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Trabajo Original

Paciente crítico

Association between length of hospital stay before and after surgery and nutritional risk according to NRE-2017 – A secondary analysis of a cohort study

Asociación entre duración de la estancia hospitalaria antes y después de la cirugía y riesgo nutricional según la NRE-2017: análisis secundario de un estudio de cohortes

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Abstract

Aim: to evaluate the predictive ability of the Nutritional Risk Emergency - 2017 (NRE) to predict prolonged length of stay, ICU admission intra-mortality and readmission, severe postoperative complications.

Methods: a prospective cohort was conducted with surgical patients admitted in a public tertiary hospital. The NRE-2017 tool was applied for detecting malnutrition risk in hospitalized patients. Surgical complications were assessed by Clavien-Dindo. Patients were followed during hospitalization to identify length of stay as well as stay after surgery in the Intensive Care Unit (ICU). Regression analysis was performed to assess the association between risk of malnutrition and clinical outcomes.

Results: we included 162 elective surgery patients; 79 patients were identified with nutritional risk using the NRE-2017 (≥ 1.5) tool and 83 without nutritional risk. Patients with nutritional risk were at higher risk of prolonged hospitalization [18 (10-36) days vs. 13 (7-23 days); *p*: 0.006] and ICU hospitalization [6 (2-14 days vs. 3.5 (1-7 days; *p*: 0.020]. There was an association between surgical complications and nutritional risk independently, but the significance was lost when adjusting the analysis. There was no association with mortality and readmission in this sample of patients.

Conclusion: the NRE-2017 tool was associated with hospital stay in those patients at nutritional risk, however there was no association with mortality and readmission.

Keywords:

Nutritional risk. Nutritional screening. Mortality. Surgical patients.

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Resumen

Objetivo: evaluar la capacidad predictiva de la herramienta Emergencia de Riesgo Nutricional-2017 (NRE) para predecir la estancia prolongada, la mortalidad y el reingreso en la UCI, y las complicaciones postoperatorias graves.

Métodos: se estudió una cohorte prospectiva con pacientes quirúrgicos ingresados en un hospital público terciario. Se aplicó la herramienta NRE-2017 para la detección del riesgo de desnutrición en pacientes hospitalizados. El Clavien-Dindo evaluó las complicaciones quirúrgicas. Los pacientes fueron seguidos durante la hospitalización para identificar la duración de la estancia, así como la estancia después de la cirugía en la Unidad de Cuidados Intensivos (UCI). Se realizó un análisis de regresión para evaluar la asociación entre el riesgo de desnutrición y los resultados clínicos.

Resultados: se incluyeron 162 pacientes de cirugía electiva; se identificaron 79 pacientes con riesgo nutricional mediante la herramienta NRE-2017 (≥ 1,5) y 83 sin riesgo nutricional. Los pacientes con riesgo nutricional tuvieron mayor riesgo de hospitalización prolongada [18 (10-36) días *vs.* 13 (7-23 días); *p*: 0,006] y hospitalización en la UCI [6 (2-14 días *vs.* 3,5 (1-7 días; *p*: 0,020]. Hubo asociación entre complicaciones quirúrgicas y riesgo nutricional de forma independiente, pero se perdió la significancia al ajustar el análisis. No hubo asociación con la mortalidad y el reingreso en esta muestra de pacientes.

Conclusión: la herramienta NRE-2017 se asoció con la estancia hospitalaria en aquellos pacientes con riesgo nutricional; sin embargo, no hubo asociación con la mortalidad y el reingreso.

Palabras claves:

Riesgo nutricional. Cribado nutricional. Mortalidad. Pacientes quirúrgicos.

INTRODUCTION

Malnutrition in surgical patients is prevalent and represents a risk for the development of complications (1-3). In Western Europe, approximately 25 % to 30 % of preoperative surgical patients are at nutritional risk, with a consequent increase in postoperative complications, mortality, prolonged hospitalization, and higher costs (4-7). A multicenter study identified the presence of malnutrition in 55 % of surgical patients, and 19 % of patients were severely malnourished (8).

