentage of energy coverage and risk factors (N=53).

Risk factor	Observed category	Reference category	b	95 % C.I. limits for b		p	R^2
				Lower	Upper		
ENVM (kcal)			0.017	-0.011	0.045	0.230	0.028
Age (years)			0.584	0.001	1.167	0.050	0.073
Sex	Males	Females	-7.765	-21.461	5.931	0.260	0.025
Ward	Internal medicine ward 1	Surgical ward	13.664	-3.347	30.676	0.113	0.141
	Internal medicine ward 2	Surgical ward	22.059	6.597	37.521	0.006	

Legend: b=regression coefficient, C.I.=confidence interval; ENVM=energy nutritional value of the menu (theoretical intake)

Table 2. The results of multiple linear regression analysis of the association between percentage of energy coverage and risk factors (N=53).

Risk factor	Observed category	Reference category	b	95 % C.I. limits for b		p
				Lower	Upper	
ENVM (kcal)			0.040	0.014	0.067	0.004
Age (years)			0.809	0.269	1.348	0.004
Sex	Males	Females	-4.643	-16.450	7.163	0.433
Ward	Internal medicine ward 1	Surgical ward	19.345	3.446	35.244	0.018
	Internal medicine ward 2	Surgical ward	29.918	15.391	44.446	<0.001

Legend: b=regression coefficient, C.I.=confidence interval; ENVM=energy nutritional value of the menu (theoretical intake)

3.4 The Analysis of Percentage of Protein Coverage

It was possible to establish PPC in all 53 patients enrolled in the study.

On average, patients did not cover their relative protein needs: the average value of PPC was 84.0±40.2% (min: 17.8%; max: 165.5%) (internal medicine ward 1: 74.3±36.2%, internal medicine ward 2: 109.2±37.2%; surgical ward: 54.9±21.7%).

The results of univariate analysis of the association between PPC and PNVM showed that in this model PNVM has already shown statistically significant association with PEC (9.5% of variability of PPC could be explained by the fact that the model consisted solely of PNVM) (Table 3). All other results are presented in Table 3.

All data necessary to perform multiple logistic regression analysis of the association between PPC and PNVM were present in all 53 patients enrolled in the study as well. The results are presented in Table 4. The model was highly statistically significant (pmodel = <0.001), and in total 47.7% of variability of PPC could be explained by this model. In comparison to the results of univariate analysis PNVM in multivariate model showed increased strength of association with PEC (Table 2), and also the percentage of variability of PPC that could be explained by PNVM increased to 36.0%.

Table 3. The results of simple linear regression analysis of the association between percentage of protein coverage and risk factors (N=53).

Risk factor	Observed category	Reference category	b	95 % C.I. limits for b		p	R^2
				Lower	Upper		
PNVM (g)			0.799	0.104	1.495	0.025	0.095
Age (years)			0.377	-0.610	1.365	0.446	0.011
Sex	Males	Females	-7.819	-30.440	14.802	0.491	0.009
Ward	Internal medicine ward 1	Surgical ward	19.344	-5.066	43.755	0.118	0.341
	Internal medicine ward 2	Surgical ward	54.284	32.097	76.470	<0.001	

Legend: b=regression coefficient, C.I.=confidence interval; ENVM=energy nutritional value of the menu (theoretical intake)

Table 4. The results of multiple linear regression analysis of the association between percentage of protein coverage and risk factors (N=53).

Risk factor	Observed category	Reference category	b	95 % C.I. limits for b		p
				Lower	Upper	
PNVM (g)			0.937	0.375	1.499	0.002
Age (years)			0.573	-0.235	1.382	0.160
Sex	Males	Females	-2.900	-20.664	14.863	0.744
Ward	Internal medicine ward 1	Surgical ward	27.948	4.021	51,876	0.023
	Internal medicine ward 2	Surgical ward	57.057	36.409	77.705	<0.001

Legend: b=regression coefficient, C.I.=confidence interval; ENVM=energy nutritional value of the menu (theoretical intake)

4 DISCUSSION

4.1 The Main Findings of the Study

The main findings of the study showed: a) that, on average, energy needs coverage was not sufficient, and that it could be significantly increased by increasing ENVM, and b) that, on average, protein needs coverage was not sufficient either, although the situation was better than in energy coverage, and that it could be, like in energy needs coverage, significantly increased by increasing PNVM. The main hypothesis – that energy and protein intake in hospitalized patients on average falls below their estimated needs – was confirmed.

