

## ORIGINAL ARTICLE

### Screening of the nutritional risk in elderly hospitalized patients with different tools

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#### KEYWORDS

Nutritional assessment;  
Frail elderly;  
Malnutrition;  
Nutritional support

#### Abstract

**Background and objective:** Nutritional assessment of the elderly is difficult and different to that performed on younger people. Specific tools for this purpose include the Geriatric Nutritional Risk Index (GNRI). The study objective was to compare this index to the Nutritional Risk Index (NRI).

**Materials and methods:** A retrospective, observational, analytical study including 113 hospitalized patients over 75 years of age receiving nutritional support. Weight, height, age, length of stay, Mini Nutritional Assessment (MNA), nutrition type and duration, and occurrence of complications were recorded. GNRI and NRI were calculated. Both indexes were compared to each other and to the parameters measured.

**Results:** Mean GNRI was 88.79 (SD: 13.1), mean NRI 79.96 (SD: 10.8), and mean MNA 17.49 (SD: 4.9). Complications occurred in 50.4% of patients, and 14% died. The NRI and the GNRI did not correlate either with length of stay ( $R = 0.136$ ) or with length of nutrition ( $R = 0.041$ ). No significant correlation was seen between the GNRI and complications, but a significant relationship was found with the NRI. After stratification into surgical and/or patients, the NRI was shown to be significantly related to complications in surgical patients only ( $p < 0.05$ ). The GNRI was not related to complications in either surgical or medical patients.

**Conclusions:** In hospitalized elderly patients, the NRI is a better predictor of complications and may be more appropriate for assessing the risk of death than the GNRI. The GNRI underestimates nutritional risk as compared to NRI.

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**PALABRAS CLAVE**

Evaluación  
nutricional;  
Anciano frágil;  
Malnutrición;  
Soporte nutricional

## Valoración del riesgo nutricional en pacientes ancianos hospitalizados mediante diferentes herramientas

**Resumen**

**Antecedentes y objetivo:** La valoración nutricional en el paciente anciano es compleja y no comparable a la de personas más jóvenes. Para ello existen herramientas específicas como el Índice de riesgo nutricional geriátrico (GNRI). El objetivo del estudio fue comparar este índice con el Índice de riesgo nutricional (NRI).

**Material y métodos:** Estudio observacional analítico retrospectivo que incluyó a 113 pacientes hospitalizados mayores de 75 años en seguimiento nutricional. Se recogió: peso, talla, edad, estancia media, Mini Nutritional Assessment (MNA), tipo de nutrición y duración de la misma y presencia de complicaciones. Se calcularon el NRI y el GNRI. Se compararon ambos índices entre sí y con los parámetros medidos.

**Resultados:** La media del GNRI fue 88,79 (DE: 13,1), la del NRI 79,96 (DE: 10,8) y la del MNA 17,49 (DE: 4,9). Un 50,4% sufrió complicaciones y un 14% fue éxito. No se correlacionó el NRI ni el GNRI con estancia media  $R = 0,136$  ni con duración de la nutrición  $R = 0,041$ . Al relacionar el riesgo nutricional con la presencia de complicaciones se observó que no había relación significativa con el GNRI, pero sí con el NRI ( $p < 0,05$ ). Estratificando en pacientes quirúrgicos y médicos existió relación significativa del NRI con las complicaciones sólo en pacientes quirúrgicos ( $p < 0,05$ ), siendo no significativa en pacientes médicos. Al analizar el GNRI se observó que no había relación significativa en ninguno de los grupos.

**Conclusiones:** En pacientes ancianos hospitalizados, el NRI predice mejor las complicaciones y podría ser más adecuado a la hora de valorar el riesgo de éxito que el GNRI. El GNRI infraestima el riesgo nutricional respecto del NRI.

