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ARÁN

Nutrición Hospitalaria

Trabajo Original

Epidemiología y dietética

Nutritional assessment of hospitalized patients in Latin America: association with prognostic variables. The ENHOLA study

Valoración nutricional en pacientes hospitalizados en hospitales latinoamericanos: asociación con factores pronóstico. El estudio ENHOLA

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Abstract

Background and aim: The prevalence of hospital malnutrition (HM) is variable, explained by the variability of patients, the nutritional evaluation method used among others. The aim is to determine the frequency of malnutrition in hospitals in Latin America, and estimate its association with mortality and length of hospital stay.

Methods: This is an analytical, observational cohort study that included 7,973 patients of both genders, 18 and older, who provided their consent. The survey was administered during the first three days of admission. The nutritional status was estimated using Subjective Global Assessment (SGA) and the Nutrition Risk Screening (NRS), body mass index (BMI), percentage of change of weight (PCW) and co-morbidities. Serum albumin was obtained from the clinical chart. Length of stay (LOS) and the survival status at discharge (dead or alive) were also recorded.

Results: By SGA: 10.9% had severe malnutrition and 34% moderate malnutrition. By NRS: 36.9% had nutritional risk. Univariate analysis showed that NRS score and serum albumin were prognostic factors for mortality: NRS 3-4 (OR: 2.3, 95% CI: 1.9-2.8), NRS 5-7 (OR: 5.8, 95% CI: 4.9-6.9), serum albumin < 2.5 g/dl, (OR: 2.9, 95% CI: 2.2-3.8). These results were consistent and similar to a multivariate analysis. Both NRS and serum albumin were also independently and clinically associated to LOS.

Conclusions: The prevalence of hospital malnutrition in Latin America is high. Our results show that screening with NRS and serum albumin can identify hospital malnutrition as well as providing clinically relevant prognostic value.

Key words:

Hospital malnutrition. Serum albumin. SGA. Length of stay.

Resumen

Introducción y objetivo: la prevalencia de la malnutrición hospitalaria (MH) es variable y puede explicarse por la variabilidad de los pacientes, el método de evaluación nutricional entre otros. El propósito de esta investigación es determinar la frecuencia de malnutrición en hospitales de Latinoamérica y estimar su asociación con mortalidad y estancia hospitalaria.

Métodos: es un estudio analítico, observacional de cohorte que incluyó a 7.973 pacientes de ambos géneros, mayores de 18 años y que estuvieron de acuerdo en participar en el estudio. La evaluación fue aplicada durante los primeros tres días de admisión al hospital. El estado nutricional fue estimado usando la evaluación global subjetiva (SGA) y el *score* de riesgo nutricional (NRS-2002). Se evaluó el índice de masa corporal (IMC), el porcentaje de cambio de peso (PCW) y las comorbilidades. La albúmina sérica se obtuvo del expediente clínico. La estancia hospitalaria (LOS) y las condiciones del egreso (vivo o muerto) fueron también registrados.

Resultados: por SGA: 10,9% tuvieron malnutrición severa y 34% malnutrición moderada. Por NRS: 36,9% tuvieron riesgo nutricional. El análisis univariado mostró que el NRS y la albúmina sérica fueron factores pronósticos de mortalidad: NRS 3-4 (OR: 2,3, 95%CI: 1,9-2,8), NRS 5-7 (OR: 5,8, 95% CI: 4,9-6,9), albúmina sérica < 2,5 g/dl, (OR: 2,9, 95% CI: 2,2-3,8); estos resultados fueron coherentes y similares al análisis multivariado. Tanto el NRS y como la albúmina sérica fueron también independientemente y clínicamente asociados a la estancia hospitalaria prolongada.

Conclusión: la prevalencia de malnutrición hospitalaria en Latinoamérica es alta. Nuestros resultados muestran que el tamizaje con NRS y la albúmina sérica inicial pueden identificar la malnutrición hospitalaria, así como proporcionar un valor clínico relevante.

Palabras clave:

Malnutrición hospitalaria. Albúmina sérica. SGA. Duración de la estancia.

