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Development, validation and implementation of a program to detect malnutrition with NRS-2002 screening tool in patients, between 16 and 93 years, from the oncology and hematology service from Valencia during 2017 and 2018

Marta PÉREZ DOMÉNECH[1,2], José M. SORIANO[1,2], Juan F. MERINO TORRES[2,3]

1 Food & Health Lab, Institute of Materials Science, University of Valencia, Valencia, Spain.
2 Joint Research Unit on Endocrinology, Nutrition and Clinical Dietetics, University of Valencia-Health Research Institute La Fe, Spain.
3 Department of Endocrinology and Nutrition, University and Polytechnic Hospital La Fe, Spain.

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ABSTRACT

Introduction: Hospital malnutrition (HM) is an increasingly prevalent situation, which involves both an increase in health costs, and also a decrease in the life quality and greater morbimortality. Nutritional screening is essential to detect malnutrition early and avoid these complications.

Objectives: To develop, validate and implement the Nutritional Risk Screening 2002 (NRS-2002) tool at the admission and during the hospitalization of a patient in the oncohematology service in a third level hospital, and know their nutritional status at the admission and the discharge.

Methods: NRS-2002 was performed on all patients admitted to the oncohaematology service, followed by the complete nutritional assessment (NA) to check its validity. NRS-2002 is repeated weekly to determine the degree of malnutrition during the hospital stay.

Results: 573 patients were admitted to the oncohematology service, of which a 34.4% suffered from malnutrition, 44.7% had risk of malnutrition and 20.9% were in good nutritional condition, at the time they were admitted to hospital according to the NRS-2002. In patients admitted for more than a week, NRS-2002 was performed weekly and found that, upon discharge, a 34.4% were malnourished, 50.8% had a risk of malnutrition and the last 14.76% were in good nutritional status; also a 12.3% worsened their nutritional status, the 68.9% maintained it and only a 18.9% improved it. 78.8% of patients with longer admissions require a NA.

Discussion: Due to the high risk of malnutrition in hospital admission, the use of nutritional screening is necessary, both at admission and during hospital stay to avoid nutritional deterioration during the same.

Conclusions: Our results suggest that the NRS-2002 is a simple and effective method for early malnutrition detection.

KEYWORDS

Nutritional screening, hospital malnutrition, malnutrition in cancer patients.

ABREVIATURES

BMI: Body Mass Index.

DRM: Disease-related malnutrition.

GLIM: Global Leadership Initiative on Malnutrition.

HM: hospital malnutrition.

MAC: mid-arm circumference.

MAMC: mid-arm muscle circumference.

NA: complete nutritional assessment.

NRS-2002: Nutritional Risk Screening 2002.

PREDYCES: study of prevalence of malnutrition and associated costs in Spain.

TSF: triceps skinfold.

WLR: weight loss rate.

Correspondencia:
José Miguel Soriano
jose.soriano@uv.es

INTRODUCTION

The World Health Organization describes hospital malnutrition (HM) as a potential but preventable medical complication that influences the outcome of treatments. Hospitalized patients with malnutrition are more likely to prolong their hospital stay, as it is associated with an increased incidence of infections and delayed wound healing, among other consequences[1]. The European Association for Parenteral and Enteral Nutrition defines it as a state that leads to loss of muscle and fat mass, which can cause a decrease in mental and physical functional capacity, as well as a worse response to diseases, which is caused by a decrease in intake and/or assimilation of nutrients[2]. In addition, in cancer patients, immune suppression can usually be caused by malnutrition, surgical trauma, and the tumor's own immunosuppressive capacity[3].

In the ill patient, malnutrition is more precisely called disease-related malnutrition (DRM) since both the disease and the relevant treatment are the main etiopathogenic factors[4]. DRM is a damage caused by the stimulation of systemic inflammation by an underlying disease[2]. It is a multifactorial problem, involving both the disease and its associated factors and the problems resulting from hospitalization. Furthermore, malnutrition has a direct effect on the evolution of the disease, since it has consequences to different organs and systems, worsening the evolution of the patient, increasing morbidity and mortality, reducing their quality of life, and, as a consequence, increasing health expenditure[4,5]. The DRM affects 30 million people in Europe and involves 170 billion euros per year. In Spain, 1.7 million adults are at risk of malnutrition[6].

