Nutrición Hospitalaria

Estudio SeDREno: prevalencia de la desnutrición hospitalaria según los criterios GLIM, diez años después del estudio PREDyCES

SeDREno study — prevalence of hospital malnutrition according to GLIM criteria, ten years after the PREDyCES study

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SUMMARY

Background & aims: the last large multicenter study on disease-related malnutrition (DRM) in Spain (the PREDyCES study) showed a 23.7 % prevalence of malnutrition, according to the Nutritional Risk Screening (NRS-2002) tool. The main objective of the SeDREno study was to assess the prevalence of hospital malnutrition upon admission, according to GLIM criteria, ten years later.

Methods: a cross-sectional, observational, multicenter study in standard clinical practice, conducted in 17 hospitals during a period of five to seven days. Patients were initially screened using the Malnutrition Universal Screening Tool (MUST), and then assessed using the GLIM criteria for diagnosis and severity grading.

Results: a total of 2,185 patients, 54.8 % males, mean age 67.1 (17.0) years (50.2 % aged ≥ 70 years), were evaluated. Malnutrition was observed in 29.7 % of patients according to GLIM criteria (12.5 % severe, 17.2 % moderate). In patients ≥ 70 years malnutrition was observed in 34.8 %. The clinical conditions significantly associated with a higher prevalence of malnutrition were dysphagia (47.6 %), cognitive impairment (43.4 %), cancer (39.1 %), gastrointestinal disease (37.7 %), diabetes (34.8 %), and cardiovascular disease (33.4 %). The multivariate analysis revealed that gender, BMI, diabetes, cancer, gastrointestinal disorders, and polypharmacy were the main independent factors associated with DRM. Malnutrition was associated with an increase in length of hospital stay and death ($p < 0.001$).

Conclusions: DRM in admitted patients has increased in Spain in the last 10 years paralleling ageing of the population. In the SeDREno study almost one in three patients are malnourished. A systematic assessment of nutritional status allows early detection and implementation of nutritional interventions to achieve a better clinical outcome.

Keywords: Malnutrition. Disease-related malnutrition. Screening. Diagnosis. GLIM criteria.

RESUMEN

Antecedentes y objetivos: el último gran estudio multicéntrico sobre desnutrición relacionada con la enfermedad (DRE) en España (el estudio PREDyCES) mostró una prevalencia de desnutrición del 23,7 % según la herramienta Nutritional Risk Screening (NRS-2002). El principal objetivo del estudio SeDREno fue evaluar la prevalencia de la desnutrición hospitalaria al ingreso según los criterios GLIM diez años después.

Métodos: estudio transversal, observacional, multicéntrico, según la práctica clínica estándar, realizado en 17 hospitales durante un período de cinco a siete días. Los pacientes fueron evaluados inicialmente con la herramienta de detección universal de desnutrición (MUST) y luego con los criterios GLIM para el diagnóstico de DRE y la clasificación de la gravedad.

Resultados: se evaluaron 2185 pacientes, con un 54,8 % de varones una edad media de 67,1 (17,0) años (50,2 % ≥ 70 años). Se observó desnutrición en el 29,7 % de los pacientes según los criterios GLIM (12,5 % grave, 17,2 % moderada). Entre los pacientes ≥ 70 años se observó desnutrición en el 34,8 %. Las condiciones clínicas asociadas significativamente con una mayor prevalencia de desnutrición fueron la disfagia (47,6 %), el deterioro cognitivo (43,4 %), el cáncer (39,1 %), las enfermedades gastrointestinales (37,7 %), la diabetes (34,8 %) y la patología cardiovascular (33,4 %). El análisis multivariante reveló que el sexo, el IMC, la diabetes, el cáncer, los trastornos gastrointestinales y la polimedicación eran los principales factores independientes asociados a la DRE. La desnutrición se asoció a un aumento de la duración de la estancia hospitalaria y la muerte ($p < 0,001$).

Conclusiones: la DRE en pacientes ingresados ha aumentado en España en los últimos 10 años en paralelo con el aumento del envejecimiento de la población. En el estudio SeDREno, casi uno de cada tres pacientes está desnutrido. La evaluación sistemática del estado nutricional permite la detección e implementación precoces de intervenciones nutricionales para lograr un mejor resultado clínico.

Palabras clave: Desnutrición. Desnutrición relacionada con la enfermedad. Cribado. Diagnóstico. Criterios GLIM.