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INTRODUCTION

Malnutrition has a high impact on increasing length of stay (LOS), morbidity, mortality and health care costs (1-4), but it is often not diagnosed promptly. There is a great variability in the prevalence of hospital malnutrition described in the literature, due to the type of patients admitted to hospitals, the population studied, as well as the method or nutritional marker used for diagnosis. Another reason for variability in hospital malnutrition prevalence is that health personnel frequently give little relevance to the nutritional status of patients instead of being a subregistry of the problem. Anthropometric parameters alone are not always good predictors, but combined with other methods they can give a reliable picture of patients (5,6). On the other hand, specificity of laboratory studies such as albumin, pre-albumin and transferrin, among others, is low and not only they denote nutritional status, but also demonstrate hepatic synthesis, hydration, inflammatory state, and index of metabolic utilization (7,8). Therefore, these methods have been considered to be more a prognostic variable than a nutritional marker.

In 1987, Detsky proposed the Subjective Global Assessment (SGA), a survey that includes clinical parameters and is validated as an appropriate instrument to screen those hospitalized patients who are malnourished at time of evaluation (1). In 2003, the European Society for Clinical Nutrition and Metabolism (ESPEN) published the ESPEN Guidelines for Nutritional Screening 2002, endorsing the use of the Nutrition Risk Screening (NRS). This method is able to screen risk of malnutrition and is employed during the process of admission to the hospital, thus evaluating anthropometric variables, food ingestion prior to the screening, the severity of the disease and the patient's age in order to discriminate patients with higher nutritional risk (9). Among eleven nutritional evaluation tools studied by Skipper, it was established that the NRS proposed by ESPEN is the most valid and reliable one (10).

The prevalence of hospital malnutrition has been estimated between 15 and 60% at admission (11), and the percentage rises to 75% in patients with a prolonged LOS (12). Russell in the United Kingdom reported a 25% prevalence of nutritional risk in hospitalized patients using the Malnutrition Universal Screening Tool (MUST) (13). The EuroOOps study (2008) reported 32.6% of hospitalized patients at nutritional risk (14) and the PREDyCES study in Spain 23.7% (15). Both used the NRS. In Latin America, there are several reports on prevalence of hospital malnutrition: 47% in Argentina (12) and 48.1% in Brazil (16) using the SGA. Correia reported a mean prevalence of 39% for moderate malnutrition and 11.2% for severe malnutrition in Latin American hospitals in 2003 (17).

The aims of this study are: to determine the prevalence of malnutrition in a group of patients from hospitals in Latin America using the SGA and NRS; to estimate the relationship between malnutrition with other clinical and demographic variables, and to determine the predictive capacity of nutritional assessment methods on mortality and length of hospital stay.

METHODS

This is an analytical, observational, cohort study performed from February 1st to September 30th, 2012. The Latin American Federation of Clinical Nutrition and Metabolic Nutritional Therapy (FELANPE), through its affiliated societies, were invited member hospitals to participate in the study. Participants included general hospitals that have at least Internal Medicine and surgery service for adults, and specialty hospitals.

The coordinating group sent to each hospital the full protocol and thereafter each hospital applied for participation having at least one responsible researcher. Patients were included consecutively from February 1st to September 30th, 2012. The inclusion criteria for patients were: male and female patients over 18 years old, admitted to the hospital, who gave informed consent agreeing to participate. Pregnant women admitted for delivery or post-partum and patients seen at the Emergency Room but not admitted were not included. The local coordinator was the responsible for the approval of the protocol by the local Institution Research Committee. The protocol was reviewed and approved by the Research and Bioethics Committees of the Mexican Social Security Institute's General Regional Hospital of Morelia, Michoacán.