The Global Leadership Initiative on Malnutrition (GLIM) recently convened experts from leading clinical nutrition societies to standardize the definition of malnutrition and diagnostic criteria for malnutrition. They define undernutrition as: "phenotypic criterion (loss of body weight, low body mass index (BMI) or reduced muscle mass) associated with an etiological criterion (reduced food intake/assimilation or inflammation/burden of disease)"[7].

DH has been a common problem for over 70 years. Currently, several studies show a prevalence in hospitalized patients of 30-50%, however, this problem is not only frequent upon admission, but increases or starts during the hospital stay[8,9]. According to the study of prevalence of malnutrition and associated costs in Spain (PREDYCES), HM affects one in four patients (23%) on hospital admission. This figure increases with age (37% in those over 70 years, and 46-50% in those over 85 years), according to sex (women 25.7%, men 20.7%), in oncological patients (35%), with cardiocirculatory diseases (29%), respiratory diseases (28%) and in hematological patients (36.8%). In addition, the hospital stay of malnourished patients is longer than that of normal-nutrition patients (11.5 and 8.5 days, respectively), as is the hospital cost (12,237 euros versus 6,408 euros). The PREDYCES study concluded: "They are one in four, and cost 50% more"[5,10].

The causes of HM are multifactorial, the disease that the patient suffers stands out, but it is also due to the decrease in the intake, the alteration of the metabolism, the appetite and the absorption of nutrients, the use of anorectic drugs, the increase in losses, the increase in both energy and protein requirements, and even in geriatric patients there are other factors such as dementia, immobilization or the lack of teeth, among others[4].

Many times, on admission, patients already present malnutrition, this is mainly due to the disease they suffer, but, in addition, they can be derived from hospitalization, derived from medical teams or related to health authorities[11].

When the nutritional status is deficient, the immune system, the gastrointestinal tract, the metabolic endocrine system and the cardiorespiratory function are affected, the healing process of the wounds is slowed down, the resistance of the surgical sutures is diminished, the risk of venous thrombosis is favored by the rest, as well as the appearance of pressure ulcers and nosocomial infection, delaying recovery, prolonging hospital stays, increasing the rate of premature readmissions and significantly altering the individual's independence and quality of life, contributing to increased morbidity and negatively impacting on health costs[10,12].

On the other hand, according to the definition of the glossary of terms in clinical malnutrition[13], nutritional screening is: "the presumptive identification, in population groups, by means of rapid action tests, of subjects in a situation of malnutrition or who is at risk of altering their nutritional status, in order to act on them early". This is a preventive method since it detects the risk of suffering from malnutrition. Even if the patients are pre-symptomatic, they may suffer from malnutrition in short period, so acting early and avoiding malnutrition is transcendental. The main objective of nutritional screening is: "to predict the likelihood of an unfavorable prognosis" and "to identify subjects who may benefit from nutritional treatment"[14]. More specifically, in cancer patients, the importance of early detection of malnutrition, through appropriate implemented and validated screening methods in the hospital service, is reflected in facts like that an early nutritional intervention could restore energy balance and improve the outcome of cachexia[15]. Nutritional screening system recommended by ESPEN for inpatients is *Nutritional Risk Screening 2002 (NRS-2002)*[16] which allows normonutrition patients to be discarded more quickly, as no anthropometric measurements are required, which is a great advantage. It is a test with high sensitivity, but low reproducibility[10].

The aim of this study is to develop, validate and implement the NRS-2002 tool at the admission and during the hospital-

ization of a patient in the oncohematology service in a third level hospital, and know their nutritional status at the admission and the discharge.

METHODS

The nutritional screening test NRS-2002 and complete nutritional assessment (NA) was performed on 573 patients, with an inclusion period of one year (June 2017-August 2018), 372 men (64.92%) and 201 women (35.08%), with an average age of 59.46 years, ranging from a minimum of 16 years to a maximum of 93 years, and a median age of 61 years. The oncology and hematology service was chosen for the pioneering implementation of the nutritional screening test and therefore for the study, because patients admitted to these areas are at very high risk of suffering from malnutrition, both on admission and during their stay in hospital. In addition, they are patients with a high time of admission, so it is easier to observe their evolution.

