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RISK FACTORS FOR MALNUTRITION AMONG HOSPITALIZED GASTROENTEROLOGICAL PATIENTS

FAKTORI RIZIKA ZA POTHRANJENOST HOSPITALIZIVANIH GASTROENTEROLOŠKIH BOLESNIKA

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RUNNING TITLE

Risk factors for malnutrition
ABSTRACT

Background / Aims. Risk factors for malnutrition of patients during hospitalization have not been precisely determined. The aim of the study was to determine these factors in hospitalized gastroenterological patients.

Methods. Nutritional status (NS) of 650 gastroenterological patients was assessed on admission and at discharge by the six parameters: unintentional weight loss, lymphocyte counts, serum albumin concentration, body mass index, triceps skinfold thickness and mid-upper arm muscle circumference. The influence on NS at discharge was tested for ten factors: gender, age, affected organ, the nature, severity and complications of the disease, the length of hospitalization, mobility worsening during hospitalization, Karnofsky score and NS on admission. Primary and secondary risk factors were defined among the factors influencing significantly the malnutrition.

Results. Seven factors were found to be the independent predictors for malnutrition in hospitalized gastroenterological patients. NS on admission was considered as primary risk factor (Forwald: Wald multivariate logistic regression analysis, p<0.001 for five applied assessment parameters). The other factors, obtained in the evaluation according to 1-3 parameters, were considered as secondary risk factors: severe disease activity, malignancy, the existence of complications, male gender, hospitalization >14 days, and mobility worsening during the hospitalization (Forwald:Wald multivariate logistic regression analysis, p from 0.001 to 0.027).

Conclusion. There are seven risk factors for malnutrition among gastroenterological patients during hospitalization. Timely nutritional support in these patients can prevent the development of intrahospital malnutrition and its negative influence on clinical outcome.

KEY WORDS: gastrointestinal diseases, hospitalization, malnutrition, risk factors
APSTRAKT

Uvod/Cilj. Faktori rizika za pothranjenost bolesnika tokom hospitalizacije nisu precizno definisani. Cilj studije je bio da se determinišu ovi faktori kod hospitalizovanih gastroenteroloških bolesnika.

Metode. Nitritivni status (NS) 650 gastroentroloških bolesnika je procenjivan na prijemu i na otpustu pomoću šest parametara procene: nenamerni gubitak težine, broj limfocita, koncentracija albumina u serumu, indeks telesne mase, debljina kožnog nabora tricepsa i obim sredine nadlaknice. Uticaj na NS na otpustu je testiran za deset faktora: pol, starost, oboleli organ, prirodu, težinu i komplikacije bolesti, dužinu hopsitalizacije, pogoršanje pokretnosti tokom hospitalizacije, Karnovski indeks i NS na prijemu. Među faktorima, koji tokom hospitalizacije značajno utiču na pothranjenost, definisani su faktori rizika.

Rezultati. Za sedam faktora je dobijeno da su nezavisni prediktori pothranjenosti. NS na prijemu je bio primarni faktor rizika (Forwald: Wald multivarijantna logistička regresiona analiza, p<0.001 za pet primenjenih parametara procene). Ostali faktori, dobijeni procenom prema 1-3 parametra, označeni su kao sekundarni faktori rizika: teška aktivnost bolesti, malignitet, postojanje komplikacija, muški pol, hospitalizacija preko 14 dana i pogoršanje pokretnosti tokom hospitalizacije, (Forwald: Wald multivarijantna logistička regresiona analiza, p od 0.001 do 0.027) Zaključak. Postoji sedam faktora rizika za pothranjenost gastroenteroloških bolesnika za vreme hospitalizacije. Pravovremena i adekvatna nutritivna podrška kod ovih bolesnika može da spreči nastanak intrahopsitalne pothranjenosti i njen negativan uticaj na klinički ishod.