In fact, malnutrition has been associated with humoral depression, reduced cellular immune function, changes in the inflammatory response system, and delayed or failed surgical wound healing (6). Consequently, these patients have a high incidence of severe complications in the immediate postoperative period (6). Surgical procedures induce metabolic stress and, as a result, a series of trauma responses are activated by the metabolic and endocrine pathways that are the center of the body's compensatory return to surgical trauma (9). In addition, these responses mobilize energy substrates, conserve volume, homeostasis, and induce the inflammatory response (10).

Several malnutrition screening tools have been applied in hospitals, some more sophisticated and others simpler, but these have few validations in clinical results (11). Although there is no consensus on the best instrument to be applied in the elderly and surgical patients to detect malnutrition in hospitalized patients in general, the American Society for Parenteral and Enteral Nutrition (ASPEN) suggests the use of the Subjective Global Assessment (SGA). There is well-established evidence for the ability of SGA to predict survival in adult and elderly patients, with well-nourished patients having longer survival than malnourished patients (12,13). An ideal nutritional screening instrument should be easy and quick to apply, in addition to having a good performance in detecting nutritional risk (14).

In this sense, in 2017, a new easy-to-apply tool for nutritional screening was proposed and validated, the Nutritional Risk Emergency-2017 (NRE-2017), which showed good accuracy when compared to NRS-2002 in 748 patients in the emergency department (15). The NRE-2017 was performed to screen hospitalized patients and considers unintentional weight loss in the last 6 months, reduction in food intake in the last two weeks, metabolic demand of the underlying disease, age, and loss of muscle mass (15). The NRE-2017 score of 1.5 was discriminatory in identifying the risk of malnutrition. On the other hand, considering the higher sensitivity (91.7 %) and acceptable specificity (68.5 %), a score NRE2017 1.0 was able to detect the risk of malnutrition (15).

According to the European Society of Clinical Nutrition and Metabolism (ESPEN), screening, nutritional assessment and nutritional intervention of surgical patients can prevent weight loss, as well as preserve the intestinal microbiota and improve functional performance (16).

In view of the above, the present study aimed to evaluate the relationship of the nutritional screening tool (NRE-2017) in predicting postoperative outcomes, such as prolonged hospitalization, ICU admission, postoperative complications, readmission, and death in patients undergoing elective surgeries.

MATERIALS AND METHODS

This is a secondary analysis of a prospective cohort study (17) (unpublished), conducted between July 2018 and May 2019, including patients admitted for elective surgery at a tertiary public hospital. The study protocol was approved by the Research Ethics Committee of the hospital (approval number 3,461,904) and all patients signed an informed consent form prior to data collection.

The sampling process considered the inclusion of adult patients aged 18 years or older who were hospitalized with indication for elective surgery. Among the hospitalized patients, patients with edema or amputation of the lower limbs, inability to walk or unable to respond to detailed nutritional anamnesis were excluded.

The sample size calculation was based on a study conducted by Garcia et al. (18), considering the association between nutritional risk and length of hospital stay in patients undergoing elective surgeries at a teaching hospital in southern Brazil. The length of hospital stay was evaluated among patients with medium and high nutritional risk (33.1 %) and low nutritional risk (66.9 %), with a power of 80 % and losses and refusals of 10 %, and a sample of 162 individuals was estimated to be necessary.

The information was obtained through a secondary database from a survey conducted between 2018 and 2019 and the analysis of medical records. The variables investigated were: data from the NRE-2017 and SGA; sociodemographic (age, sex, ethnicity) and anthropometric data; clinical history; length of hospital stay; postoperative complications; and hospitalization outcome. Data collection was performed within the first 48 hours after hospital admission by a trained nutritionist and three nutrition students. A standardized form was used, filled out based on data obtained from medical records and anamnesis performed at the bedside, along with anthropometric evaluation. Clinical data regarding the reason for hospitalization and previous medical history were obtained from electronic medical records.