Regarding to this study, the NA was performed in all cases, independently of the nutritional screening test, to assess its usefulness, as well as its efficiency and effectiveness.

Firstly, the computer support was designed, using a clinical management system for hospital patients, Orion Clinic, specifically through direct access to the Dietetics program created to carry out the nutritional screening test.

Once the nutritional screening is done, an alert is generated to the nutrition service by means of a list that indicates the test score corresponding to each patient.

The nutritional screening test used was NRS-2002. If the final test is positive (>3 points), an alert will be generated to the hospital's nutrition service and the NA will be performed. Through this assessment, malnutrition is diagnosed and classified according to its degree of severity.

Finally, when malnutrition is diagnosed, the doctor in charge and the nutrition and endocrinology service will be informed so that they can take the necessary measures to prevent or treat HM.

NA is performed when the nutritional screening test concludes that the patient is at risk of malnutrition or undernutrition. In this study, all patients are tested to ensure that the nutritional screening was performed correctly.

NA consists of anthropometric, biochemical, dietary, and clinical indicators of the patient. Firstly, the personal data are completed, such as age, sex and the pathology he suffers from. These data are noted in the patient's medical history.

Secondly, the anthropometric assessment is performed, where we ask the usual weight; we measure height and weight, the triceps skinfold (TSF) and the mid-arm circumference (MAC); finally, we calculate the weight loss rate (WLR), the BMI and the mid-arm muscle circumference (MAMC). Unintentional WLR as a form of nutritional depletion is commonly seen in aging, cancer, and many chronic diseases23. Once all the data is complete, we compare the TSF, MAC and MAMC data in the percentile table and observe in which percentile our patients are and, therefore, the type of malnutrition and protein depletion they suffer. In our study we measured body mass, height, TSF and MAC. With these data we have calculated the BMI and the MAMC with the International Society for the Advancement of Kinanthropometry method (ISAK)[17].

The biochemical evaluation is extracted from the daily analyses carried out by the doctor in charge. In our study we looked at creatinine, lymphocyte and glomerular filtrate data because they are the only nutritionally relevant data that appear in all daily analyses.

About the dietary indicators, first of all, the type of diet is observed, and a 24-hour record is made, asking the patient or the accompanying person how much food was ingested at each intake. The dietary indicators give information on both the number of requirements covered and the composition of the diet.

The kilocalories and grams of protein of each intake are calculated and added up, calculating the total contribution in the diet. If the patient has any type of supplementation, either oral or by tube, the total intake is noted and calculated. The percentage of covered needs, both in terms of kilocalories and proteins, is then calculated using the following formula:

$$\%\ requirements\ covered = \left(\frac{total\ intake}{requirements}\right) \times 100$$

Finally, the clinical indicators, which are evaluated in a subjective way, either by observation or by asking the patients and, if this is not possible, their companions. In some of them, such as nausea, vomiting, diarrhea or constipation, if the answer is yes, the number of times and the duration of these are further deepened; in the case of dysphagia, what texture is compromised.

Data were summarized using mean (standard deviation) and median (1st, 3rd quartile) for numerical variables, and absolute frequency (relative) for qualitative variables. To measure agreement between the two diagnoses, Cohen's Kappa was calculated for each visit. The level of association

Table 1. Concordance Analysis Summary.

VISIT	KAPPA VALUE
1	0.57
2	0.63
3	0.70
4	0.72

between the variables was measured using the Goodman and Kruskal measure.

RESULTS

The agreement during visit 1 is moderate, with a value k=0.57, increasing progressively in visits 2, 3 and 4 to considerable agreement, with k-values of 0.63, 0.70 and 0.72 respectively (Table 1).

In our study we found out that according to the nutritional screening test NRS-2002, 34.38% were malnourished on hospital admission (197 patients), 44.68% at risk of malnutrition (256 patients) and only 20.94% in good nutritional condition (120 patients) (Figura 1A).