Each hospital coordinator conducted a training session with the researchers prior to the application of the ENHOLA *(Evaluación Nutricional en Pacientes Hospitalizados en Latinoamérica)* survey to standardize the answers of the SGA and the NRS. The survey had to be accomplished in the first three days after admission (18). The SGA classified patients in three levels: a) well-nourished; b) moderate malnutrition or suspicion of malnutrition; and c) severe malnutrition. The NRS classified patients in two categories: no nutritional risk (score < 3) and at nutritional risk (score ≥ 3) (1,9). Other questions were added in the survey related to the area of the hospital where the patient was admitted, dates of admission and discharge, co-morbidities, clinical diagnosis, type of nutritional therapy, some general laboratory parameters and the condition at discharge: dead or alive. Determination of weight and height was divided in two categories: a) measured, if the patient could be measured and weighed on a scale with stadimeter; and b) estimated, if the patient was not able to get up to obtain the weight and height with a scale with stadimeter. This data were noted in the patients' clinical chart.

It was also verified if the clinical record included any information about nutritional status of the patient, diagnosis at admission, co-morbidities, capacity of the patients to eat by themselves, or if they had to be fed; and whether or not they liked the hospital food. The body mass index (BMI) and the percentage of change in weight (PCW) in the last six months were calculated and recorded (since NRS considers change in weight, BMI and food ingestion percentage as its variables).

Serum albumin was considered if included in clinical chart by the time of survey (normal serum albumin was considered between 3.5 and 5.5 g/dl); serum albumin in all hospitals was measured for nephelometry. At the time of discharge, length of hospital stay in days, and the condition of discharge dead or alive were documented from the clinical chart. When discharging from

hospital, we could assess whether patients were transferred to a convalescent clinic or long care center because in some countries, including Mexico, there are no such centers within the Health System. Mortality was assessed according to the status of discharge.

STATISTICAL ANALYSIS

Data were analyzed through descriptive statistics (mean and frequencies) as well as dispersion tests (standard deviation and standard error). The Kolmogorov-Sminorv test with Lilliefors adjustment was performed to establish the normality of distribution for quantitative variables. Chi-square test was employed to analyze qualitative variables among patients. The Student's *t* test and analysis of variance for independent samples were used (as required) to compare between quantitative variables. The odd risk (OR) and its 95% confidence interval (95% CI) were calculated to determine the association of malnutrition to possible risk factors or co-morbidities. To evaluate LOS, a multivariate analysis model was employed, thus generating "dummy" variables when necessary, in order to integrate the influence of possible independent risk factors.

Logistic regression was applied to assess the estimated risk of mortality pairing it with the risk of malnutrition measured by NRS, malnutrition measured by SGA, hospital area of admission (Medicine Ward, Surgery Ward or Intensive Care Unit), serum albumin, and BMI as continuous independent numeral variable. Statistical significance was reached at p-value < 0.05. Data were analyzed with the statistical software SPSS (version 18.0).

RESULTS

Twelve out of 17 countries in Latin America collaborated in the study (Argentina, Chile, Colombia, Ecuador, El Salvador, Guatemala, México, Panama, Paraguay, Peru, Uruguay and Venezuela). A total of 8,131 patients from 47 hospitals were initially evaluated, 158 had not any nutritional assessment (SGA nor NRS), thus they were eliminated, and a total of 7,973 patients were finally included for analysis. The interviewers were: nutritionists 69.5%, physicians 20.6%, nurses 9.4% and pharmaceutical staff 0.5%.

The patients in our study had a mean age of 55.6 ± 19.1 years, and the gender distribution was 48.9% male and 51.1% female that had been admitted to different public and private hospitals (Table I). The distribution by hospital area of admission was: 4,353 patients (54.6%) at a Medicine Ward, 3,081 patients (38.6%) at a Surgery Ward and 539 patients (6.8%) at an Intensive Care Unit.

NUTRITIONAL ASSESSMENT

By means of the SGA we found 2,707 patients (34%) with moderate malnutrition or suspicion of malnutrition, 872 patients (10.9%) with severe malnutrition and 4,394 (55.1%) well-nourished patients. On the other hand, the NRS found 2,941 patients (36.9%) with nutritional risk and 5,032 patients (63.1%) without it. The prevalence of malnutrition by hospital area and disease category according to SGA and NRS is presented in tables II and III; in these tables, critically ill patients were grouped into the Intensive Care Unit group. As regards to references to patients' nutritional status, 38.3% of hospital charts contained them. Using the SGA, the prevalence of malnutrition in public and private hospitals was of 45.3% and 43.6%, respectively. Using the NRS, the prevalence of nutritional risk in public and private hospitals was of 37.7% and 34.5%, respectively.