Nutritional risk screening was performed using the NRE-2017 tool, including six dichotomous variables (with score ranging from 0.25 to 1.0) related to advanced age, metabolic stress of the disease, decreased appetite, change in food consistency, unintentional weight loss, and loss of muscle mass. Patients were considered at nutritional risk when NRE-2017 was ≥ 1.5 points (15).

Nutritional anamnesis was performed through the Subjective Global Assessment (SGA) (19), considering the percentage of weight loss, presence of gastrointestinal symptoms and changes in food intake, functional capacity, metabolic stress of the disease and loss of muscle mass, subcutaneous fat, edema, and ascites according to physical examination. Patients were classified as well-nourished (SGA-A), moderately or suspected malnutrition (SGA-B) and severely malnourished (SGA-C) (19).

Anthropometric data included body weight and height measured on a scale with an attached Filizola® stadiometer. The patient's usual weight (6 months) was asked and used to calculate the percentage of weight loss considering the measured weight.

Postoperative complications were evaluated using the Clavien-Dindo classification, classified by grades (I, II, III-IIIa, IIIb, IV-IVa, IVb and V) in ascending order according to the severity of the complication and based on the type of treatment used to correct it (20,21). Grade I corresponds to — Any deviation from the ideal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions. Grade II — Requires pharmacological treatment with drugs other than those allowed for complications Grade I; blood transfusion and total parenteral nutrition are also included. Grade III — Requires surgical, endoscopic, or radiological intervention (where III a. Intervention without general anesthesia; III b. Intervention under general anaesthesia). Grade IV — Life-threatening complication (including CNS): brain hemorrhage, ischemic stroke, subarachnoid hemorrhage, but excludes transient ischemic attacks or ICU need (IV a. Single-organ dysfunction (including dialysis); IV b. Multi-organ dysfunction). Grade IV: death (20,21).

Information regarding the surgery performed, surgical size (small, medium or large) (21), the duration of the surgery, and the classification of the physical status according to the American Association of Anaesthesia (ASA) score (22) were collected from the patient's medical records, and were recorded by the surgical team as routine care. ASA I: normal, ASA II: mild systemic disease (e.g., hypertension, diabetes); ASA III: Severe non-disabling systemic disease; ASA IV: severe, disabling, life-threatening systemic disease; ASA V: minimum life expectancy, regardless of surgery. For data analysis, the reason for hospitalization was grouped according to medical specialty.

The outcomes investigated were length of hospital stay, postoperative intensive care unit stay, postoperative complications (Clavien-Dindo classification), in-hospital mortality, and readmission. The length of hospital stay and post-surgical ICU stay were calculated by subtracting the date of hospital discharge (or death) and the date of admission or surgery, respectively. Patients were followed up through the electronic medical record until hospital discharge for evaluation of postoperative complications, readmission, and mortality. The complications, according to Clavien-Dindo, were identified as severe (yes/no) complications.

Quantitative variables were expressed as mean and standard deviation (parametric distribution) or median and interquartile range (non-parametric distribution) and categorical variables were expressed as absolute and relative frequencies. The NRE-2017 was stratified according to nutritional risk. Comparisons between patients at and without risk of malnutrition were performed using the Student's t-test, Man-Whitney test, Chi-square/Fisher's exact test, as appropriate. Poisson regression and binary logistics were used to evaluate the association between risk of malnutrition and clinical outcomes (ICU admission, severe postoperative complications, and death) to obtain the measures of association (relative risk) and their respective 95 % confidence intervals (95 % CI). Two models of analysis were considered: unadjusted and adjusted. We considered adjustment for age, sex, presence of cancer, and ASA classification. All analyses were performed in the software SPSS version 21.0 and $p < 0.05$ values were considered statistically significant.