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## Introduction

Malnutrition is a very common condition in elderly patients. Its impact varies depending on the studies conducted, screening tools applied, and cut-off points used. A prevalence ranging from 10% and 85% has been estimated in hospitalized patients<sup>1-3</sup>.

Age-related changes increase nutritional risk in elderly patients due to changes in body composition (increased fat mass and decreased lean mass and function or sarcopenia)<sup>4</sup> and the impairment of control mechanisms of homeostasis and metabolism. Multiple pathological factors that may contribute to the exacerbation of a poor underlying nutritional status should be added to this physiological situation<sup>5</sup>. This condition makes elderly people more susceptible to malnutrition, an increased risk of hospital admission, and the occurrence of complications during their hospital stay<sup>1</sup>. The early detection of malnutrition is therefore particularly important due to the significant association between nutritional status and prognosis in elderly patients<sup>6</sup> and to the possibility of an early implementation of measures to improve both<sup>7</sup>.

There are many tools for detecting malnutrition, but when they are applied to the elderly the results show a great variability and a probable underestimation of their true nutritional status in relation to age and comorbidities<sup>8</sup>. These nutritional tools have been validated both for screening for malnutrition (NRS-2002, MUST) and for evaluating nutritional status (Mini Nutritional Assessment [MNA], VGS) and predicting the risk of the occurrence of complications (NRI) in these patients<sup>9,10</sup>. These scales are not always adequate for the

elderly because of the different situation of these patients, and not all have been standardized for them<sup>8</sup>.

Today, the most respected test for assessing nutritional status is the MNA, which is useful both for detecting malnutrition and for predicting the occurrence of complications<sup>11-13</sup>. The main limitation of this tool is that it is validated for elderly patients examined in a community setting or who are institutionalized; it uses no biological markers and loses efficacy in hospitalized or acutely ill elderly patients<sup>5,14</sup>. In elderly inpatients, other tests are required to assess nutritional status and the potential occurrence of complications. For inpatients, the European Society of Parenteral and Enteral Nutrition (ESPEN) recommends use of Nutritional Risk Screening (NRS-2002)<sup>11</sup>, a tool not validated in the elderly or as a prognostic marker but superior to the MNA for elderly inpatients<sup>14</sup>.

The Nutritional Risk Index (NRI) is one of the tools used to assess morbidity and mortality based on nutritional status<sup>15,16</sup>. This index uses changes in patient weight and albumin as markers of the risk related to nutritional status. The NRI is less reliable when applied to elderly patients because it was devised for young surgical patients and there are difficulties when trying to determine the usual weight of elderly patients<sup>8,17</sup>. In an attempt to solve these problems with the NRI in the elderly, the Geriatric Nutritional Risk Index (GNRI), developed in 2005, replaces usual weight by ideal weight as measured by the Lorentz formula and uses lower cut-off values for the different grades of risk associated with nutrition<sup>17</sup>.

The objective of this study was to compare this new index to the NRI in a series of hospitalized patients in order to: a)

check its validity for detecting the possibility of complications; b) assess the relationship of both indices with the mean hospital stay and mortality of these patients; and c) compare the value of both indices for screening nutritional risk.

## Materials and methods

### Study design

This was a retrospective, observational, analytical study conducted in patients admitted to medical and surgical hospital units. All patients were monitored by the Unit of Nutrition and Dietetics (UnyD) of the Section of Endocrinology and Nutrition of Complejo Asistencial Universitario de León.

### Patients

One hundred and thirteen patients over 75 years of age were enrolled by consecutive sampling from among the nutritional monitoring histories taken at admission from 2007 to 2009. No patient was excluded. Patients admitted to both medical and surgical departments were considered. Surgical patients were defined as those undergoing any type of surgery.

