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Original

Association between nutritional risk based on the NRS-2002 test and hospital morbidity and mortality

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Abstract

Objective: **To analyse the relationship between the presence of malnutrition (MN), as measured by the NRS-2002 nutritional evaluation, and the rate of morbidity and mortality.**

Design: **Cross-sectional study.**

Setting: **Patients admitted to Mateu Orfila Hospital, the regional hospital for the island of Menorca, Spain.**

Subjects: **1,075 patients who were admitted to Mateu Orfila Hospital (Menorca) who had laboratory studies and a nutritional risk (NR) evaluation available were studied. Those who had a clinical suspicion of MN or those at risk were studied.**

Intervention: **Demographic (age, gender) and clinical (current weight, normal weight, body mass index, weight loss, oral intake, presence of intestinal failure, fistula, renal failure, respiratory infection, urinary infection, hyperglycaemia, admission to the ICU, hospital stay, days of parenteral nutrition treatment and reason for admission) were collected during hospitalisation, as well as hospital mortality and mortality at 6 months following discharge. All underwent the NRS-2002 test.**

Results: **The mean patient age was 67.9 years and 58.3% were men. 62% of patients met the criteria for manutrition according to the NRS-2002 test. A statistically significant association was seen between malnutrition according to the NRS-2002 and intestinal failure, fistula, renal failure, respiratory infection, hyperglycaemia, hospital mortality and mortality at 6 months.**

Conclusion: **Malnutrition affects more than half of the patients who are admitted to a medium-long admission hospital and it is associated with increased morbidity and mortality. The results underscore the need to establish an update plan and preventative and therapeutic nutritional follow-up. These measures reduce the rate of avoidable complications and save the costs associated with them.**

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EVALUACIÓN DE LA ASOCIACIÓN ENTRE EL GRADO DE RIESGO NUTRICIONAL SEGÚN EL TEST NRS-2002 Y LA MORBIMORTALIDAD HOSPITALARIA

Resumen

Objetivo: **Determinar la relación entre el grado de Desnutrición (DN), detectada según el test de valoración nutricional NRS-2002, y la tasa de morbimortalidad.**

Métodos: **Estudio transversal de 1075 pacientes que ingresaron en el Hospital Mateu Orfila (Menorca) de los que se disponía una analítica de ingreso y valoración del riesgo nutricional (RN) mediante el test NRS-2002. Se recogieron datos demográficos (edad, sexo) y clínicos (peso actual, peso habitual, Índice Masa Corporal, pérdida peso, ingesta oral, presencia de fracaso intestinal, fístula, fracaso renal, infección respiratoria, infección urinaria, hiperglucemia, estancia en la UCI, estancia hospitalaria, días de tratamiento de nutrición parenteral y enfermedad motivo de ingreso) durante su hospitalización así como la mortalidad hospitalaria y a los 6 meses posteriores al alta.**

Resultados: **La edad media de los pacientes fue de 67,9 años y el 58,3% eran hombres. El 62%de los pacientes presentaron criterios de DN según el test NRS-2002. Se halló asociación estadísticamente significativa entre DN según el test NRS-2002 y fracaso intestinal, fístula, fracaso renal, infección respiratoria, hiperglucemia, mortalidad hospitalaria, mortalidad 6 meses y estancia hospitalaria.**

Conclusiones: **La DN afecta a más de la mitad de los pacientes que ingresan en un hospital de media-larga estancia y se asocia con mayor morbi-mortalidad. Los resultados nos permiten establecer un plan de actuación y seguimiento nutricional de prevención y tratamiento.**

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Palabras clave: *NRS-2002. Malnutrición.*

Introduction

In countries with a varied level of development, special importance is given to the problem of malnutrition in hospitalised patients. In the past 25 years, the prevalence and incidence of hospital malnutrition has barely changed. Along these lines, the study performed by the expert group that was convened in February of 2002 by the European Council deserves special mention. Their conclusions highlighted the need for preventing malnutrition (MN)[1] because it affects 10-80% of patients upon admission and during their stay depending on the type of hospital and its caseload. Such a wide difference in prevalence rates is primarily due to the fact that the studies included different populations and used different methods, underestimation of the problem, scant attention given to the nutritional state in the medical records and deficiencies in detecting nutritional needs. An international consensus has been reached that at least 30 to 50% of hospitalised patients suffer from malnutrition.[2-7]