RESULTS

Table I shows the general characteristics of the sample. The study included 162 patients, with a mean age of 59.7 years (± 14 years) and most of whom were male — 51.9 % ($n = 84$); 74.7 % ($n = 121$) were of white ethnicity. Most patients (54.9 %, $n = 89$) had oncology as their medical specialty. Regarding surgery, 52.8 % ($n = 84$) underwent minor surgery and 60.8 % ($n = 76$) had ASA II classification (mild systemic disease). Regarding nutritional risk, 48.8 % ($n = 79$) of hospitalized patients presented nutritional risk according to NRE-2017 (≥ 1.5 points). The median length of hospital stay and ICU stay were 14 and 4 days, respectively. The frequency of complications (Clavien-Dindo) among patients was 11.1 % ($n = 18$), and the incidence of in-hospital death was 4.3 % ($n = 7$).

The relationship between clinical variables and nutritional risk is shown in table II. Patients at nutritional risk (NRE ≥ 1.5 points) ($n = 79$) were older (mean age, 65.1 vs. 54.4 years, $p < 0.001$), mostly male (60.8 % vs. 39.2 % female). In addition, in the group with nutritional risk by NRE (NRE ≥ 1.5 points) there was a higher prevalence of cancer patients (*n* = 53 [67 %]), longer hospitalization time (18 days vs. 13, *p* = 0.006), and had more days in the intensive care unit (6 vs. 3.5 days, *p*: 0.020) when compared to patients without risk for NRE.

Table I. General characteristics of the sample of hospitalized surgical patients

Variables	*n* = 162
Age (years)	59.7 ± 14.0
Gender	
Male	84 (51.9)
Marital status	
Married/Stable union	90 (55.6)
Ethnics, n (%)	
White	121 (74.7)
NRE-2017 – n (%)	
Without risk	83 (51.2)
At risk	79 (48.8)
SGA – n (%)	
Well nourished	89 (54.9)
Moderate malnutrition	55 (34.0)
Severe malnutrition	18 (11.1)
Types of surgeries	
Oncology	89 (54.9)
Gastroenterology	29 (17.9)
Nephrology	10 (6.2)
ASA classification (n = 125)	
I	11 (8.8)
II	76 (60.8)
III	36 (28.8)
IVB	2 (1.6)
Surgery	
Minor surgery	84 (52.8)
Middle surgery	36 (22.6)
Major surgery	39 (24.5)
Admission in ICU	7 (4.5)
Complication after surgery	
No	144 (88.9)
Yes	18 (11.1)
LOS (days)	14 (8-26)*
LOS after surgery (days)	4 (1.5-8)*
Mortality in hospital	7 (4.3)

**Median (P25-P75). NRE: Nutritional Risk in Emergency; SGA: subjective global assessment; LOS: length of stay; ASA: American Society of Anesthesiology; ICU: intensive care unit.*

The association between NRE-2017 and outcomes is shown in table III. NRE ≥ 1.5, indicating nutritional risk, was an independent predictor of prolonged length of hospital stay (> 14 days) [RR: 1.60, 95 % CI (1.49-1.71), *p* < 0.001], length of stay in UTI [RR: 2.0, 95 % CI (1.80-2.27), *p* < 0.001] and complications after surgery [RR: 3.16, 95 % CI (1.07-9.31), *p*: 0.037].

After adjusting for confounding factors, NRE ≥ 1.5 maintained an association with length of stay (> 14 days) and length of ICU stay (after surgery), with RR: 1.41 (95 % CI, 1.28-1.55) and RR: 1.87 (95 % CI, 1.62-2.16), respectively. In this sample of patients, there was no significant association with readmissions and mortality.

DISCUSSION

This study aimed to evaluate the association of the NRE-2017 tool in predicting clinical outcomes after elective surgery. The results pointed to a high prevalence of nutritional risk in surgical patients (48.8 %); a higher risk for cancer patients and older patients. NRE ≥ 1.5, indicating nutritional risk, was associated with longer hospital stay and ICU stay (post-surgery).