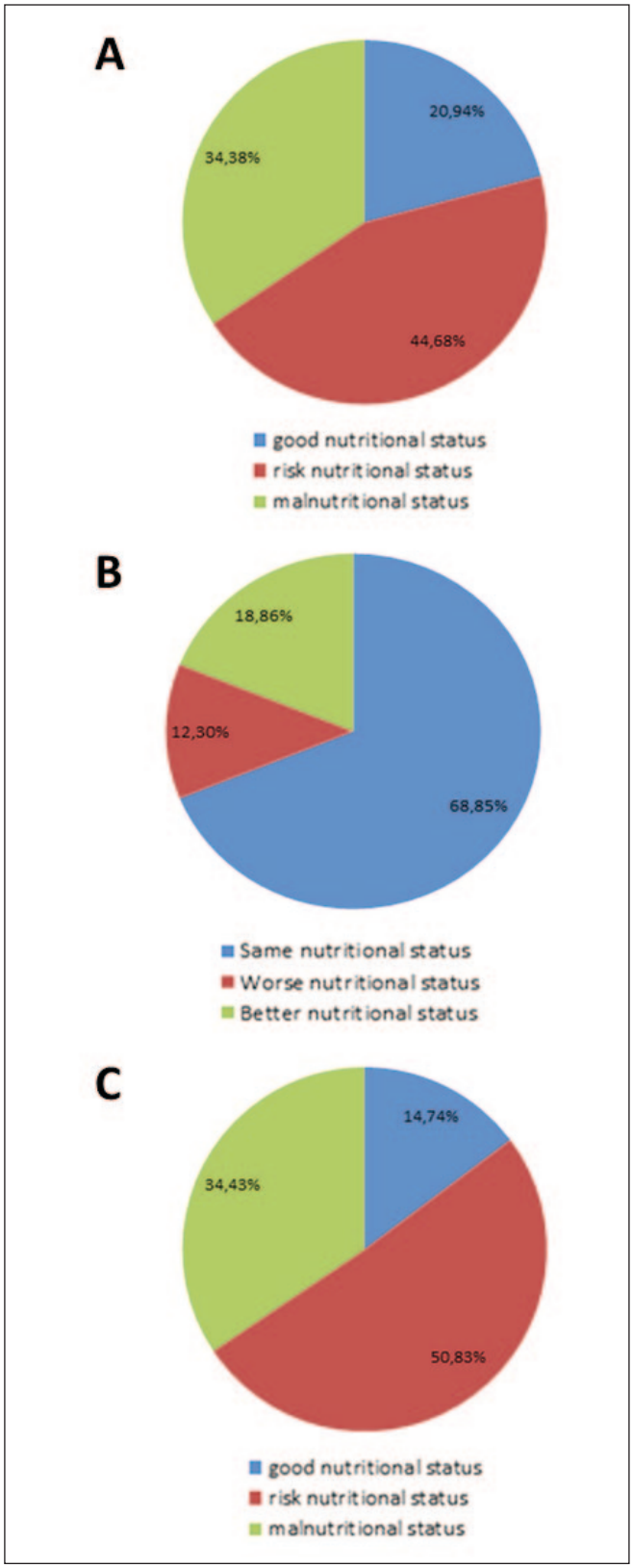
In addition, patients with longer admissions (>1 week) were re-evaluated weekly. 68.86% of patients maintained their nutritional status throughout their stay in hospital, with no improvement or worsening: they remained at normal nutritional status, risk of malnutrition and undernutrition from the time they were admitted to hospital (7.38%, 31.97% and 29.51% respectively). On the other hand, 18.86% of patients improved their nutritional status upon discharge from hospital: they went from risk of malnutrition to normonutrition and from malnourished to risk of malnutrition (7.38% and 11.48% respectively). Finally, the nutritional status of 12.3% of the patients got worse during their stay in hospital: they went from normonutrient to risk of malnutrition and from risk of malnutrition to malnourished (7.38% and 4.92% respectively) (Figura 1B).