### Data collection

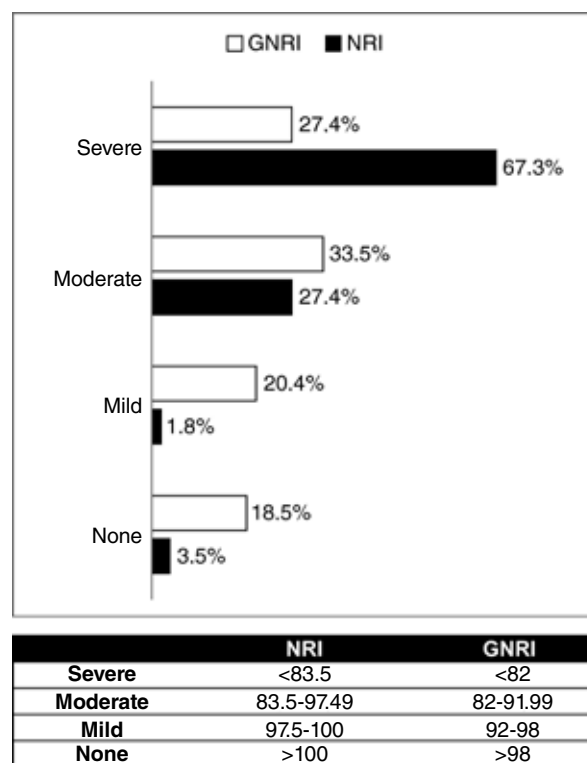
Data collected included date of birth, weight, height, admission date, date when artificial nutritional support was discontinued, discharge date, date of death, and plasma albumin levels at the time of the initial assessment. Data were also collected regarding medical complications (pressure sores, hypokalemia, diarrhea, phlebitis, sepsis, respiratory infection, urinary infection, renal failure, ischemic colitis), surgical complications (fistula, obstruction, peritonitis, repeat surgery, abscess, bleeding, paralytic ileus, perforation), and patient death.

MNA data of patients admitted to medical departments were collected. NRI and GNRI data were calculated using the validated formulas<sup>8,17</sup>:  $NRI = (1.519 \times \text{albumin [g/L]}) + (41.7 \times \text{current weight [kg]}/\text{usual weight [kg]})$ ,  $GNRI = (1.519 \times \text{albumin [g/L]}) + (41.7 \times \text{current weight [kg]}/\text{ideal weight [kg]})$  taking into consideration the ideal weight calculated using the Lorentz formula (height was estimated using ulnar distance<sup>18</sup>), while current weight was measured in two ways: 1) by weighing with a scale in their room patients able to stand; 2) considering the estimated weight for a body mass index (BMI) of 22 kg/m<sup>2</sup> in patients who could not move. The risk limits differed depending on the formula used (Fig. 1).

Length of stay, duration of nutritional support, and weight loss before nutritional intervention, estimated from the difference between usual weight and weight at the start of nutritional support (measured or estimated), were also recorded.

### Statistical analysis

Mean age, GNRI and NRI values, and average stay and duration of nutritional support were analyzed by descriptive



**Figure 1** Patient distribution in the different ranges of nutritional risk. GNRI, Geriatric Nutritional Risk Index; NRI, Nutritional Risk Index.

statistics. The frequency of complications and death rates were calculated, and also the proportion of patients with different grades of nutritional risk according to both the GNRI and the NRI. These values were collected for both the whole patient group and after stratifying them into medical or surgical patients. After stratification into medical or surgical patients, mean age, GNRI, NRI, BMI, and weight loss were compared using a Student's *t* test. Median hospital stay and duration of nutritional support were compared using a Mann-Whitney *U* test. Differences in qualitative variables (type of nutrition, occurrence of complications, and death) between medical and surgical patients were analyzed using a Chi-square test. A Pearson's correlation was used to test the relationship between the NRI and the GNRI, and between these indices and mean hospital stay, duration of nutritional support, MNA, BMI, and weight loss.

Differences between the different extremes of malnutrition were analyzed using an ANOVA test for duration of nutrition and a Kruskal-Wallis test for mean stay.