Patients who could not eat by themselves and had to be helped (19.7%) presented a higher risk of malnutrition (OR = 4.4; 95% CI: 3.9-4.9). Also, 40.1% of patients did not like hospital food, so that they presented more risk of malnutrition (OR = 3.6; 95% CI: 3.2-3.9), both assessed by NRS.

CO-MORBIDITIES

Among the co-morbidities found, patients with chronic liver failure presented an increased risk of malnutrition (OR = 3.37; 95% CI: 2.2-5.0), chronic respiratory failure (OR = 2.4; 95% CI: 1.9-3.1), chronic kidney failure (OR = 2.16; 95% CI: 1.7-2.6) and chronic heart failure (OR = 1.44; 95% CI: 1.1-1.76).

ANTHROPOMETRY

Weight and height were measured in only 4,784 of the 7,973 patients (60%). Regarding patients that could not be weighed and measured at the time of the survey, their data were taken from their clinical charts. Upon analyzing PCW we found that 6,522 (81.8%) patients had lost more than 1 kilogram in the previous 6 months and among them 4,128 (63.3%) had lost more than 10% of their usual weight. The estimated risk of mortality was higher when patients lose more than 10% of their usual weight (OR = 3.5; 95% CI: 2.8-4.4).

Table I. Hospital data

	Hospitals n = 47 (%)	**Patients n = 7,963 (%)**
Type of hospital		
Public	36 (78)	6,084 (76)
Private	11 (22)	1,879 (24)
Hospital capacity (staffed beds)		
Small size hospital (≤ 250 beds)	20 (43.5)	4,674 (58.7)
Medium size hospital (251 to 500 beds)	18 (38.2)	38.2 (28.7)
Large size hospital (≥ 501 beds)	9 (18.3)	18.3 (12.6)

Table II. Subjective Global Assessment (SGA) according to hospital area and disease category

	Well- nourished n (%)	Moderate (or suspicion of) malnutrition n (%)	Severe malnutrition n (%)
Hospital area			
Medicine n = 4,353	2,246 (51.6)	1,573 (36.1)	534 (12.3)
Surgery n = 3,081	1,959 (63.6)	863 (28)	259 (8.4)
Intensive Care Unit n = 539	189 (35.1)	271 (50.3)	79 (14.7)
Total	4,394 (55.1)	2,707 (34)	872 (10.9)
Disease category			
Surgical (no oncology, no trauma) n = 1,758	1,246 (55.2)	397 (22.6)	115 (6.5)
Cancer n = 1,402	464 (33.1)	679 (48.4)	259 (18.5)
Cardiovascular n = 749	449 (59.9)	247 (33)	53 (7.1)
Respiratory n = 705	326 (46.2)	279 (39.6)	100 (14.2)
Trauma n = 702	462 (65.8)	197 (28.1)	43 (6.1)
Renal n = 701	348 (49.6)	274 (39.1)	79 (11.3)
Digestive n = 599	298 (49.7)	241 (40.2)	60 (10)
Neurological n = 476	240 (50.4)	170 (35.7)	66 (13.9)
Hematological n = 87	48 (55.2)	32 (36.8)	7 (8)
Other n = 730	484 (66.3)	168 (23)	78 (10.7)

Table III. Nutrition Risk Screening (NRS) according to hospital area and disease category

	Without nutritional risk n (%)	With nutritional risk n (%)
Hospital area		
Medicine n = 4,353	2,664 (61.2)	1,689 (38.8)
Surgery n = 3,081	2,228 (72.3)	853 (27.7)
Intensive Care Unit n = 539	140 (26)	399 (74)
Total	5,032 (63.1)	2,941 (36.9)
Disease category		
Surgery (no oncology, no trauma) n = 1,758	1,336 (76)	422 (24)
Cancer n = 1,402	689 (49.1)	713 (50.9)
Cardiovascular n = 749	512 (68.4)	237 (31.6)
Respiratory n = 705	393 (55.7)	312 (44.3)
Trauma n = 702	415 (59.1)	287 (40.9)
Renal n = 701	457 (65.2)	244 (34.8)
Digestive n = 599	368 (61.4)	231 (38.6)
Neurological n = 476	232 (48.7)	244 (51.3)
Hematological n = 87	62 (71.3)	25 (28.7)
Other n = 730	539 (73.8)	191 (26.2)