4.2 Other Important Findings

Somewhat overlooked contributing factor in the development of hospital malnutrition is that not only food intake but also the amount of the provided food is insufficient. We found a direct association between the provided quantity of energy and protein and the actual intake. Simply and unsurprisingly, if more food is provided, more can possibly be eaten. We observed that too often the provided food was insufficient. 1800-2000 kcal menus were often prescribed universally to both men and women of different heights and weights. A rather high percentage of patients would not cover 100% of the estimated energy needs even if the meals would be fully consumed. This is especially evident in men with higher weight and in patients with conditions characterized by increased metabolism. We also noted patients receiving restrictive menus that are intended for a short time use and have only about 1200 kcal and 40 g of protein. Other researchers also reported that the amount and quality of hospital and nursing home meals often fell below the needs of patients (25, 26). Hankey and Wynne (27) performed a study in an elderly care hospital on 72 elderly patients (>65 years). Mean energy provision (not intake) was only 1472±320 kcal, also the recommendations for fibre and several micronutrients were not met. In another study (28), Wright with colleagues (25) analyzed the energy and nutrient content of hospital diets (regular, soft, low sodium, 1500 kcal, 60 g protein, full liquid and clear liquid) most commonly prescribed to elderly patients in two American hospitals. It would seem that malnutrition is too often treated without regard to what actually caused or contributed to its development. We reached the point where nutrition risk screening is mandatory in all acute care hospitals accredited by Joint Commission (29), but the provision of basic meals that would cover 100% of patient's individual energy, protein and other nutrient needs is not.

The menus with modified texture and restrictive diets are especially prone to being insufficient (25). We also noticed that hospital menus may be "too healthy"; the hospital food has low energy density. Especially for the elderly, small energy and protein dense meals would be more beneficial (30-33). Broths, soups, stewed fruit and similar foods with negligible energy and protein content are abundant in hospital menus and can be problematic. Especially soups have, for their energy content, a disproportionate satiating effect, so the food intake from the successive dishes is greatly reduced (34, 35). A limiting factor in spontaneous food intake is not the energy value, but the volume of the food (33); the amount of ingested food stays the same despite the increased energy density (34, 35). Enrichment of hospital food with a goal to provide increased energy density was proven to be an effective method in increasing energy intake of hospitalized patients (30-33). Hospital food can be easily and cheaply enriched with cream, cheese, ricotta, milk powder, protein powders, maltodextrins, canola oil and butter.

Nutritional risk (1, 4) and low food intake is still widespread in hospital environments worldwide (Table 6).

Food intake in hospitals should be monitored with the same diligence as blood pressure and temperature. Food intake monitoring is simple and does not require special equipment or in depth knowledge (13).

Energy intake (what patients actually ingested) of hospitalized patients in EU is, on average, below 1500 kcal, with protein intake around 60 g (9-11). In one similar Slovenian study (8), the average intake was 1364±326 kcal/d and 61.83±13.78 g of protein.

4.3 The Limitations and Strengths of the Study

The study has some limitations. Firstly, the main limitation of this study is that it was performed on only 53 patients. Secondly, the patients included in the study received normal hospital food, therefore the food was subjected to slight variations in portioning. Finally, it was performed in only one hospital. Here, we also have to stress that, in any case, the results and, consequently, also the study should not be considered representative of the entire hospital.

On the other side, this pilot study has also important strengths. The major one is that it pointed out the possibility of insufficient energy and protein coverage in hospitalized patients. This is an emerging problem in ageing populations and it should be taken into consideration. Another strength is the simple method used for rough but quick assessment of food intake, which is feasible to perform anywhere.

4.4 The Implications of the Study Results for Public Health

As in previous studies we can conclude that hospital malnutrition is still widely present in EU and is still being under-detected (1, 4). The actual food intake is rarely monitored, even when malnutrition is detected (3, 13, 14). From the perspective of public health, early detection of malnutrition and effective nutritional intervention with sufficient energy and protein intakes means better clinical outcomes, shorter hospital stay and lower costs of treatment (13).