A Chi-square test was used for analyzing. a) the relationship between the presence or absence of complications and the different grades of risk of the NRI and the GNRI; b) the relationship of these indices to patient death or survival; c) the relationship of the different grades of malnutrition based on MNA with both indices. When the relationship between the NRI and the GNRI was analyzed, the patients were stratified as surgical or non-surgical (medical).

**Table 1** Mean and median characteristics of patients stratified as medical or surgical patients

	Surgical	Medical
Age	80.41 (SD: 4.09)	81.8 (SD: 4.43)
Mean stay (days)*	32 (IQR: 27)	22.5 (IQR: 17.5)
Duration of nutrition (days)*	13 (IQR: 11)	8.5 (IQR: 9)
BMI (kg/m <sup>2</sup> )	24.54 (SD: 3.81)	24.82 (SD: 5.25)
Weight loss (kg)	4.75 (SD: 5.33)	4.22 (SD: 6.41)
NRI	80.41 (SD: 10.28)	79.02 (SD: 11.98)
GNRI	89.39 (SD: 11.86)	88.09 (SD: 14.83)
Sex	M: 60.3% F: 39.7%	M: 63% F: 37%
Complications	54%	45.7%
Death	7.9%	21.7%
Type of nutrition*	EN: 21.9% TPN: 78.1%	EN: 53.3% TPN: 46.7%

\*Significant difference ( $p < 0.05$ ).

BMI, body mass index; EN, enteral nutrition; F, female; GNRI, Geriatric Nutritional Risk Index; IQR, interquartile range; M, male; NRI, Nutritional Risk Index; SD, standard deviation; TPN, total parenteral nutrition.

Results are given as mean (standard deviation) or median (interquartile range). A value of  $p < 0.05$  was considered statistically significant.

## Results

A total of 113 patients with a mean age of 80.86 (4.2) years were analyzed. Of these, 62.8% were male and 37.2% were female. Among these patients, 60.2% were admitted to surgical departments and 39.8% to medical departments. Median hospital stay was 27 (23) days. Complications occurred in 50.4% of patients, and 14% of patients died.

All patients received artificial nutritional support for a median time of 12 (11) days. Enteral and parenteral nutrition was administered to 32.7% and 67.3% of patients respectively.

The mean NRI was 79.96 (10.8), and the mean GNRI, 88.79 (13.1). The mean MNA in patients in medical departments was 17.49 (4.9). When the NRI was used, most patients were found to be distributed in the groups at higher nutritional risk, while when the GNRI was used, patients were seen to be more evenly distributed between the different nutritional risk groups (Fig. 1). Upon patient stratification into medical and surgical groups, no significant differences were found between the groups regarding mean age, NRI, GNRI, BMI, and weight loss. No significant differences were found either regarding sex, complications, or deaths. However, significant differences were found in mean stay ( $p = 0.02$ ) and duration of nutrition ( $p = 0.01$ ), and also in type of nutrition ( $p = 0.01$ ) (Table 1).

A correlation was found of both indices with the BMI, weight loss before admission and, in patients admitted to medical departments, with the MNA (Table 2). No significance was found in an analysis of the correlation of both indices with mean stay and duration of nutrition, but a relationship was seen between both parameters ( $r = 0.522$ ;  $p < 0.01$ ).

**Table 2** Correlation of both indices with body mass index and weight loss before admission

	GNRI	NRI
BMI	$r = 0.622$ CI (0.49 to 0.72)	$r = 0.197$ CI (-0.03 to 0.34)
Weight loss	$r = -0.328$ CI (-0.49 to -0.15)	$r = -0.372$ CI (-0.46 to -0.12)
MNA	$r = 0.553$ CI (0.27 to 0.75)	$r = 0.401$ CI (0.08 to 0.64)

BMI, body mass index; GNRI, Geriatric Nutritional Risk Index; MNA, Mini Nutritional Assessment; NRI, Nutritional Risk Index.