INTRODUCTION

Disease-related malnutrition (DRM) is a common social and health problem that mainly affects persons over the age of 65 years, increases their morbidity, and decreases their quality of life (1). Hospital malnutrition is associated with increased morbidity, mortality, a higher rate of readmission, the need for post-discharge rehabilitation support, and therefore higher healthcare and social costs (2).

In Spain, data published over the past 10 years show that the prevalence of malnutrition in hospitalized patients ranges from 15.6 % to 86 % (1-11). The largest such study was the PREDyCES study, conducted in 2009, which involved 31 centers and included 1,707 patients, where nutritional status was assessed using the NRS-2002 (Nutritional Risk Screening 2002) tool within 48 hours of admission, which showed a DRM prevalence of 23.7 % in admitted patients (3). Another major multicenter study was the VIDA study, conducted in 1,090 diabetic patients evaluated using the Mini Nutritional Assessment (MNA) tool, where 39.1 % of patients were at risk of malnutrition and 21.2 % were suffering from malnutrition (2). Outside Spain, the EuroOOPS study evaluated 5,051 patients admitted to European hospitals using the NRS-2002 tool, and found 32.6 % of patients at risk of malnutrition (12).

The widely varying prevalence of risk of malnutrition and DRM described in the literature is largely due to differences in the populations studied and in the tools used for screening and diagnosing nutritional status (7).

In September 2018 a new global consensus definition of malnutrition was published by the Global Leadership Initiative on Malnutrition (GLIM), which is composed of representatives from four major academic societies on nutrition from around the world (13). The stated purpose of GLIM is to reach global consensus on the identification and endorsement of criteria for the diagnosis of malnutrition in clinical settings. The GLIM criteria propose assessing phenotypic criteria including body weight change, thinness (low body mass index), and reduced muscle mass, as well as etiologic criteria including poor nutritional intake and disease burden. Furthermore, GLIM criteria also propose classifying malnourished people into two grades (stage 1/moderate, and stage 2/severe). The GLIM criteria offer some advantages over the 2012 ASPEN and 2015 ESPEN criteria. While previous criteria are effective for diagnosing malnutrition, they are less useful for determining the severity of malnutrition. The GLIM criteria are less subjective and more clinically intuitive, and include parameters that are more consistent with the traditional concepts of non-severe and severe malnutrition.

The aims of the present study were: 1) to evaluate the current prevalence of malnutrition in inpatients according to the GLIM criteria, ten years after the PREDyCES study; and 2) to define patients with increased risk factors and clinical parameters related to malnutrition. This is the first large multicenter study published that uses GLIM criteria to define malnutrition in Europe.

MATERIALS AND METHODS

Study design

This was a cross-sectional, observational, multicenter study in standard clinical practice that evaluated the prevalence of hospital malnutrition upon admission using the GLIM criteria. It was conducted at 17 hospitals in five autonomous communities in northern Spain (Asturias, Basque Country, Navarre, Cantabria, and La Rioja) over a period of five to seven days in February 2019 (SeDREno: DRM north week), similar to the study carried out by the British Association for Parenteral and Enteral Nutrition (BAPEN) in 2007 (BAPEN´s Nutrition Screening Week) (14).

Patients were recruited randomly during the first 48 hours after admission at different hospitals. Site-specific lists were drawn up with the number of patients to be recruited, based on the number of admissions during the previous year, in order to improve the representativeness of the sample according to hospital size, and to avoid an imbalanced casemix of recruited patients.

We considered the following inclusion criteria: subjects aged 18 years or over, inpatients admitted to hospital within 48 hours before recruitment, and signing a written informed consent for (patient or proxy). The criteria for patient exclusion were: pregnancy; subjects admitted to the intensive care, obstetrics, dermatology, ophthalmology, short-stay, pediatric, emergency, palliative care, burns, psychiatry, or eating disorders units; and patients with a short expected length of stay (< 48 h).

Patients included were subjected to anthropometric measurements as well as a specific malnutrition screening test using the Malnutrition Universal Screening Tool (MUST) within the first 48 hours after admission.

Sample size

Sample size for the main prevalence analysis was calculated based on the prevalence of hospital malnutrition according to the PREDyCES® study (23.7 %). Taking this prevalence as a reference, and assuming an accuracy of 2.5 % and a significance level of 1 %, a sample of

1,975 patients was required. In order to prevent biased results due to possible differences in malnutrition according to hospital size, groups of hospitals (less than 200 beds, 200-500 beds, and > 500 beds) were identified to select the sites for inclusion in the study. Thus, 1,681 patients were recruited at large hospitals (> 500 beds), 337 at medium-sized hospitals (200-500 beds), and 167 patients were included from small hospitals (< 200 beds). The number of patients recruited in each autonomous community was proportional to its population: Basque Country, n = 1030 (47.1 %); Principality of Asturias, n = 397 (18.2 %); Community of Navarre, n = 330 (15.1 %); Cantabria, n = 278 (12.7 %), and La Rioja, n = 150 (6.9 %).