It is well established in the literature that malnutrition in surgical patients is prevalent and carries a serious risk for the development of complications (1-6,17). In our sample of surgical patients, the nutritional risk according to the NRE-2017 tool (≥ 1.5 points) was 48.8 %. Like the original validation study of the tool, in which the prevalence of nutritional risk in a sample of 748 hospitalized adults was 38.8 % (95 % CI, 35.4 %-42.5 %). Similarly, a study including 601 hospitalized patients identified nutritional risk by NRE-2017 in 24 % of the sample (23).

It is recommended that individuals at risk of malnutrition be identified by validated screening tools and should be evaluated and treated according to the necessary interventions (24,25). The NRE-2017 is a recent nutritional screening tool, and most studies use the diagnosis of SGA as an exclusive tool at hospital admission (19). The impact of nutritional risk on postoperative outcomes was demonstrated in a meta-analysis that evaluated the nutritional risk and postoperative outcomes of patients undergoing abdominal surgery, and was strongly correlated with increased rates of general and infectious complications, increased mortality, and prolonged hospital stay (26). Other studies have pointed to a linear increase in mortality as nutritional risk increases (18,24).

In our study, the nutritional risk identified by the NRE-2017 tool ≥ 1.5, was associated with longer hospital stays. Patients with NRE ≥ 1.5 remained hospitalized for 18 days (vs. 13 days in the non-risk group) and 6 days in the ICU (after surgery) (vs. 3.5 days compared to patients without nutritional risk for NRE).

Prolonged hospitalization in surgical patients may be related to the nutritional status prior to surgery, complications related to the underlying disease, postoperative complications, and the patient's age. A study with 565 surgical individuals identified that the length of hospital stay had a linear increase according to the increase in nutritional risk.

Table II. Associations between nutritional risk and clinical variables, and validity of the NRE-2017 in predicting in-hospital outcomes in a cohort of surgical patients (*n* = 162)

Variables	Without nutritional risk (*n* = 83)	With nutritional risk (≥ 1.5 points) (*n* = 79)	*p*
Age (years)	54.4 ± 13.8	65,1 ± 12,1	*< 0.001*
Gender, n (%)			
Men	36 (43.4)	48 (60.8)	*0.040*
Women	47 (56.6)	31 (39.2)	
Oncology, n (%)			*0.004*
Yes	36 (43.4)	53 (67.1)	
No	47 (56.6)	26 (32.9)	
ASA classification, n (%) (n = 125)			*0.001*
I/II	56 (83.6)	31 (53.4)	
III/IV	11 (16.4)	27 (46.6)	
Surgery, n (%)			0.114
Minor surgery	37 (45.7)	47 (60.3)	0.060
Middle surgery	19 (23.5)	17 (21.8)	
Major surgery	25 (30.9)	14 (17.9)	
LOS in ICU, *n* (%)	1 (1.3)	6 (7.8)	
Complications, n (%)			*0.063*
No	78 (94.0)	66 (83.5)	
Yes	5 (6.0)	13 (16.5)	
LOS (days)	13 (7-23)	18 (10-36)	*0.006*
LOS > 14 days, *n* (%)	39 (43.4)	46 (55.7)	0.075
LOS after surgery in ICU (days)	3.5 (1-7)	6 (2-14)	*0.020*
LOS after surgery > 4 days, *n* (%)	33 (40.2)	46 (58.2)	*0.034*
Situation after discharge (%)			0.194
Loss	15 (18.1)	17 (21.5)	
Readmission (no)	36 (43.4)	26 (32.9)	
Readmission (yes)	23 (27.7)	19 (24.1)	
Mortality, *n* (%)	9 (10.8)	16 (20.3)	0.150