The mean BMI was 25.3 ± 5.6 kg/m^2. The study showed that 7.5% patients had a BMI below 18.5 kg/m^2, and 44.7% of patients had a normal BMI (18.6-24.9 kg/m^2). Besides, 29.9% of patients had a BMI between 25 and 29.9 kg/m^2, and 17.9% of the evaluated patients had a BMI above 30 kg/m^2.

Patients with a BMI < 18.5 kg/m^2 have a higher risk of mortality: OR = 2.9 (95% CI: 2.3-3.7). Patients with normal BMI (BMI = 18.5 to 25.0) have OR = 1.1 (95% CI: 0.9-1.4). Whilst overweight and obesity patients (BMI more than 25) have a lower mortality risk: OR = 0.5 (95% CI: 0.4-0.6), as shown in figure 1A.

SERUM ALBUMIN

There were only 3,448 (43.2%) reports of serum albumin in patient's charts. Of these, 59.1% (2,037) were ≤ 3.49 g/dL. Mortality was 7.1% for patients with albumin ≤ 3.49 g/dL and 1.0% for patients with albumin ≥ 3.50 g/dL. The concentration of serum albumin in relation to nutritional status by SGA (A) and nutritional risk by NRS (B) is detailed in table IV. A progressive increase in mortality risk was observed (Fig. 1B).

MORTALITY

Mortality was 5.5% (n = 439). By NRS, mortality for patients with nutritional risk was 4.57% (n = 365) and for those without risk it was 0.93% (n = 74).

The univariate analysis showed a significant increase in mortality risk when checking variables such as weight loss > 10%, NRS 3-4, NRS 5-7, serum albumin < 2.5 g/dL, and moderate and severe malnutrition (SGA), being the most important NRS > 5 (OR = 5.8 CI 95%: 4.8-6.9) and severe malnutrition (SGA) (OR = 13.7 CI 95%: 10.3-18.3) (Table V). More indeed, the estimated risk of mortality for BMI below 18.5 kg/m^2 was OR 2.96 CI 95% 2.32-3.79 (Fig. 1A), and for serum albumin between 2.01-2.5 g/dL it was OR 2.931 CI 95% 2.24-3.83 (Table V and Fig. 1B).

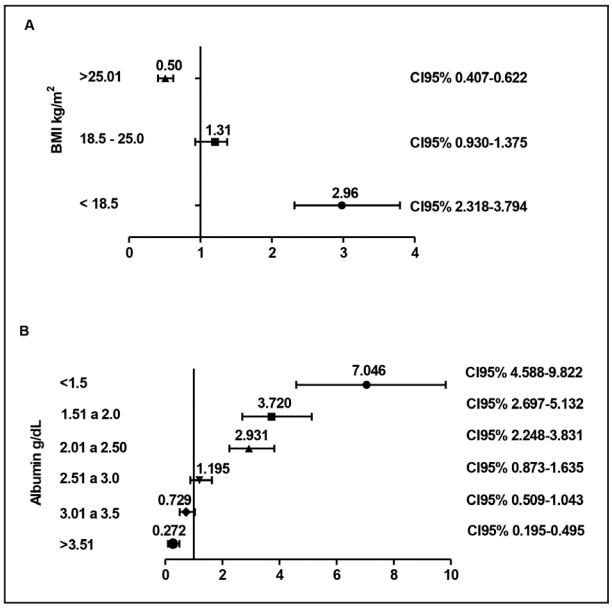

Figure 1.
Estimated risk of mortality (OR) for BMI (A) and serum albumin (B).