With the development of feeding, diet and artificial nutritional support techniques being obvious, the most plausible explanation for the persistence of malnutrition is that the positive effect of these improvements is counteracted by the increasing complexity of the diseases being treated currently and the treatments being administered, some of which were unimaginable a few years ago (surgery and age, oncology, transplants, burns, etc.). Therefore, malnutrition is the result of the complex interaction between disease and nutrition. It has important clinical and economic consequences. Clinically, it may contribute to an increase in the number and severity of disease complications by weakening the level of immune response and, certainly, increasing morbidity and mortality.[6-14]

The techniques for preventing, detecting and controlling malnutrition have also not been updated to any great degree. Added to the lack of establishing measures for detecting and controlling these patients is the inefficient use of the available nutritional support resources.[15-20] It is important to identify patients who are malnourished or are at risk of malnutrition early in order to establish adequate nutritional support as soon as possible. In order to accomplish this, detection systems or populations screening is necessary, at admission, during hospital stays and at discharge.[21-24]

The tool proposed for malnutrition screening in this study is the NRS-2002 test because, of the more than 70 screening methods in existence, the European Society for Clinical Nutrition and Metabolism (ESPEN) recommends its use in hospitalised patients.[25] Following this evaluation, we have studied the clinical repercussions of HM based on its severity.

The purpose of this work is to study the relationship between the presence of MN, detected with the NRS-2002, and the morbidity and mortality rates in our hospital.

Methods

This is a follow-up study of 1.114 patients, with 39 missing patients due to a lack of data at the moment of study, who were admitted to Mateu Orfila Hospital (Menorca) in the period between June of 2009 and January of 2011. So 1075 were finally studied.

All adult patients who were admitted during this period who had laboratory studies and a MN evaluation using the NRS-2002 test were included in the study.

Patients who did not have laboratory studies of their nutritional profile on admission, because clinicians did not consider them to be at risk for MN or who were "missing" due to lack of data were excluded.

All the patients were informed about the study before participating.

The following variables were recorded: gender, age, weight, height, body mass index (BMI) and weight loss in the past 3 months. In addition, the NRS-2002 structured nutritional evaluation test was administered to patients for whom laboratory studies were ordered on admission. The morbidity and mortality (death during admission and at 6 months) and their clinical progress was recorded: rate of intestinal failure (retroperitoneal bleeding, abscess or peritonitis), incidence of fistula (suture dehiscence or spontaneous), incidence of renal failure (serum creatinine > 2.2 mg/dl or serum urea > 80 mg/dl), days on parenteral nutricion (TPN) , days in the intensive care unit, hospital stay, respiratory, urinary and wound infections and the incidence of hyperglycaemia (serum glucose > 160/mg dl).

Intervention

Mateu Orfila General Hospital has been using an automated screening method (FANBAL), similar to since 2009 based primarily on laboratory data(protein parameters, cholesterol and lymphocyte).[13] In order to establish it, the Clinical Laboratory and Informatics departments developed the application that automatically generates this screening, with the goal of automatically calculating the nutritional status of adult patients who are admitted to the hospital and those whom the treating practitioner has requested a laboratory profile. The necessary information is obtained from the Admission Department's databases (affiliation, age, date and duration of admission) and the central laboratory (albumin, prealbumin, total protein, cholesterol, total lymphocytes, progression of the process).

Afterwards, the dietician-nutritionist (DN) applies the NRS-2002 method to all patients with a laboratory request in the admission profile. If a patient is determined to have malnutrition or to be at risk for malnutrition using these methods, their complete nutritional status is evaluated. With this information, a complete individualised nutritional plan is developed that includes the clinical history, complete physical exami-

nation, anthropometrics and laboratory analysis. If the patient has a final NRS ≥ 3 on admission, the patient is considered to suffer from malnutrition. If the result of the NRS-2002 shows that the patient is not at risk for or have MN, the patient will be re-evaluated at one week or earlier if there are clinical changes or changes in treatment[26]. The process culminates with the nutritional risk report (NRR) being sent to the treating physician, together with specific recommendations for nutritional support when needed.

Statistical analysis

The central tendencies and dispersion were calculated. In order to compare categorical variables, the Chi-squared test was used. Student's t-test was used to compare continuous variables. In order to evaluate the association between the presence of malnutrition based on the NRS-2002 test, and the progression of morbidity and mortality parameters, the odds ratios (OR) were calculated together with their 95% confidence intervals. *P*-values < 0.05 were considered statistically significant for the purpose of hypothesis testing.