KLJUČNE REČI: gastrointestinale bolesti, hospitalizacija, pothranjenost, faktori rizika

Risk factors for malnutrition among hospitalized gastroenterological patients
INTRODUCTION

Malnutrition is a serious health problem that affects more than 20% of patients on hospital admission.\textsuperscript{1-3} It significantly contributes to many adverse outcomes, such as cardiovascular and infective complications, increased morbidity and mortality, prolonged hospitalization, increased hospitalization costs and increased re-admission rates after discharge from the hospital.\textsuperscript{4-8} Although these consequences of poor nutritional status are well known, malnutrition is often undiagnosed on hospital admission. Furthermore, some patients have deterioration of the nutritional status and become malnourished during hospitalization, regardless of their initial nutritional status, but this change often remains unrecognized by the medical staff.\textsuperscript{7,9,10} If we keep in mind that malnutrition can potentially be prevented and treated, identification and definition of risk factors for malnutrition is of particular interest. Many studies investigated the risk factors for malnutrition among the patients on hospital admission.\textsuperscript{1,11-13} However, there is a lack of data regarding the prevalence and risk factors for malnutrition during hospitalization. Some authors highlight gender, age, malignant tumors, reduced food intake, prolonged therapeutic fasting, as factors associated with malnutrition, but the significance of these factors has not been precisely determined.\textsuperscript{14,15}

This study presents our experience with risk factors for malnutrition among hospitalized gastroenterological patients. As well, information is presented how to recognize a risky patient who is a candidate for nutritional intervention.

METHODS

Study design and patient population. A prospective study included 650 gastroenterological patients, treated in our clinic during a fifteen months period. The criteria on inclusion were: age of eighteen years or more, admission Karnofsky score > 40 and length of hospital stay for at least seven days. The study protocol was approved by the local Ethics Committee, and each patient gave written informed consent before entering the study.

Assessment of Nutritional Status. Nutritional status (NS) was evaluated on admission and within 24 hours prior to hospital discharge. We used six nutritional status assessment parameters (NSAPs): unintentional weight loss (WL), lymphocyte counts (LYM), serum albumin concentration (ALB), body mass index (BMI), triceps skinfold thickness (TSF) and mid-upper arm muscle circumference (MAMC). In the patients with hypersplenism and ascites NS was not evaluated according to lymphocyte counts and weight loss respectively.
BMI (kg/m²) was calculated as weight (kg) divided by the square of the height (m²). In the case of ascites, BMI was defined using the Powel-Tuck equation. TSF and mid-upper arm circumference (MAC) were determined at the mid-point between the acromion and olecranon processes of the non-dominant side, by callipers and tape. MAMC was estimated using the following formula: MAMC (cm) = MAC (cm) − 3.14 x TSF (cm).

According to NS on admission and at discharge, patients were classified into two groups: non-malnourished (normally nourished, overweight and obese) and malnourished.

**Factors influencing the NS during hospitalization.** The influence on NS was tested for the following ten factors: gender, age, affected organ, the nature and severity of the disease, complications of the disease, the length of hospitalization, mobility worsening during the hospital stay, NS on admission and Karnofsky score on admission. Karnofsky score was used as a tool for the assessment of functional capacity of the patient.

According to affected organ patients were divided into groups with the disease of: 1. esophagus, stomach and duodenum (ESD), 2. liver and bile ducts (LBD), 3. pancreas and 4. intestine. Biological nature of the disease was defined as benign and malignant. Malignity was confirmed histopathologically and/or by a significant increase of tumor markers in the blood or ascites. Severity of the disease was defined according to ESPEN recommendations as severe, moderate and mild.

Complications included infectious complications (pneumonia, urinary tract infections, sepsis) and organic failure (cardiac, respiratory and renal failure). According to mobility, patients were classified as: mobile (able to carry out usual activities), semi-mobile (need some help of hospital staff, particularly for activities that require leaving the hospital room) and stationary (bedridden).

**Risk factors for malnutrition during hospitalization.** Risk factors were determined among the factors that significantly influenced malnutrition during hospitalization. Risk factors that have been obtained by estimation of nutritional status according to the 4-6 NSAPs were qualified as the primary, while those that have been obtained by estimation according to the 1-3 NSAPs were qualified as the secondary risk factors.