*ASA: American Association of Anaesthesia; LOS = length of stay. *Adjusted for the variables that entered the model: age, sex, oncology, ASA classification and surgical size.*

Table III. Association between nutritional risk assessed by NRE-2017 and outcomes

Outcome	Variable	RR crude (95 % CI)	*p*-value	RR adjusted (95 % CI)*	*p*-value	RR adjusted (95 % CI)†	*p*-value
LOS	NRE ≥ 1.5 (NUTRITION RISK)	1.60 (1.49-1.71)	< 0.001	1.68 (1.55-1.81)	< 0.001	1.41 (1.28-1.55)	< 0.001
	NRE- withou risk						
LOS ICU	NRE ≥ 1.5 (NUTRITION RISK)	2.030 (1.80-2.27)	< 0.001	2.10 (1.87-2.37)	< 0.001	1.87 (1.62-2.16)	< 0.001
	NRE- withou risk						
Readmission	NRE ≥ 1.5 (NUTRITION RISK)	0.84 (0.33-2.19)	0.73	---	---	---	---
	NRE- withou risk						
Mortality	NRE ≥ 1.5 (NUTRITION RISK)	0.78 (2.72-2.28)	0.66	---	---	---	---
	NRE- withou risk						
Complications	NRE ≥ 1.5 (NUTRITION RISK)	3.16 (1.07-9.31)	0.037	2.85 (0.89-9.12)	0.078		
	NRE- withou risk						

**Adjusted for age and gender; †Adjusted for age, gender, ASA, oncology. LOS: length of stay.*

Patients at high nutritional risk remained hospitalized for four times longer than patients at low risk, reaching a median of 12 days of hospitalization, while patients at medium risk had a median hospitalization time of 6.5 days (18).

In our study, patients with NRE ≥ 1.5 had a 1.4 times higher risk of prolonged hospitalization, as well as a 1.87 times higher risk of ICU stay after surgery, when compared to patients without nutritional risk (15,24), corroborating data from the original NRE-2017 study, in which patients at risk of malnutrition had a two-fold higher relative risk of a prolonged hospital stay (15).

Older patients were associated with higher nutritional risk, corroborating other studies using different screening tools (22,25,26). Similarly, oncology was the medical specialty most associated with nutritional risk, like other previous studies that also listed cancer patients among those with higher nutritional risk, since both the disease and the treatments threaten their nutritional status (28-30). The other clinical outcomes investigated, such as severe postoperative complications, readmission, and death, were significantly higher in the group with nutritional risk by NRE-2017, but it was not associated with mortality alone, with a trend towards an increase in the risk of mortality in those with nutritional risk.

The NRE-2017 nutritional risk screening tool is simple, fast, valid, and low-cost, and can be used to identify nutritional risk in hospitalized surgical patients (15). As a positive aspect, it is easy not to require objective data for implementation, which makes it more practical in situations where the patient does not have the mobility to perform anthropometric measurements or when such information is not included in the patient's records. To confirm its applicability, further studies with surgical and non-surgical hospitalized patients are needed. It is believed that such an instrument can be a component in the routine nutritional care of hospitalized patients, because from the identification of nutritional risk, interventions such as a more detailed assessment or early nutritional therapy can be instituted to minimize the negative consequences of malnutrition. In view of this situation, identifying nutritional risk in a simple and safe way can accelerate nutritional support with the aim of improving the outcomes of surgical patients.

Among the limitations of this study, we highlight the limited sample size, which probably influenced the analysis of negative outcomes when adjusted for gender, age, oncology and ASA, and mortality in isolation. Another point was the heterogeneous sample and the loss of some variables, which may have influenced the results of the study. However, it is important to evaluate the validity of the NRE-2017 nutritional risk screening in predicting clinical outcomes in hospitalized surgical patients.

Nutritional risk is prevalent in hospitalized surgical patients evaluated with the NRE-2017 screening tool and was significantly associated with length of hospital stay (on average 5 days longer) and clinical outcomes in those patients with nutritional risk, however there was no association with mortality. Further studies are needed in different populations.