In order to study the existence of an association between one of the three dependent variables (hospitalisation days, TPN days and days on the ICU) and the independent variables (morbidity and mortality and malnutrition), three multiple regression models were constructed. The initial models included all of the anthropometric variables. The final methods were constructed using algorithmic selection with the backward method, using *p*-values < 0.05 as the threshold of statistical significance. In all of the models, normal distribution of the independent variables was confirmed and multicollinearity was ruled out by means of a correlation matrix in which no linear correlation between any pair of variables was statistically significant. The goodness of fit of the models was estimated with the R^2 statistic. In order to study the existence of an association between the dependent variables intestinal failure, renal failure, respiratory infection, urinary infection, hyperglycaemia, *exitus* during hospitalisation and *exitus* at 6 months (all of which were transformed to dichotomous variables) and the anthropometric variables of morbidity-mortality and malnutrition, 8 logistical regression models were constructed. In the final models, Only independent variables asssociated with the dependent variable (those for which the 95% CI of the odds ratio did not include 1.0) were kept in the model. The goodness of fit of all of the models was estimated using the Hosmer-Lemeshow test. All of the analyses were performed using SPSS 12.0.

Results

Between June 2009 and January 2011, 1.075 patients were finally included in the study and 39 were excluded due lack of data.

Table I
Anthropometric characteristics, morbidity and oral intake of the patients studied (data are given as mean (SD) or %)

Variables	*Results*
Number of patients	1,075
Anthropometric data	
Age	67.9 years (17.7)
Gender	626 male/449 female
Current weight	70.9 kg (15.2)
Normal weight	73.1 kg (14.7)
Height	1,63 m (0,1)
BMI	25.8 kg/m^2 (5.1)
Weight lost (%)	-3.1 (6.9)
Reason for admission (%)	
Digestive	26.1
Respiratory	19.5
Cardiovascular	18.0
CNS	14.2
Renal	6.6
Metabolic	2.7
Orthopedic	2.6
Haematologic	2.4
AIDS	0.1
Other	6.5
Total oral intake (%)	
76-100	41.0
51-75	26.1
26-50	19.9
0-25	12.7

Their anthropometric characteristics, reason for admission and food intake percentages are shown in table I. All underwent the NRS-2002 test.

62% showed nutritional risk. The mean current weight was 70.9 kg and the normal weight was 73.1 kg. In almost 13%, the oral intake was scant (0-5% of the total daily recommendation) and in 20% it was considerably reduced (25-60% of the total daily recommendation). The mean BMI was 25.8 (± 5.09).

The presence of malnutrition (NRS ≥ 3) was associated with a higher incidence of intestinal failure (OR: 4.8; 95% CI: 2.0-11.3), fistula (OR: 3.1; 95% CI: 1.5-6.1), renal failure (OR: 3.2; 95% CI: 2.2-4.6), respiratory infection (OR: 2.9; 95% CI: 1.9-4.3), urinary infection (OR: 2.0; 95% CI: 1.2-3.5), hyperglycaemia (OR: 2.4; 95% CI: 1.7-3.5), exitus (OR: 6.8; 95% CI: 3.1-14.9), exitus at 6 months (OR: 4.9; 95% CI: 2.4-10.2) and hospital stay (p = 0.003) (table II).

On multiple linear regression models (table III), the variable "malnutrition" didn't enter in any model (hospital stay, TPN days or ICU days).

On logistical regression (table IV), malnutrition (NRS ≥ 3) was associated with a higher incidence of intestinal failure (OR: 4.3; 95% CI: 1.8-10.4), fistula (OR: 2.4; 95% CI: 1.1-5.1), renal failure (OR: 2.8; 95% CI: 1.9-4.0), respiratory infection (OR: 2.5; 95% CI: 1.7-3.7), urinary infection (OR: 1.8; 95% CI: 1.0-3.2), hyperglycaemia (OR: 1.7 ; 95% CI: 1.1-2.4), *exitus*

Table II
Data of morbidity, mortality and hospital length of stay of patients in the study sample (date are given as mean (SD) or number of patients (%))