It can be seen that, of the 68.86% of patients who maintain their nutritional status, 61.48% are at risk of malnutrition or undernutrition, requiring a NA. If we add to this the 12.3% of patients which their nutritional status worsened during their hospital stay, we conclude that 73.78% of the total patients who are admitted to hospital for more than one week require a NA, and, if necessary, extra nutritional support.

We can see that, at hospital discharge, 34.43% are malnourished, 50.83% at risk of malnutrition and 14.76% with good nutritional status, so that 85.26% of patients need extra nutritional support (Figure 1C).

If we apply the GLIM criteria, we have found that 100% of the patients present an inflammatory load due to the tumor disease they suffer, as well as 26% of the patients ingest ≤50% of the energy requirements for >1 week and 82.4% of the patients ingest ≤100% of the requirements for > 2 weeks. 100% of patients meet at least 1 etiological criterion. On the other hand, with regard to the phenotypical criteria, 55.1% of the patients present a weight loss greater than 5%, 23.4% of the patients present BMI <20 Kg/m2 and 54% of the patients with admissions greater than a week's duration present a decrease in muscle mass measured by the MAMC. 72.3% of the patients present at least 1 phenotypic criterion

Figura 1. Nutritional status of patients al hospital admission (A), evolution of the nutritional status of patients admitted during their hospital stay (B), and nutritional status of patients al hospital discharge (C).



and 100% of the patients present at least 1 etiological criterion, so it is concluded that 72.3% of the patients studied present malnutrition according to GLIM criteria.

DISCUSSION

Gutiérrez et al. conducted a study with a sample of 247 patients hospitalized in a second level hospital, finding that 42% of the patients were at risk of malnutrition in the first 24 hours after admission. In addition, they concluded that there was a significant association between nutritional risk and decreased food intake in the last week, as well as severity of illness, age and gender. On the other hand, a decrease in food intake increased the probability of presenting a nutritional risk by 6.67 times[18]. Barbosa et al. concluded that 46.4% of the 763 patients studied were at nutritional risk, with greater possibilities in men and the elderly. In addition, BMI <20.5 kg/m² and WLR in the last 3 months were the most important factors contributing to the determination of nutritional risk[19]. Burgos et al. concluded that 83% of the 101 chronic patients with complex hospital needs were malnourished or at risk of malnutrition according to the NRS-2002. In addition, they found that malnourished patients had greater home care needs and higher mortality rates during admission and at 5 months after assessment. The factors most strongly associated with malnutrition were BMI and female sex[20]. Li et al. detected the nutritional risk on hospital admission of 745 elderly patients using the NRS-2002 nutritional screening test, obtaining a 39.81% risk of malnutrition. Specifically, 33.38% of patients were at risk of malnutrition and 6.43% were malnourished. The incidence of risk of malnutrition in gastroenterology, hematology and respiratory services was 51.72%, 46.88% and 43.33%, respectively, higher than in other services. It concluded that patients at nutritional risk were more likely to have high hospital stays, and that malnourished or at-risk patients who received extra nutritional support had shorter hospital stays and fewer infectious complications than patients without extra nutritional support[21]. Álvarez et al. conducted a study with 444 cancer patients, presenting 50.2% of the same nutritional risks. The factors most associated with this risk were male gender, age, BMI <20.5, weight loss, poor food intake and hematological tumors[22]. Müller et al. studied all patients admitted for 12 months to the nephrology service of the University Hospital of Bern Inselspital, Switzerland, specifically 696 patients. They found that 35.6% of them were at risk of malnutrition, as well as a significant association between an NRS-2002 result > 3 and higher hospital mortality, and the risk of malnutrition with longer hospital stay and higher hospitalization cost[23]. García et al. carried out a study using the implementation of the NRS-2002 nutritional screening test. In the implementation phase, they studied 1123 patients, finding that 19% were at risk of malnutrition according to the nutritional screening test. Of these, 77% were >70 years old. 27% had higher scores in the section on alteration of nutritional status, 27% in the section on severity of disease and 40% in both sections equally. 25% of the patients at risk according to the NRS-2002 were readmitted in less than 30 days and the mortality rate was 5%. On the other hand, in the consolidation phase, they studied 2527 patients: 15% were at nutritional risk. 73% were > 70 years old[24].