An analysis of the mean duration of nutrition in the different risk categories showed no significant difference in either the NRI or the GNRI. Nor was any significance found in any of the two indices when mean stay was analyzed ( $p > 0.05$ ).

No significant difference ( $p = 0.276$ ) was found in an analysis of the relationship between the occurrence of complications and the grade of nutritional risk calculated by the GNRI, while statistical significance ( $p = 0.007$ ) was found when risk calculated with the NRI was used in the analysis. A higher complication rate was found among patients with the lowest NRI (Fig. 2).

After stratification into surgical and medical patients, a significant relationship between the NRI and complications was found in surgical patients only ( $p = 0.003$ ), while the relationship was not significant in medical patients ( $p = 0.43$ ). When the GNRI was analyzed, no significant relationship found in any of the groups.

By contrast, analysis of the relationship between death and grade of nutritional risk showed no significant difference

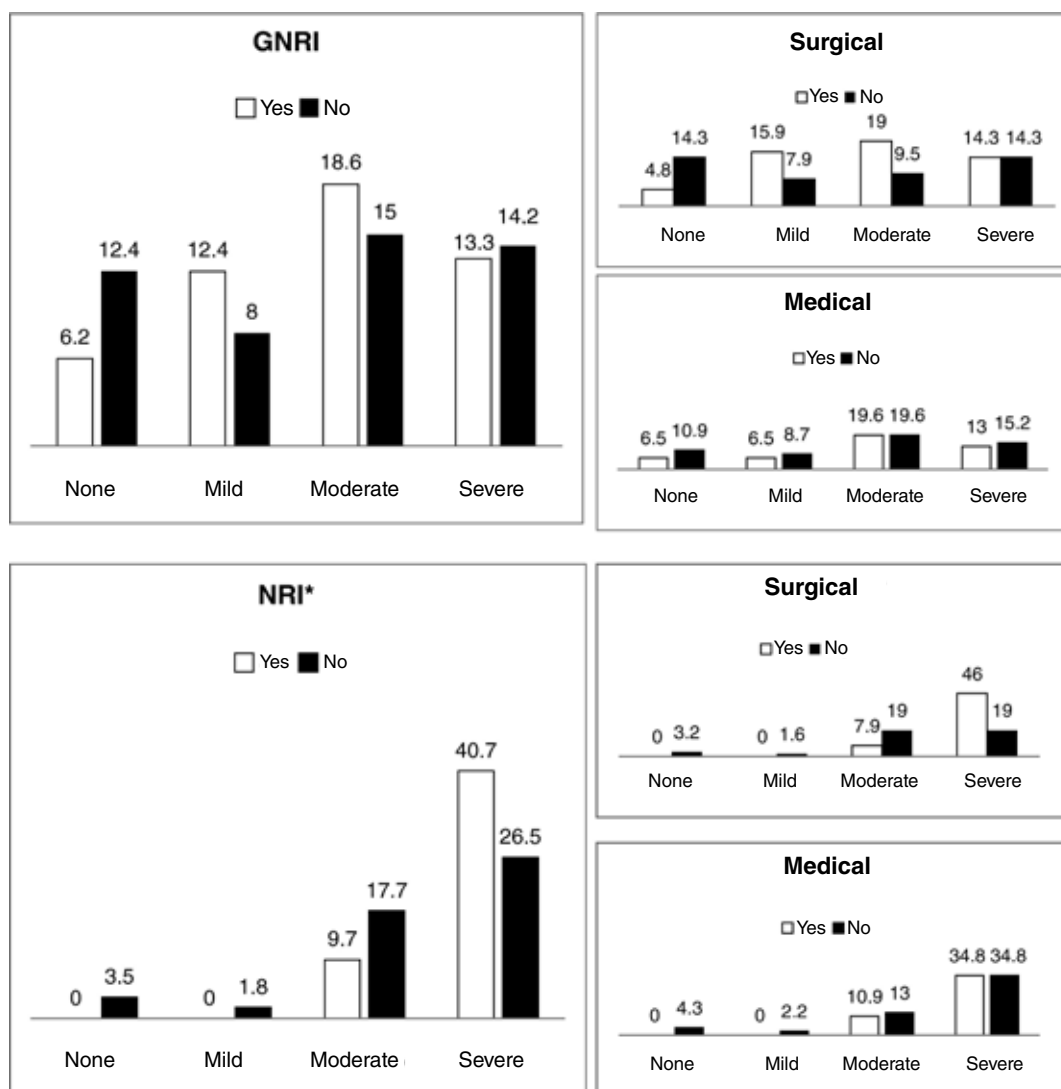


Figure 2 Complication rate in patients by risk grade calculated with both tools (\*significant relationship  $p < 0.005$ ). GNRI, Geriatric Nutritional Risk Index; NRI, Nutritional Risk Index.

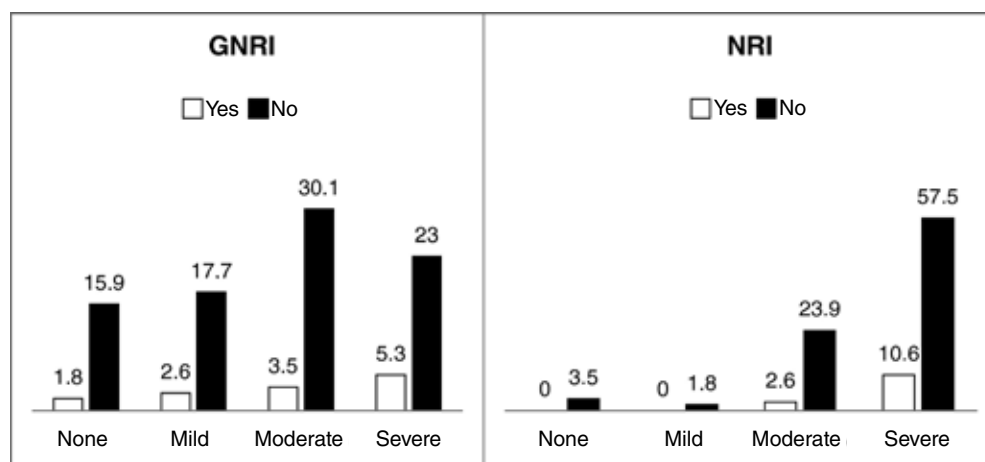
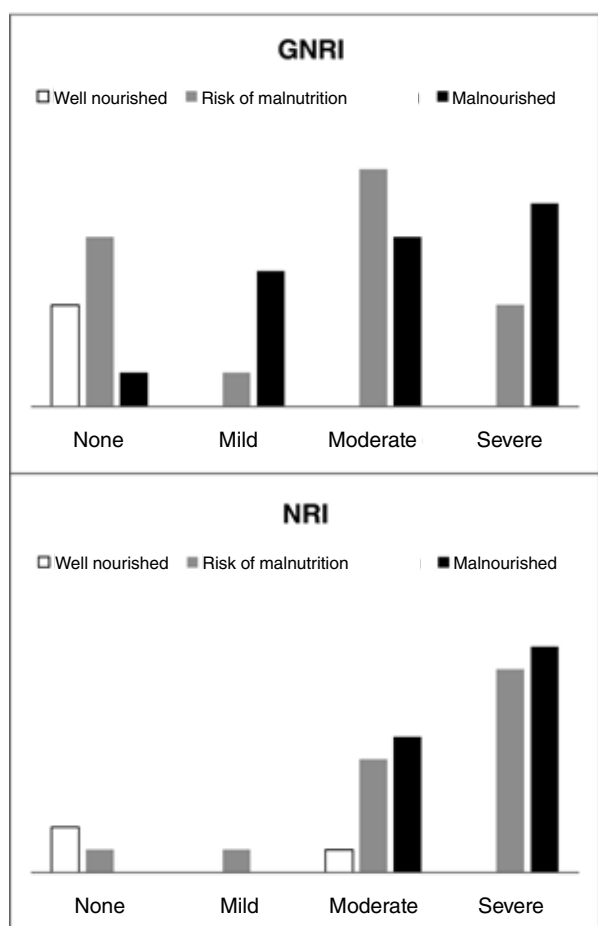