4.5 Suggestions for Future Research in the Field

This study should be succeeded by a larger study conducted in several hospitals that would determine the prevalence of malnutrition and nutritional risk in Slovenian hospitals. Moreover, the effect of hospital food fortification on the actual food intake should be examined.

5 CONCLUSION

In this study, we demonstrated energy and protein intake on three clinical wards. When compared to the estimated energy and protein needs, we determined that food intake was in general insufficient. For successful prevention and early detection of malnutrition, food intake in hospitals must be monitored. We recommend using a simple method: after a meal, the nurse writes down if the patient ate all, nothing, ¼, ½, or ¾ of the food on the tray. Although it is simple and approximate, used with NRS 2002, it can detect a nutritional risk earlier than any other method. However, if the provided food was not sufficient (as was demonstrated in many studies, including this one), this could lead to a substantial error. An adequate hospital menu for an individual patient should always be chosen, preferably at admission. All patients need to receive minimally the amount of food that would cover or exceed their needs. Malnutrition is a disease and food is a prevention and therapy. Feeding a patient should be done with equal care and responsibility as their therapy application.

CONFLICTS OF INTEREST

The authors declare that no conflicts of interest exist.

FUNDING

None.

ETHICAL APPROVAL

The study was approved by The Republic of Slovenia National Medical Ethics Committee and was conducted in accordance with declaration of Helsinki and Oviedo convention.

REFERENCES

1. Farkas J, von Haehling S, Kalantar-Zadeh K, Morley JE, Anker SD, Lainscak M. Cachexia as a major public health problem: frequent, costly, and deadly. J Cachexia Sarcopenia Muscle 2013; 4: 173-8.
2. Pirlich M, Schutz T, Norman K, Gastell S, Lubke HJ, Bischoff SC. et al. The German hospital malnutrition study. Clin Nutr 2006; 25: 563-72.
3. Lamb CA, Parr J, Lamb EIM, Warren MD. Adult malnutrition screening, prevalence and management in a United Kingdom hospital: cross-sectional study. Br J Nutr 2009; 102: 571-5.
4. Agarwal E, Ferguson M, Banks M, Bauer J, Capra S, Isenring E. Nutritional status and dietary intake of acute care patients: results from the Nutrition Care Day Survey 2010. Clin Nutr 2012; 31: 41-7.
5. Trtnik N. Prehransko presejanje pri ugotavljanju stanja prehranjenosti bolnikov: magistrsko delo s področja živilstva. Ljubljana: Biotehniška fakulteta, 2011: 98.
6. Jensen GL, Mirtallo J, Compher C, Dhaliwal R, Forbes A, Grijalba RF. et al. Adult starvation and disease-related malnutrition: a proposal for etiology-based diagnosis in the clinical practice setting from the International Consensus Guideline Committee. Clin Nutr 2010; 29: 151-3.