Data	*Patients without MN according to NRS-2002 n = 408 (38%)*	*Patients with MN according to NRS-2002 n = 667 (62%)*	*p-value*	*OR*	*95% CI*
Intestinal failure	6 (1.5)	44 (6.6)	0.000	4.8	2.0-11.3
Fistula	10 (2.4)	47 (7.1%)	0.001	3.1	1.5-6.1
Renal failure	42 (10.2)	179 (27.0)	0.000	3.2	2.2-4.6
Respiratory infection	35 (8.5)	141 (21.3)	0.000	2.9	1.9-4.3
Urinary infection	18 (4.4)	56 (8.4)	0.013	2.0	1.2-3.5
Hyperglycaemia	47 (11.5)	160 (24.1)	0.000	2.4	1.7-3.5
Wound infection	8 (1,9)	25 (3.8)	0,103	1,9	0,8-4,4
Exitus	7 (1.7)	70 (10.5)	0.000	6.8	3,1-14,9
Exitus at 6 months	17 (4.1)	117 (17.6)	0.000	4.9	2,4-10,2
TPN days	8.4 (4.99)	10.71 (8.32)	0.393		
ICU days	6.96 (15.78)	8.19 (10.88)	0.651	1.2	1,1-3,2
Hospital stay	10.56 (11.36)	12.76 (11.92)	0.003		

TPN: Total parenteral nutrition; ICU: Intensive care unit.

Table III
Multiple linear regression models

Response variable	*Variables*	*B coefficient*	*Standard error*	*p-value*
Hospital stay	Intestinal failure	3.4	1.7	0.048
	Fistula	6.2	1.6	0.000
	Renal failure	3.8	0.8	0.000
	Wound infection	13	2.2	0.000
	Hyperglycaemia	3	0.9	0.000
				0.001
TPN days	Renal failure	3.6	1.5	0.019
	Urinary infection	4.7	2.6	0.072
	Wound infection	8.5	2.2	0.000
ICU days	Fistula	5.4	2.9	0.07
	Renal failure	5.5	2	0.009
	Respiratory infection	10.4	2.1	0.000
	Wound infection	10.4	4.3	0.017

Goodness of fit test: hospital length of stay (days) ($R^2 = 0.6$), TPN days ($R^2 = 0.57$) and ICU length of stay (days) ($R^2 = 0.43$).

(OR: 4.2; 95% CI: 1.9-9.5), and *exitus* at 6 months (OR: 4.4; 95% CI: 2.1-9.1) in the multivariate analysis. In contrast, MN was not associated with an increase in hospital stay, ICU stay, or increased duration of PN treatment on the multiple linear regression.

Discussion

The tool used in this study for the nutritional evaluation (NRS-2002) has previously been validated[27,28] and is the tool that the experts at ESPEN recommend for use in hospitalised patients.[25] The values reported in the literature of its sensitivity, specificity and positive predictive value are around 62, 93 and 85%, respectively.[29]

The estimated prevalence of hospital malnutrition in our hospital (62%) with this test is similar to that reported in a recent meta-analysis.[6] These data concur with those obtained in a sample of hospitalised patients in internal medicine and general digestive surgery units[30], and they approximate those from another study that used the same nutritional evaluation test.[31]

In this study, there is evidence of the association between the influence of malnutrition, probably associated with other factors, and the increase in morbidity and mortality versus the group of normally-nourished patients (tables III and IV) based on the multivariate analysis. If we focus on studies that analyse the relationship between malnutrition and mortality in Spain, Villalobos Gamez et al.[21] observed that malnutrition is

Table IV
Logistic regression models

Response variable	*Variables in the equation*	*OR*	*95% CI*
Intestinal failure	Fistula	12.1	6.1-23.9
	Malnutrition (NRS ≥ 3)	4.3	1.8-10.4
Fistula	Intestinal failure	6.6	3.0-14.3
	Wound infection	13.2	5.6-31.2
	Malnutrition (NRS ≥ 3)	2.4	1.1-5.1
Renal failure	Urinary infection	2.1	1.2-3.5
	Malnutrition (NRS ≥ 3)	2.8	1.9-4.0
	Hyperglycaemia	3.5	2.5-4.9
Respiratory infection	Urinary infection	1.7	0.9-2.9
	Hyperglycaemia	2.5	1.7-3.6
	Malnutrition (NRS ≥ 3)	2.5	1.7-3.7
Urinary infection	Renal failure	2.1	1.3-3.6
	Malnutrition (NRS ≥ 3)	1.8	1.0-3.2
Hyperglycaemia	Intestinal failure	3.1	1.7-5.9
	Renal failure	3.2	2.3-4.5
	Respiratory infection	2.3	1.6-3.4
	Malnutrition (NRS ≥ 3)	1.7	1.1-2.4
Exitus	Renal failure	5.1	3.0-8.6
	Respiratory infection	1.6	0.9-2.9
	Hyperglycaemia	1.9	1.1-3.3
	Malnutrition (NRS ≥ 3)	4.2	1.9-9.5
Exitus at 6 months	Renal failure	2.1	1.2-3.6
	Malnutrition (NRS ≥ 3)	4.4	2.1-9.1