Figure 3 Death rate in patients by risk grade calculated with both tools. GNRI, Geriatric Nutritional Risk Index; NRI, Nutritional Risk Index.



**Figure 4** Relationship between the different malnutrition ranges according to the MNA and the different risk grades according to the NRI and the GNRI. GNRI, Geriatric Nutritional Risk Index; NRI, Nutritional Risk Index.

between the two indices, although a higher death rate was seen among patients with a lower NRI (Fig. 3). After stratification into medical and surgical patients, no significant relationship was also found with any of the two indices.

When patients admitted to medical departments were assessed, a significant relationship was found between the different grades of malnutrition in the MNA and the different risk grades in both the NRI and GNRI, with patients with greater malnutrition being in categories with a higher nutritional risk (Fig. 4). No significant relationship was found when the relationship of the MNA to complications was analyzed ( $p = 0.425$ ).

## Discussion

The GNRI has been studied in recent years in relation to the occurrence of complications<sup>19</sup> and progressive muscle dysfunction<sup>20-22</sup> in elderly patients, and as a nutritional screening tool<sup>23</sup>. This index has also been compared with other more standardized indices such as the MNA<sup>24</sup> and the

NRI<sup>25</sup>. The GNRI has been shown to be valid in both cases, but always in combination with other indices. However, most authors agree that further evidence in support of the GNRI is still required.

The results of this study show that the relationship of the GNRI with complications in patients on nutritional support is not significant, while a significant relationship of the NRI with such complications is found in both surgical patients and patients overall. This would suggest that, in elderly patients, NRI continues to be a good predictor of complications and that its modification by the GNRI offers no advantages. When complications occurring within the different grades of nutritional risk were compared, a significant difference was seen when the NRI was used, while no such difference was found for the GNRI. Most patients in the higher risk categories according to the NRI experienced complications, while in the case of the GNRI complications were distributed between the different ranges. According to these observations, the GNRI of these patients would not be useful for predicting complications, while the more widely-used NRI would be more helpful for risk detection in hospitalized elderly patients. Stratification into medical and surgical patients showed a significant relationship between the NRI with complications in surgical but not in medical patients. This agrees with the purpose for which the index was created, namely the detection of nutritional risk in young surgical patients<sup>15,16</sup>. It is also true that the characteristics of the two groups (medical and surgical) that were analysed were not always identical (Table 1) and one of these was the type of nutrition used, which may account for the differences found. This is because surgical patients are predominantly managed with parenteral nutrition and medical patients are given enteral nutrition. Stratification in the GNRI analysis showed no significant differences between any of the two groups, which suggests that it may not be a good predictor.

Calculating the mean of the different indices revealed that the patients in the sample were at severe nutritional risk according to the NRI and at only moderate nutritional risk according to the GNRI. According to the MNA, the patients were at risk of malnutrition, although this was not very comparable because it was only measured in patients in medical departments. These data agree with the characteristics of the sample, consisting of patients for whom some nutritional support had been requested because of potential malnutrition.

The MNA was only performed on patients admitted to medical departments, and a significant correlation of both indices studied with the MNA was found. This correlation could be artifactual, because the MNA, GNRI, and NRI all share terms, but some differences exist, such as some questions in the MNA which are not included in the tested indices and the absence in the MNA of laboratory parameters such as albumin. Similarly, a significant difference was found upon the stratification by grade of each index and their comparison to each other, with patients having a poorer nutritional risk being in the higher risk categories. This suggests that a poorer nutritional status would be associated with a higher risk. Both indices would thus be complementary and highly valuable for assessing hospitalized patients, which agrees with what the literature says.