Furthermore, Stollhof et al. examined 1372 hospitalized patients using the NRS-2002 screening test, concluding that 51% of patients were at risk of malnutrition. Differentiating according to the services studied, it was found that 62% of patients in septic surgery were malnourished, 41% of patients in traumatology and 58% of patients in arthroplasty. Moreover, this study finds the additional economic cost of a patient with poor nutritional status to public spending, calculating a total of 290,207.17€ in 2 years of the study, specifically for each male patient was calculated a cost of 7768€, which increased to 7849.72€ after detecting malnutrition (NRS ≥ 3)[25]. Li et al. evaluated 1664 patients with metastatic gastric cancer using the NRS-2002 test, finding that a value >3 in the test is associated with greater postoperative morbidity, higher mortality and shorter progression-free survival than those patients who obtained <3 in the nutritional screening test. In addition, patients with a >3 value tended to have lower serum albumin and less first-line chemotherapy (CT)[26]. Chivu et al. studied at the University General Hospital of Valencia, a tertiary hospital in the Valencian Community, the detection of malnutrition using the Hospital Malnutrition Assessment Tool, which is an unvalidated nutritional screening test. It was found that 33.5% of the patients were at risk of malnutrition. Patients with a positive nutritional screening test were older than normonutrient patients and their body weight decreased by 5-10%. 55.2% of the patients decreased >50% of their usual intake[27].

On the other hand, the Global Subjective Assessment method (GSA) was also used by Moriana et al. to detect malnutrition in a third-grade hospital in Valencia, obtaining that 50% of the 197 patients studied were malnourished. The average stay of malnourished patients was longer than that of patients at risk of malnutrition and normonutrients, 13.5, 12.1 and 6.97 days respectively. The GSA correlated significantly with anthropometric and biochemical parameters of malnutrition[28]. Sremanakova et al. assessed the risk of malnutrition in 727 patients hospitalized after a stroke using the MUST screening test, of the 1101 admitted to this service, meaning that only 66% of the patients were examined. Of these, 78.5% were at low risk of malnutrition, while 4.1% and 17.4% were at medium or high risk of malnutrition, respectively, which adds up to 21.5% of patients at medium to high risk of malnutrition and who should be monitored nutritionally, as they are more likely to have longer hospital stays and a higher risk of mortality (10.9% and 3.5%, respectively). Significantly, and despite the low prevalence of risk of malnutrition in these patients, almost 1/3 of the patients were not evaluated[29]. In fact, the use of NRS-2002 as tool in weight

loss during hospitalization and its relation-ship with the type of disease is very useful[30]. For all these reasons, the importance of implementing a nutritional screening test that detects the DRM early when the patient is admitted to hospital has been sufficiently demonstrated. As far as we know, our study is the first to show that the NRS-2002 nutritional screening test is a useful, valid and highly applicable tool for the early detection of malnutrition and, therefore, to act quickly, avoiding possible complications in an oncohaematology service in a third level hospital.

CONCLUSIONS

In conclusions, nutritional screening based on the Nutritional Risk Screening 2002 presents better concordance analysis as the number of patient reevaluations increases. According to the Nutritional Risk Screening 2002 method, 34.4% of patients admitted to the oncohematology service of the Hospital Politécnico La Fe present malnutrition, 44.7% risk of malnutrition and 20.9% of the patients studied present normonutrition. Furthermore, 12.3% of patients with admissions of more than one week worsened their nutritional status, 68.9% maintain it and only 18.9% improve it. 78.8% of patients with longer admissions require a complete nutritional assessment. At hospital discharge, 34.4% of patients are malnourished, 50.8% are at risk of malnutrition and only 14.8% are in good nutritional condition. Finally, Nutritional Risk Screening 2002 is a suitable method for the early detection of malnutrition in the patient hospitalized in an oncohematology unit. Due to the profile of the patient by their average age, as well as the profile of the center and service where they are institutionalized.

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