We analyzed the estimated risk for mortality in relation to the NRS score, and found that as the NRS score increases, the estimated mortality risk increases proportionally and significantly, particularly in patients at surgical and medical wards (Fig. 2). Noteworthy, when values were integrated in a logistic regression model, only serum albumin and NRS value ≥ 3 parameters reached significance. Results were consistent: the higher the NRS value (dummy variable), the more mortality took effect (Table VI).

Table IV. Serum albumin (g/dL) according to SGA (A) and NRS (B) in each hospital area

(A) SGA				
Hospital área	**Well-nourished**	**Moderately (or suspicion of) malnutrition**	**Severe malnutrition**	**p**
General	3.50 ± 0.02	3.06 ± 0.02	2.65 ± 0.03	0.0001*
Medicine	3.46 ± 0.02	3.08 ± 0.02	2.71 ± 0.04	0.0001*
Intensive Care Unit	2.79 ± 0.07	2.61 ± 0.06	2.45 ± 0.09	0.020*
Surgery	3.73 ± 0.03	3.02 ± 0.04	2.61 ± 0.06	0.0001*
*ANOVA *p < 0.05.*				
(B) NRS				
Hospital área	**Without nutritional risk**	**With nutritional risk**	**p**	
General	3.46 ± 0.02	2.87 ± 0.02	0.0001*	
Medicine	3.40 ± 0.02	2.92 ± 0.02	0.0001*	
Intensive Care Unit	2.85 ± 0.10	2.58 ± 0.04	0.010*	
Surgery	3.66 ± 0.03	2.93 ± 0.04	0.0001*	

*Student's t test for independent samples *p < 0.05.*

Table V. Univariate analysis of the relationship of nutritional parameters with mortality

Variable	OR	CI 95%	p
Weight loss > 10%	3.5	2.81-4.37	0.0001
NRS 3-4	2.36	1.96-2.82	0.0001
NRS 5-7	5.83	4.87-6.96	0.0001
Serum albumin < 2.5 g/dL	2.93	2.24-3.83	0.0001
Moderate malnutrition (SGA)	4.79	3.65-6.28	0.0001
Severe malnutrition (SGA)	13.73	10.31-18.28	0.0001

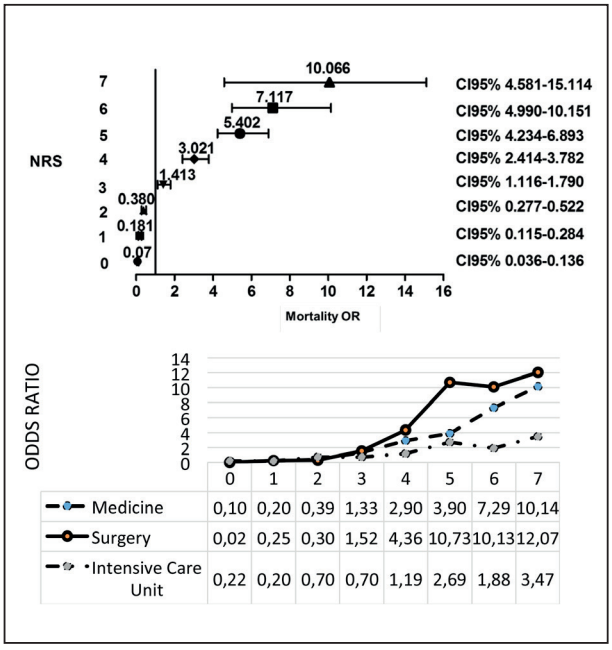

Figure 2.

Estimated risk of mortality (OR) according to NRS. Top: general. Bottom: hospital area.

LENGTH OF STAY (LOS)

The median LOS was 8 days (range: 1-185 days). Factors associated to LOS in the multivariate regression model were age, serum albumin, NRS 3-4 and NRS 5-7 (Table VII). Independently, those individuals who died at hospital had a higher LOS (median: 13 days [1-99]) when compared to patients alive (median: 8 days [1-185]) (p = 0.0001).