When patient distribution within each of the nutritional risk ranges was analyzed, the GNRI was seen to have higher values than the NRI and to assign patients to lower risk categories. These characteristics are inherent in the calculations of each index. This suggests that the GNRI method may not adequately estimate the actual risk to patients, but this consideration depends on the ability of the index to detect complications.

When the correlation of the GNRI and the NRI was tested, a significant correlation was seen to be related to the fact that they share terms (current weight and albumin). The same occurred when both indices were correlated to the BMI.

Nutritional status has been associated with a longer mean hospital stay and increased hospitalization costs. It is thus important to detect patients with, or at risk of, malnutrition and to act accordingly<sup>26,27</sup>. In this sample, a significant correlation was found between the length of stay and the duration of nutritional support. This may suggest either that patients who required nutrition for a longer time because of the severity of their disease were hospitalized longer, or that their long stay duration was the reason for prescribing them artificial nutritional support for a longer time. Studies with a different design are needed to assess this relationship.

Taking all this into consideration, it would be interesting if the tools analyzed could be related to mean patient stay and to the need for more or less prolonged support, which would affect costs. Data analysis showed no correlation between any of the two risk indices and length of stay or duration of nutrition. No significant difference was seen either when length of stay and duration of nutrition were compared with the different grades of nutritional risk. While no relationship was found between these parameters, our study was not intended to test them, and the selected sample therefore included only patients who were already on nutritional support, which means that their prior state could have conditioned their length of hospital stay.

As regards mortality, previous studies have shown that a lower GNRI is associated with an increased mortality risk in non-hospitalized and hospitalized elderly patients, and also in patients on hemodialysis<sup>28,29</sup>. No significant relationship was found in the study sample between death and grades of risk in either the GNRI or the NRI, although regarding the latter index, deaths were shown as occurring in patients in the poorest risk stages, whereas in the GNRI they were not. The fact that the difference was not significant may be due to the small sample size. According to this observation, the NRI may be a better predictor of risk of death, but studies with larger samples would be required to confirm this.

The study sample was adequate for the main study objective (i.e. to detect the difference in detection of complications by both indices), but patient distribution between medical and surgical patients was not comparable (Table 1). All patients were on nutritional support. This represents a potential study bias because not all hospitalized elderly patients were assessed, but only those for whom their physicians had requested nutritional assessment and support. As regards type of nutrition, more patients were on parenteral nutrition, which represents a bias in terms of sample characteristics which should be taken into account in interpreting the results.

The nutritional status of hospitalized patients is related to the occurrence of complications and nosocomial infection<sup>24,25</sup>, with the resultant increase in death rates and costs. The special situation of elderly patients makes them more prone to complications, hence the need for the indices studied.

Based on the data, the GNRI does not appear to be superior to the NRI for use in hospitalized elderly patients with a poor nutritional status in our setting. As previously noted, the differences between both indices include the use of ideal weight and different values for stratifying the grades of risk. A significant correlation was found between both indices and weight loss, which means that despite the use of different weights for calculating both indices, a relationship exists between nutritional risk and weight loss. Based on this, we may say that the main drawback of the GNRI could be the different allocation to risk groups, which underestimates the possibility of these patients suffering complications.

In conclusion, in hospitalized elderly patients: a) the NRI is a better predictor of complications than the GNRI, particularly in surgical patients; b) the NRI may be more adequate than the GNRI for assessing the risk of death; c) the GNRI underestimates nutritional risk as compared to the NRI; d) the MNA and nutritional risk indices may be complementary for the detection of nutritional status and its associated risks.

## Conflict of interest

The authors state that they have no conflict of interest.

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