**Statistical analysis.**

Statistical analysis was performed using SPSS 11.5 for Windows software (SPSS, Inc., Chicago, IL), and p value of < 0.05 was considered to be statistically significant. The Student’s t-test for parametric data, and the Mann-Whitney U-test for categorical data, were performed to compare characteristics between two groups. Correlation between two
variables was tested by binary logistic analysis. Prediction of malnutrition at discharge was determined using Forwald: Wald multivariate logistic regression analysis.

**RESULTS**

**Characteristics of the patients.** During the study period 989 consecutive patients were screened. We excluded from the study 339 patients: sixty-seven patients at screening did not qualify for participation in the study, in one hundred and eighty-six patients length of hospital stay was shorter than seven days, forty-two patients had a lethal outcome in the hospital and forty-four patients left the study for their own reasons. The study was completed by 650 patients: 360 males and 290 females. Average values for age, Karnofsky score, and length of hospitalization were 60.3 ± 16.1; 94.8 ± 8.8 and 13.5 ± 6.7 days respectively. Malignant disease was diagnosed in 236 (36.30%) patients. The most common were intestinal diseases (40.92%), followed by the LBD (34.46%), pancreatic (14.16%) and ESD diseases (10.46%).

**Assessment of Nutritional Status.** On hospital admission, depending on the NSAPs we used, malnutrition was diagnosed in 7.7-31.7% of patients, while 68.3-92.3% of patients were non-malnourished. At discharge, malnutrition was diagnosed in 8.0-38.2% of patients, while 61.8-92% were non malnourished (Table 1).

**Factors influencing the NS during hospitalization.**

- **Gender.** Malnutrition was significantly more common in male, if the NSAPs were MAMC (Binary logistic analysis; \( p < 0.001 \)) and ALB (Binary logistic analysis; \( p = 0.040 \))
- **Age.** Regardless of the NSAP applied, the average age was similar for malnourished and non-malnourished patients at discharge (Student's t-test; \( p > 0.05 \))
- **Affected organ.** Regardless of the NSAP applied, malnutrition was more common in the patients with intestinal disease and LBD disease, than in the patients with disease of ESD and pancreas. These differences were statistically significant if the assessment parameter was ALB (Binary logistic analysis; \( p = 0.035 \)).
- **The nature, severity and complications of the disease.** Regardless of the NSAP applied, malnutrition was significantly more common in the patients with malignant disease (Binary logistic analysis; \( p \text{ from } <0.001 \text{ to } 0.028 \)), with severe disease (Binary logistic analysis; \( p \text{ from } \)}
0.001 to 0.006), and with complications of the disease (Binary logistic analysis; p from < 0.001 to 0.013).

- **The length of hospitalization.** The average length of hospitalization was higher in patients who were malnourished at discharge, but these differences were statistically significant if the assessment parameters were BMI (Student's t-test; p=0.005), TSF (Student's t-test; p=0.020) or ALB (Student's t-test; p<0.001). Furthermore, malnutrition was significantly more common in patients with hospitalization longer than 14 days if the assessment parameters were WL (Binary logistic analysis; p=0.022), TSF (Binary logistic analysis; p=0.030) or ALB (Binary logistic analysis; p<0.001).

- **Mobility worsening during the hospital stay.** Malnutrition at discharge was significantly more common in the patients with mobility worsening during the hospital stay than in the patients without mobility worsening. The differences were not statistically significant only if the assessment parameters was TSF (Binary logistic analysis p>0.05).

- **Karnofsky score on admission.** The average Karnofsky score on admission and at discharge was always significantly lower in patients who were malnourished at discharge (Mann Whitney test; p<0.001). Regardless of the NSAP applied, malnutrition at discharge was significantly more common in the patients with admission Karnofsky score ≤ 80, than in the patients with admission Karnofsky score >80 (Binary logistic analysis; p<0.001).

- **Nutritional status on admission.** Malnutrition at discharge was more common in the patients who were malnourished on admission, than in the patients who were non-malnourished on admission. These differences were not statistically significant only, if the assessment parameters was WL (Binary logistic analysis p>0.05).