DISCUSSION

The study was performed in 47 hospitals in 12 countries. Due to the heterogeneity of the population of the participating hospitals and countries, the study does not necessarily reflect the prevalence of hospital malnutrition in each of these countries or in Latin America as a whole. Besides, the study reveals malnutrition at admission, but not malnutrition generated during hospitalization secondary to the disease, fasting or diagnostic or therapeutic procedures (15).

All patients were evaluated as a whole group, even though they were from a private or public hospital, as there was no difference as regards malnutrition prevalence using SGA or NRS. Other authors also found no statistical differences in the nutritional status of patients evaluated in private or public general hospitals (40).

The average age in our study is below the one reported in other European studies (14,15). Patients who are malnourished or at risk should be screened in the first days after admission to the hospital, so that an objective and timely assessment can be performed and nutritional problems can be prevented or corrected (22-24). Two instruments (SGA and NRS) were used to assess the nutritional status in our study; both have been widely discussed in various reports (10,11,19-21). By SGA we found that 34% of patients were moderately malnourished and 10.9% had severe malnutrition. In a similar study by Correia, moderate and severe malnutrition prevalence was 39% and 11.2%, respectively (17).

Charney (25) emphasizes the lack of agreement on the definition of nutritional screening between international nutrition societies such as the ADA (American Diabetes Association), ASPEN (American Society for Parenteral and Enteral Nutrition) and ESPEN. For this reason there is no standard reference tool for nutritional screening and/or assessment (15,23,26,27) and given the heterogeneity of the population and that hospital malnutrition is a dynamic continuum (25,28), a standard reference tool was not put into place in this study. Another finding from the study is that nutritional screening or assessment should be part of the

Table VI. Logistic regression model for nutritional variables and mortality

Parameter	B	p	Exp B	CI 95%
Serum albumin	0.80	0.0001	2.23	1.64-3.05
NRS 3-4	1.78	0.0001	6.04	2.72-12.41
NRS 5-7	2.33	0.0001	10.33	4.27-24.98

Cox-Snell $r^2 = 0.102$.

Table VII. Multivariate regression model for nutritional variables and LOS

Variable	Beta	t	p
Constant	27.698	11.173	0.0001
Age	-0.048	-1.979	0.048
Serum albumin	-4.219	-7.078	0.0001
NRS 3-4	3.810	3.498	0.0001
NRS 5-7	6.316	4.019	0.0001

$r^2 = 0.125$.

clinical record and enforced in the first 24 to 48 hours (24). In performing the study, it was found that only 38% of charts had a reference to the patients' nutritional status, which shows a significant underreporting conducive to late diagnosis. Also, 40% of patients refused the scheduled hospital diet and this was associated with malnutrition. This fact was associated with an increase of the nutritional risk and is added to the impact of fasting periods for diagnostic or therapeutic procedures (29). Another important point is that 19.7% of patients were not able to feed themselves, and this had a strong association with malnutrition.

The prevalence of patients at nutritional risk using NRS (36.9%) is slightly higher than reported in the PREDYCES (23.7%) and EuroOOps (32.6%) studies probably due to differences in the populations under research (the present study was carried out in Latin America and the other two in Europe), as well as in health systems and socioeconomic status. Olivares reports a prevalence of 47.3% in Spain though (41). This is the second collaborative study performed by the FELANPE initiative. This study could be compared to the ELAN study published by Correia (17) (first collaborative study) in Latin America in a similar population; SGA was used in both. In both studies, weight registration increase (ELAN 26.5% and ENHOLA 60%) and albuminemia registration (ELAN 26.5% and ENHOLA 43.2%) were registered in the clinical chart. The prevalence of malnutrition slightly decreases (ELAN 50.2%, ENHOLA 44.9%). The only explanation for these differences is the educational influence FELANPE has had in recent years through the basic courses offered to doctors, nutritionists, nurses and pharmacists (39).

Jensen et al. (4) specified the need to evaluate the acute or chronic inflammatory condition of the patient because it is as critical as the present nutritional status to determine the patient's outcome. The NRS is the instrument that best assesses this disease condition. To our knowledge, this is the first multicenter study in Latin America using the NRS and the first evaluating intensive care patients. Consistent with this, intensive care patients are at the greatest nutritional risk followed by those of medical and surgical wards. The same was observed in the EuroOOps (14) and the PREDyCES studies (19).