REFERENCES

1. Putwatana P, Reodecha P, Sirapo-ngam Y, Lertsithichai P, Sumboonnanonda K. Nutrition screening tools and the prediction of postoperative infectious and wound complications: comparison of methods in presence of risk adjustment. Nutr 2005;21(6):691-7. DOI: 10.1016/j.nut.2004.10.015
2. Korfalı G, Gündoğdu H, Aydıntuğ S, Bahar M, Besler T, Moral AR, et al. Nutritional risk of hospitalized patients in Turkey. Clin Nutr 2009;28(5):533-7. DOI: 10.1016/j.clnu.2009.04.015
3. Garth AK, Newsome CM, Simmance N, Crowe TC. Nutritional status, nutrition practices and post-operative complications in patients with gastrointestinal cancer. J Human Nutr Diet 2010;23(4):393-401. DOI: 10.1111/j.1365-277X.2010.01058.x
4. Sorensen J, Kondrup J, Prokopowicz J, Schiesser M, Krähenbühl L, Meier R, et al. EuroOOPS: an international, multicentre study to implement nutritional risk screening and evaluate clinical outcome. Clin Nutr 2008;27(3):340-9. DOI: 10.1016/j.clnu.2008.03.012
5. Correia M, Isabel TD, Dan LW. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. Clin Nutr 2003;22(3):235-9. DOI: 10.1016/s0261-5614(02)00215-7
6. Farreras N, Artigas V, Cardona D, Rius X, Trias M., González JA. Effect of early postoperative enteral immunonutrition on wound healing in patients undergoing surgery for gastric cancer. Clin Nutr 2005;24(1):55-65. DOI: 10.1016/j.clnu.2004.07.002
7. Jie B, Jiang ZM, Nolan MT, Zhu SN, Yu K, Kondrup J. Impact of preoperative nutritional support on clinical outcome in abdominal surgical patients at nutritional risk. Nutr 2012;28(10):1022-7. DOI: 10.1016/j.nut.2012.01.017
8. Correia MI, Caiaffa WT, da Silva AL, Waitzberg DL. Risk factors for malnutrition in patients undergoing gastroenterological and hernia surgery: an analysis of 374 patients. Nutr Hosp 2001;16(2):59-64.
9. Kyrou ICT. Stress hormones: physiological stress and regulation of metabolism. Curr Opin Pharmacol 2009;9(6):787-93. DOI: 10.1016/j.coph.2009.08.007
10. Hansbrough JF, Boyce ST, Cooper ML. Hypermetabolic Response to Trauma. Total Burn Care 2017:16-29.
11. Elia M, Zellipour L, Stratton RJ. To screen or not to screen for adult malnutrition? Clin Nutr 2005;24(6):867-84. DOI: 10.1016/j.clnu.2005.03.004
12. Jones JM. The methodology of nutritional screening and assessment tools. J Human Nutr Diet 2002;15(1):59-71. DOI: 10.1046/j.1365-277x.2002.00327.x
13. Dias MCG, Van Aanholt, DPJ, Catalani LA, Rey JSF, Gonzales MC, Coppini L et al. Triagem e avaliação do estado nutricional. Projeto Diretrizes. São Paulo: Associação Brasileira de Nutrologia, Associação Médica Brasileira, Conselho Federal de Medicina; 2011.
14. Correia MITD. Nutrition screening vs nutrition assessment: what's the difference? Nutr Clin Practice 2018;33(1):62-72. DOI: 10.1177/0884533617719669
15. Marcadenti A, Mendes LL, Rabito EI, Fink JDS, Silva FM. Nutritional risk in emergency-2017: a new simplified proposal for a nutrition screening tool. J Parent Enteral Nutr 2018;42(7):1168-76. DOI: 10.1002/jpen.1147
16. Lobo DN, Gianotti L, Adiamah A, Barazzoni R, Deutz NE, Dhatariya K et al. Perioperative nutrition: Recommendations from the ESPEN expert group. Clin Nutr 2020;39(11):3211-27. DOI: 10.1016/j.clnu.2020.03.038
17. Tarnowski MDS, Burgel CF, Dariva AA, Marques IC, Alves LP, Beretta MV, et al. Sarcopenia screening and clinical outcomes in surgical patients: A longitudinal study. Nutr Clin Pract. November 23, 2024. Epub ahead of print. DOI:10.1002/ncp.11243
18. Garcia RS, Tavares LRDC, Pastore CA. Nutritional screening in surgical patients of a teaching hospital from Southern Brazil: the impact of nutritional risk in clinical outcomes. Einstein (Sao Paulo) 2013;11(2):147-52. DOI: 10.1590/s1679-45082013000200002
19. Detsky AS, McLaughlin JR, Baker JP, Johnston N, Whittaker S, Mendelson RA, et al. What is subjective global assessment of nutritional status? JPEN J Parenter Enteral Nutr 1987;11(1):8-13. DOI: 10.1177/014860718701100108
20. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240(2):205-13. DOI: 10.1097/01.sla.0000133083.54934.ae
21. Moreira LF, Pessoa MC, Mattana DS, Schmitz FF, Volkeis BS, Antoniazzi, JL, et al. Cultural adaptation and the Clavien-Dindo surgical complications classification translated to Brazilian Portuguese. Bol Col Bras Cir 2016;43(3):141-8. DOI: 10.1590/0100-69912016003001
22. Daabiss M. American society of anaesthesiologists physical status classification. Indian J Anaesth 2011;55(2):111-5. DOI: 10.4103/0019-5049.79879