7. van Bokhorst-de van der Schueren MAE, Soeters P, Reijven P, Allison S, Kondrup J. Diagnosis of malnutrition - screening and assesment. In: Sobotka L, editor. Basics in clinical nutrition. 4th ed. Prague: Galen, 2011: 21-31.
8. Volk I. Analiza stanja hranjenosti, energijskega vnosa in vnosa makro hranil pri bolnikih v bolnišnici: specialistično delo. Ljubljana: Fakulteta za zdravstvene vede, 2011: 61.
9. Thibault R, Chikhi M, Clerc A, Darmon P, Chopard P, Genton L. et al. Assessment of food intake in hospitalised patients: a 10-year comparative study of a prospective hospital survey. Clin Nutr 2011; 30: 289-96.
10. Dupertuis YM, Kossovsky MP, Kyle UG, Raguso CA, Genton L, Pichard C. Food intake in 1707 hospitalised patients: a prospective comprehensive hospital survey. Clin Nutr 2003; 22: 115-23.
11. Schindler K, Pernicka E, Laviano A, Howard P, Schutz T, Bauer P. et al. How nutritional risk is assessed and managed in European hospitals: a survey of 21,007 patients findings from the 2007-2008 cross-sectional nutritionDay survey. Clin Nutr 2010; 29: 552-9.
12. Vičič V. Analiza dejanskega vnosa energije in makrohranil ter prehranskega statusa pacientov v bolnišnični oskrbi. Ljubljana: Biotehniška fakulteta, 2015: 64.
13. Hiesmayr M, Schindler K, Pernicka E, Schuh C, Schoeniger-Hekele A, Bauer P, et al. Decreased food intake is a risk factor for mortality in hospitalised patients: the NutritionDay survey 2006. Clin Nutr 2009; 28: 484-91.
14. Agarwal E, Ferguson M, Banks M, Batterham M, Bauer J, Capra S. et al. Malnutrition and poor food intake are associated with prolonged hospital stay, frequent readmissions, and greater in-hospital mortality: results from the Nutrition Care Day Survey 2010. Clin Nutr 2013; 32: 737-45.
15. Rotovnik-Kozjek N, Miloševič M, Cerović O, Sedej I, Knap B, Kompan L. et al. Priporočila za prehransko obravnavo bolnikov v bolnišnicah in starostnikov v domovih za starejše občane. Ljubljana: Ministrstvo za zdravje, 2008.
16. Loser C. Malnutrition in hospital the clinical and economic implications. Deutsch Arzteblatt Intern 2010; 107: 911-22.
17. Culebras JM. Malnutrition in the twenty-first century: an epidemic affecting surgical outcome. Surg Infect (Larchmt) 2013; 14: 237-43.
18. Kondrup J, Elia, M. Basic concepts in nutrition. In: Sobotka L, editor. Basics in clinical nutrition. 4th ed. Prague: Galen, 2011: 1-20.
19. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. ESPEN guidelines for nutrition screening 2002. Clin Nutr 2003; 22: 415-21.
20. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clin Nutr 2003; 22: 321-36.
21. Harris JA, Benedict FG. A biometric study of human basal metabolism. Proc Natl Acad Sci U S A 1918; 4: 370-3.
22. Ferrie S, Ward M. Back to basics: estimating energy requirements for adult hospital patients. Nutr Diet 2007; 64: 192-9.
23. Ferrie S, Rand S, Palmer S. Back to Basics: Estimating protein requirements for adult hospital patients: a systematic review of randomised controlled trials. Nutr Diet 2013; 4: 201-14.
24. Pai MP, Paloucek FP. The origin of the “ideal” body weight equations. Ann Pharmacother 2000; 34: 1066-9.
25. Wright JE, Willis GJ, Edwards MS. Nutritional content of hospital diets. Jama 2004; 291: 2194-6.
26. Williams L, Jones J, Davidson HIM, Bannerman E. An investigation into food provision and consumption in an orthopaedic rehabilitation hospital in Scotland. Proc Nutr Soc 2011; 70(OCE5): 2.
27. Hankey CR, Wynne HA. An audit of meal provision in an elderly care hospital. Int J Qual Health Care 1996; 8: 375-82.
28. Berner YN, Stern F, Polyak Z, Dror Y. Dietary intake analysis in institutionalized elderly: a focus on nutrient density. J Nutr Health Aging 2002; 6: 237-42.
29. Chima CS, Dietz-Seher C, Kushner-Benson S. Nutrition risk screening in acute care: a survey of practice. Nutr Clin Pract 2008; 23: 417-23.
30. Pritchard SJ, Davidson I, Jones J, Bannerman E. A randomised trial of the impact of energy density and texture of a meal on food and energy intake, satiation, satiety, appetite and palatability responses in healthy adults. Clin Nutr 2014; 33: 768-75.
31. Gall MJ, Grimble GK, Reeve NJ, Thomas SJ. Effect of providing fortified meals and between-meal snacks on energy and protein intake of hospital patients. Clin Nutr 1998; 17: 259-64.
32. ÖDlund Olin A, Armyr I, Soop M, JerstrÖM S, Classon I, Cederholm T. et al. Energy-dense meals improve energy intake in elderly residents in a nursing home. Clin Nutr 2003; 22: 125-31.
33. Olin AO, Osterberg P, Hadell K, Armyr I, Jerstrom S, Ljungqvist O. Energy-enriched hospital food to improve energy intake in elderly patients. JPEN J Parenter Enteral Nutr 1996; 20: 93-7.
34. Rolls BJ, Fedoroff IC, Guthrie JF, Laster LJ. Foods with different satiating effects in humans. Appetite 1990; 15: 115-26.
35. Rolls BJ, Roe LS, Meengs JS. Salad and satiety: energy density and portion size of a first-course salad affect energy intake at lunch. J Am Diet Assoc 2004; 104: 1570-6.