When evaluating different diseases, it is emphasized that cancer, respiratory problems, kidney disease, gastrointestinal or neurological conditions are associated with malnutrition in over 50% of cases by SGA. In non-cancer surgical pathology malnutrition prevalence was 29.1% and in trauma it was 34.2%. By using NRS, only neurological disorders, cancer, respiratory disease and trauma had a nutritional risk greater than 40%. This demonstrates the differences between the two methods.

In the univariate analysis, changes in usual weight was the most significant variable for estimated mortality risk, since those who lost more than 10% of normal weight had a 3.5 times higher risk of dying. The percentage of patients who had weight loss was higher than the one reported in other studies (29). Increased mortality was associated with a BMI < 18.5. In relation to BMI, our data showed the striking "protector" effect of overweight and obesity (BMI more than 25) for mortality. This paradoxical effect, known as inverse epidemiology, was initially described by Fleischmann in hemodialysis patients (31), and is also described in other conditions such as heart failure (32) or chronic lung disease (33). In 2014, Prescott analyzed 14,044 obese patients who had severe sepsis concluding that obesity is associated with lower one-year mortality, with in-hospital mortality or similar to that found in our study, and that this condition increased the cost of health care (34). To our knowledge this epidemiological reverse effect had not been reported previously in a study of nutritional screening in hospitalized patients with assorted diseases.

The overall mortality rate reported for patients without nutritional risk (NRS) and well-nourished patients (SGA) is the same (0.93%). These results are consistent with those reported in other studies (14,15,38). Conversely, those with nutritional risk (NRS) have higher mortality (4.57%).

The NRS shows a progressive increase in mortality risk as the score increases, confirming that with a NRS of 0-2 patients are at no risk. Starting from 3, a significant increase in the risk of mortality is observed. This study reported a mortality risk ten times greater in patients who had risk of malnutrition with a NRS score of 5-7 (OR: 10.3, 95% CI 4.3-24.9). This suggests that considering the NRS as a continuous variable may increase the validity of the test. The NRS in surgical and medical wards also showed a significantly increased risk of mortality starting from a score of 3 and above. This increase was also observed in Intensive Care units but the mortality risk was not as high, probably because with these patients, many other variables are involved in the outcome besides nutritional status.

Length of stay (LOS) was higher in patients with moderate and severe malnutrition by SGA and in patients at nutritional risk using the NRS. These results agree with those found in the EuroOOps (14) and PREDyCES (15) studies. Predictive factors for LOS were serum albumin, age and NRS. This is consistent with that reported by Villamayor (38), who maintains that serum albumin is known to have the capacity to predict mortality and LOS. It has been widely discussed in numerous studies that albumin is a good predictor of mortality in hospitalized patients (36,37). Another important finding of this study is that the risk of mortality increases progressively when serum albumin is below 2.5 g/dL rather than 3.5 g/dL, as traditionally considered.

One limitation of this study is the non-random selection method and the diversity of the participant population among the 12 countries, which does not represent the prevalence of malnutrition stratified by country. The effect of hospitalization on nutritional status was not assessed. Therefore, only prevalent but no incident cases of hospital malnutrition were determined. However, in our opinion, the large sample size and the heterogeneity of the studied population support the external validity of the study and, therefore, its applicability to similar populations.

In conclusion, the results of this study show that the frequency of malnutrition in the first days after admission to hospitals in 12 countries in Latin America is high, and that malnutrition is associated with a significant increase in mortality and LOS. The NRS is an adequate instrument for nutritional screening to early detect nutritional risk (which entails risk for mortality and prolonged hospital stay). NRS seems to have more impact on clinical practice when its results are used in a continuous rather than a

categorical form, as demonstrated in this study that the higher its value, the greater the risk. An NRS score greater than 5 and a serum albumin below 2.5 g/dL were the most significant variables associated with mortality and prolonged hospital stay in our study, also highlighting the protective effect of overweight and obesity.

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