Hosmer-Lemeshow goodness of fit tests: intestinal failure (p = 0.7), fistula (p = 0.9), renal failure (p = 0.8), respiratory infection (p = 0.74), urinary infection (p = 0.73), hyperglycaemia (p = 0.14), exitus (p = 0.78), exitus at 6 months (p = 0.8).

one of the factors associated with an increase in mortality in MN (versus NN) patients (15.2% and 2.6%, respectively). For their part, Correia and Waitzberg[9] demonstrated that the mortality rates in MN patients were 12.4% and 4.7% . When comparing our hospital mortality results with these studies, our study coincided with the previous studies in also finding an increase in *exitus* in hospitalised patients with MN. These results were confirmed in the multivariate analysis in which the malnutrition variable entered in both the *exitus* model (OR: 4.2; 95% CI: 1.9-9.5) and the *exitus* at 6 months model (OR: 4.4; 95% CI: 2.1-9.1).

Regarding mean hospital stay, an optimal nutritional status was associated with a shorter hospital stay (table II), but this datum was not confirmed on the multiple linear regression model. Other authors have confirmed this finding.[9,10,21] Additionally, the study by Robinson[32] estimated that in patients who had a deterioration in their nutritional status on admission, their hospital stay increased by 30%.

Regarding the variables studied, days on parenteral nutrition (PN) and days on the intensive care unit did not enter into the final multiple linear regression models probably due to a lack of statistical power due to the low number of patients evaluated for these variables. Conversely, in the study by Pikul,[33] there was a statistically significant association with an increase in ICU stay.

Special mention should be made of the increase in hyperglycaemia in malnutrition patients. Our study observed the association between Mmalnutrition and the increase in the incidence of hyperglycaemia, which is also confirmed on the logistical regression model in which malnutrition was associated with an increased risk of hyperglycaemia (OR = 1.7; 95% CI: 1.1-2.4). This effect is significant due to the poor prognosis of patients with insulin resistance and persistently increased glucose levels, which is associated with a higher incidence of infections and mortality.[34] Recently, the study by Leite et al.[35] demonstrated that patients with hyperglycaemia had a significantly greater mortality rate than patients with a history of controlled diabetes or normal glucose levels.

In our study, the incidence of respiratory and urinary infection was greater in the MN patient group. This was confirmed in the final logistical regression model, which has malnutrition in both the urinary infection model (OR = 1.8; 95% CI: 1.0-3.2) and the respiratory infection model (OR = 2.5; 95% CI: 1.7-3.7). Schneider[36] also found the association between malnutrition and the risk of nosocomial infection in the malnutrition group versus the NN group (8.7 and 4.4%). In a study

in 2010, Rodrigues-Pecci[37] observed that the presence of pneumonia in hospitalised malnutrition patients was associated with an increase in mortality.

On the logistical regression model, associations were also confirmed between digestive complications and malnutrition: higher incidence of fistula (OR = 2.4; 95% CI 1.1-5.1) and intestinal failure (OR = 4.3; 95% CI: 1.8-10.4). Recently, Kanda et al.[38] analysed the association between the nutritional status and postoperative complications in patients with a diagnosis of pancreatic cancer. They found an association between a low BMI and deterioration of the nutritional status and the appearance of pancreatic fistula (2.52 times greater than in normally-nourished patients).

Additionally, the incidence of renal failure in malnutrition patients was higher (OR = 2.8; 95% CI: 1.9-4.0), which is important because renal failure is often associated with sepsis, trauma and multi-organ failure in the critical hospitalised patient.[39]

All of this not only has clinical implications, but also economic implications given that the increase in hospital stay and the clinical complications derived from malnutrition lead to an increase in the cost of hospitalisation and in indirect costs. The results of the analysis by Kruizenga et al.[40] are interesting. They estimate the magnitude of the savings derived from early detection of MN in hospitalised patients; they are not insignificant.

Regardless of the screening method used, we feel that all patients should undergo evaluation of their nutritional status upon admission to the hospital and at least once during their stay. The NRS-2002 test constitutes a good screening test of nutritional status.[28] With its establishment, it has been observed that if the score is greater than 3 points, it is associated with an increase in risk in the morbidity and mortality variables studied. Therefore, it allows for early establishment of a nutritional action and preventative follow-up plan for monitoring the morbidity and mortality risks associated with NR.

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Conflict of interest

The authors declare no conflict of interests.

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