**Risk factors for malnutrition during hospitalization.** There are 9 factors that may influence NS during hospitalization (Table 2). Six of them influence the NS according the evaluation of NS with 5 or all 6 parameters: nutritional status on admission, mobility worsening during the hospital stay, Karnofsky score on admission, the nature, severity and complications of the disease. The remaining three factors influence the NS under certain conditions: gender, affected organ and the length of hospitalization.

Seven factors were found (Forwald: Wald multivariate logistic regression analysis) to be the independent predictors for malnutrition during hospitalization. Only NS on admission was obtained in the evaluation according to more than half of NSAPs, therefore it was considered as primary risk factor. The other six factors: severe disease activity, malignant
disease, the existence of complications, male gender, the length of hospitalization > 14 days, and mobility worsening during the hospital stay, were obtained in the evaluation according to 1-3 NSAPs, therefore they were considered as secondary risk factors. (Table 3).

DISCUSSION

Although interest and awareness of the clinical significance of nutritional status have existed for over forty years, malnutrition is a problem that is still present, even in large hospitals. Previous studies have shown that the prevalence of malnutrition on hospital admission is in the range from 22% to 73%. In our study, depending on the NSAPs we used, malnutrition on hospital admission was diagnosed in 7.7-31.7% of patients, which is partly in accordance with the results of the other authors. Probably, a lower percentage of malnutrition could be explained by the specificity of our series, which only included gastroenterological patients. The percentage of malnourished patients at discharge was higher by 0.7-6.5%, and malnutrition existed in 8.0-38.2% of our patients. Compared to admission, at discharge 0.6-16% patient had a deterioration in nutritional status. Similar results have been published by some other authors, who reported a significant decrease in MAMC, fat-free mass, albumin level, weight and BMI during hospitalization. In our study there was a decrease in the values of all NSAPs, except lymphocytes.

Risk factors for malnutrition during hospitalization

Gender and age. According to our results, male gender is a secondary risk factor for malnutrition during hospitalization. This is in accordance with the results obtained by the other authors. The result of our study could be explained by the higher prevalence of malignancies among men and greater weight loss in men than in women during hospitalization. Although malnutrition often accompanies older age, and older patients are at increased risk for malnutrition at both, admission and discharge, in our patients average age was similar for malnourished and non-malnourished patients at discharge. In the study of Kang, malnutrition was higher in the patients over 70 years, while Zhu showed that malnutrition at discharge was significantly higher at age 65 and older. The difference in results between our and the other studies is probably related to the specificity of our series, which consisted of gastroenterological patients only, while most other studies included patients with various internal and neurological diseases.
**Affected organ.** Generally, in the patients with gastroenterological diseases, the prevalence and the risk of hospital malnutrition is higher than in patients with other diseases, due to impaired digestion and absorption, loss of appetite, prolonged therapeutic fasting and increased nutritional requirements. Following the changes in the nutritional status of his patients, Cui found a significant reduction in the body weight and calf circumference in the patients with benign digestive tract disease at their discharge from the hospital. In our study malnutrition was more common in the patients with intestinal disease and LBD disease, probably due to the higher prevalence of malignant diseases in these patients, but they were not found to be independent predictors for malnutrition during hospitalization. This result is similar to the results of some other studies. 

**Severe disease activity and malignant disease.** In our series severe disease activity and malignancy were secondary risk factors for malnutrition among hospitalized patients. Severe disease activity is thought to cause increased nutritional requirements due to stress metabolism. Therefore, many authors agree that the risk of intrahospital malnutrition correlates with the severity of the disease and that malnutrition is more pronounced in advanced stages of the disease. There is no doubt regarding the association between malignant disease and nutritional status. It is known that numerous metabolic disorders and negative energy balance in malignancies lead to malnutrition and cachexia. According to the results of other studies, the prevalence of hospital malnutrition is high in oncology patients. Pirlih pointed to malignancy as one of three independent predictors of malnutrition on hospital admission. However, in the current literature, association between malignant disease and malnutrition during hospitalization has been less studied. We found that malignancy is risk factor for malnutrition during hospitalization. Similar results were published by some other authors. An interesting result of Panella is that nutritional status is not associated with the stage of malignancy.