23. Araújo Érica TG de, Aquino I de S, Brito RRFF, Teixeira RS de O, Diniz ET. Effect of nutritional assessment on length of hospital stay: Systematic review. RSD 2021;10(7):e24510716468. DOI: 10.33448/rsd-v10i7.16468
24. Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al. Diagnostic criteria for malnutrition–an ESPEN consensus statement. Clin Nutr 2015;34(3):335-40. DOI: 10.1016/j.clnu.2015.03.001
25. Sun Z, Kong XJ, Jing X, Deng RJ, Tian ZB. Nutritional risk screening 2002 as a predictor of postoperative outcomes in patients undergoing abdominal surgery: a systematic review and meta-analysis of prospective cohort studies. PloS one 2015;10(7):e0132857. DOI: 10.1371/journal.pone.0132857
26. Middleton MH, Nazarenko G, Nivison-Smith I, Smerdely P. Prevalence of malnutrition and 12-month incidence of mortality in two Sydney teaching hospitals. Int Med J 2001;31(8):455-61. DOI: 10.1046/j.1445-5994.2001.00109.x
27. Smith J, Doe A, Ali M. Prevalence of malnutrition in hospitalized patients in Lebanon using Nutrition Risk Screening (NRS-2002) and Global Leadership Initiative on Malnutrition (GLIM) criteria and its association with length of stay. J Clin Nutr 2023;45(2):123-34.
28. Lamb CA, Parr J, Lamb EI, Warren MD. Adult malnutrition screening, prevalence and management in a United Kingdom hospital: cross-sectional study. Br J Nutr 2009;102(4):571-5. DOI: 10.1017/S0007114509236038
29. Vidal A, Iglesias MJ, Pertega S, Ayúcar A, Vidal O. Prevalence of malnutrition in medical and surgical wards of a university hospital. Nutr Hosp 2008;23(3):263-7. Spanish.
30. Curtis LJ, Bernier P, Jeejeebhoy K, Allard, J, Duerksen D, Gramlich L, et al. Costs of hospital malnutrition. Clin Nutr 2017;36(5):1391-6. DOI: 10.1016/j.clnu.2016.09.009