**Complications of the disease.** In our patients the presence of complications was a secondary risk factor for malnutrition during hospitalization. There is evidence in the literature that most of these conditions are characterized by hypermetabolism, due to the action of proinflammatory cytokines. Unlike many clinical and epidemiological studies, that define malnutrition as a risk factor for infection and poor outcome, studies that define clinical complications as a risk factor for malnutrition are rare. Pinchcofsky and Kinyoki considered persistent fever a risk factor for deteriorating nutritional status of adult
hospitalized patients and children under the age of 5 years respectively.\textsuperscript{47,48} The results of some studies indicate that the presence of infection adversely affects nutritional status in surgical and nonsurgical patients.\textsuperscript{14,37,49}

\textit{The lenght of hospitalization}. Most authors agree that prolonging hospitalization increases the risk of malnutrition.\textsuperscript{49,50,51} In his study Pinchcofsky found significant decreases in nutritional parameters after three weeks of hospitalisation.\textsuperscript{47} Weinsier demonstrated that hospitalization longer than 14 days was critical for the onset of malnutrition.\textsuperscript{52} This is the result obtained in our series also. The authors consider that patients during hospitalization have higher nutrient needs and lower appetite due to inflammatory processes associated with the disease.\textsuperscript{53}

\textit{Mobility worsening during the hospital stay}. Although recommended in various tests for initial nutritional status screening, mobility worsening has been less discussed in studies to date. According to our results mobility worsening is a risk factor for hospital malnutrition. This result is in line with the results of some other studies.\textsuperscript{25,37,54} It is not surprising, since mobility is a component of a patient's functional ability, substantial for performing daily activities independently.

\textit{Karnofsky score on admission}. In our study malnutrition at discharge was significantly more common in the patients with admission Karnofsky score $\leq 80$, but we did not find that it is an independent predictor for malnutrition. Although the results of some other studies show that malnutrition is associated with a lower Karnofsky score, none of them pointed the Karnofsky score as a risk factor for malnutrition.\textsuperscript{55-57} In these studies a low Karnofsky score could be a consequence, rather than a cause of malnutrition.

\textit{Nutritional status on admission}. According to our results, nutritional status on admission is the only primary risk factor for malnutrition at hospital discharge. Doctors must be aware that patients may already be malnourished on admission and that 35%-70% of hospitalized patients do not consume enough calories to meet their nutritional needs.\textsuperscript{58} In the study by McWhirter patients who were severely malnourished on admission had the greatest weight loss at discharge.\textsuperscript{59} Similar results have been published by some other authors.\textsuperscript{5,15,17,60}

\textbf{Conclusion}. There are seven risk factors for malnutrition of gastroenterological patients during hospitalization: one primary and six secondary. Primary risk factor is NS on admission, while severe disease activity, malignancy, the existence of complications, male gender, hospitalization $>14$ days, and mobility worsening during the hospitalization are
secondary risk factors. Clinicians should pay more attention to the identification and continuous monitoring of these factors and patient's nutritional status during hospitalization. Only in this way, it will be possible to provide timely and adequate nutritional support and prevent/treat malnutrition and its negative influence on clinical outcome.

**Limitation of the study.** This paper has limitations, which we want to mention. Firstly, only patients from the one gastroenterologic clinic were included, so the results might have been different if the study had been conducted in multiple centers, including gastroenterology departments outside university clinics. Secondly, according to the inclusion criteria, patients who participated in the study had Karnofsky score over 40. As Karnofsky score indicates functional capacity of the patients, the inclusion of a patients with a lower score might increase the percentage of malnourished patients on admission. Considering these limitations, the next study should certainly be designed to be multicenter and to include a wider patient population.

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Table 1.

Nutritional status according to different NSAPs

| NSAP | Patients | Admission | | | Discharge | | |
|------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | TOTAL | Non-malnourished | Malnourished | Non-malnourished | Malnourished | |
| WL | 620¹ | 496 (80.0%) | 124 (20.0%) | 486 (78.4%) | 134 (21.6%) | |
| BMI | 650 | 600 (92.3%) | 50 (7.7%) | 598 (92.0%) | 52 (8.0%) | |
| TSF | 650 | 578 (88.9%) | 72 (11.1%) | 568 (87.4%) | 82 (12.6%) | |
| MAMC | 650 | 457 (70.3%) | 193 (29.7%) | 458 (70.5%) | 192 (29.5%) | |
| ALB | 650 | 444 (68.3%) | 206 (31.7%) | 402 (61.8%) | 248 (38.2%) | |
| LYM | 636² | 474 (74.5%) | 162 (25.5%) | 468 (73.6%) | 168 (26.4%) | |

NSAP - nutritional status assessment parameter, WL - weight loss, BMI - body mass index, TSF - triceps skinfold thickness, MAMC - mid-upper arm muscle circumference, ALB - serum albumin concentration, LYM - lymphocyte counts; ¹ Thirty patients with ascites were not analyzed; ² Fourteen patients with hypersplenism were not analyzed

Table 2.

Factors significantly influencing the NS at discharge (Binary logistic analysis)

| FACTORS | WL P | BMI P | TSF P | MAMC P | ALB P | LYM P |
|---------|------|------|-------|--------|-------|-------|
| 1 Gender | -    | -    | -     | 0.001  | 0.040 | -     |
| 2 Affected organ | -    | -    | -     | -      | 0.035 | -     |
| 3 The nature of the disease | 0.001 | 0.007 | 0.013 | 0.028  | 0.001 | 0.001 |
| 4 Severity of the disease | 0.004 | 0.001 | 0.002 | 0.003  | 0.001 | 0.001 |
| 5 Complications of the disease | 0.001 | 0.001 | 0.001 | 0.001  | 0.001 | 0.013 |
| 6 Karnofsky(admission) ≤ 80 | 0.001 | 0.001 | 0.001 | 0.001  | 0.001 | 0.001 |
| 7 Hospitalization>14 days | 0.022 | -     | 0.030 | -      | 0.001 | -     |
| 8 Mobility worsening | 0.003 | 0.007 | -     | 0.001  | 0.001 | 0.024 |
| 9 NS on admission | -    | 0.001 | 0.001 | 0.001  | 0.001 | 0.001 |

NS - nutritional status, WL - weight loss at discharge, BMI - body mass index, TSF - triceps skinfold thickness, MAMC - mid-upper arm muscle circumference, ALB - serum albumin concentration, LYM - lymphocyte counts; P- Probability
Table 3.

Risk factors for malnutrition at discharge

| FACTORS                     | WL P | BMI P | TSF P | MAMC P | ALB P | LYM P |
|------------------------------|------|-------|-------|--------|-------|-------|
| 1 Gender                     | -    | -     | -     | 0.001  | -     | -     |
| 2 The nature of the disease  | 0.026| -     | -     | -      | -     | -     |
| 3 Severity of the disease    | -    | -     | -     | 0.001  | 0.002 | 0.021 |
| 4 Complications of the disease| 0.001| -     | -     | 0.027  | 0.001 | -     |
| 5 Hospitalization>14 days    | -    | -     | -     | -      | 0.016 | -     |
| 6 Mobility worsening         | -    | -     | -     | 0.001  | -     | 0.014 |
| 7 NS on admission            | -    | 0.001 | 0.001 | 0.001  | 0.001 | 0.001 |

Forwald: Wald multivariate logistic regression analysis; P- Probability. Relative risks (RR) and confidence intervals (CI) are: for Gender (RR=0.335; CI=0.177-0.634); for The nature of the disease (RR=1.594; CI=1.058-2.402); for Severity of the disease (RR=1.717-2.249; CI=1.085-3.696); for Complications of the disease (RR=3.887-4.830; CI=1.752-7.272 / 8.572-8.621); for Hospitalization >14 days (RR=1.778; CI=1.111-2.844); for Mobility worsening (RR=0.103-0.245; CI=0.028-0.079 / 0.372-0.756); for NS on admission (RR=35.976-139.059; CI=21.404-69.462 / 60.471-278.385).

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