Variables and measurements

Sociodemographic and clinical variables were recorded upon admission: age, sex, educational background, employment status, marital status and place of residence, comorbidities (diabetes, cancer, dysphagia, cardiac, respiratory, gastrointestinal and renal diseases or cognitive impairment), type of admission (emergency/planned), and department of admission (medical/surgical).

Screening and diagnosis of malnutrition

Screening is advised as a first step prior to diagnosis of malnutrition in order to identify persons at risk of malnutrition. The screening tool used was the MUST, a validated nutrition screening tool developed by the BAPEN (15). All patients were screened for nutritional risk and, according to the MUST score obtained, were categorized into: low risk (0 points), intermediate risk (1 point) or high risk (2 or more points).

Height and weight were measured and BMI was calculated for all patients at the time of admission. In cases where the patient could not be weighed or their height measured, their estimated weight and height were obtained following the routine clinical practice of each center with one of the validated predictive equations (16). The percentage of weight loss in the last 3-6 months was established

based on actual data concerning the weight available in the patient's medical history, and the weight provided by the patients themselves or estimated by their physician.

The diagnosis of malnutrition was established according to the GLIM criteria: a combination of at least one phenotypic criterion (percentage weight loss or low body mass index) and one etiologic criterion (inflammation: all patients included had an acute disease/injury or a chronic disease). Loss of muscle mass was not included since this was not routine practice at the time of conducting the study. Following the GLIM criteria, patients were classified into groups of severe malnutrition (weight loss greater than 10 % in the previous six months or BMI < 18.5 kg/m^2 if < 70 years of age or BMI < 20.0 kg/m^2 if ≥ 70 years of age), moderate malnutrition (weight loss between 5 % and 10 % in the previous six months or BMI = 18.5 to 20.0 kg/m^2 if < 70 years of age or BMI = 20.0 to 22.0 kg/m^2 if ≥ years of age), and no malnutrition (weight loss less than 5 % in the previous six months or BMI ≥ 20.0 kg/m^2 if < 70 years of age or MBI ≥ 22.0 kg/m^2 if ≥ 70 years of age) (13).

Statistical analysis

The statistical analysis was carried out with the SPSS 24.0. software (IBM Corp., SPSS Statistics for Windows, Version 24.0. Armonk, NY, USA). For quantitative variables, first we checked for normal distribution using the Kolmogorov-Smirnov test. If the variable approached Gaussian distribution, the mean and standard deviation and the median and 25th and 75th percentiles were calculated. For qualitative variables, absolute and relative frequency as percentage of each category are shown.

The MUST questionnaire was used to screen for nutritional status. The prevalence of hospital malnutrition was calculated as the percentage of patients presenting with malnutrition (GLIM criteria) at the time of inclusion with respect to the total number of patients included.

Arithmetic means and standard deviations (SD) were chosen to describe quantitative variables, and frequency and percentage of patients in each category to describe qualitative variables. To analyze the prevalence of hospital malnutrition based on the patients' sociodemographic and clinical factors a dichotomous variable was used, where patients with moderate malnutrition and patients with severe malnutrition were unified.

A logistic regression model was applied to clinically relevant parameters upon admission in order to analyze which variables affected the prevalence of malnutrition in a multivariate way. Variables for inclusion in the model were selected after an analysis of data according to the forward method based on maximum likelihood, and statistical significance was established at $p = 0.05$.

The level of agreement of malnutrition between screening with the MUST tool and diagnosis with the GLIM criteria was performed by calculating the weighted and linear kappa indexes, following Altman's criteria (17). McNemar's Chi-squared test was used for comparison of prevalence between MUST screening and GLIM criteria. To evaluate agreement, positive MUST screening is considered = 1 + 2 and negative MUST screening = 0.

Participating hospitals

Seventeen hospitals in five autonomous communities in the north of Spain accepted the invitation to participate in the SeDREno study. The population of these five communities represents approximately 10 % of the total population of Spain. The participation of each community was proportional to the population registered in the Spanish National Statistics Institute (INE) for 2018 (18).

This study was approved by the Hospital Complex of Navarre Ethics Committee (EC) and the ECs of all participating centers. Patients included in the study signed an informed consent form. Participating sites with their corresponding investigators and research assistants are shown in table VI**.**

RESULTS

Patient clinical and demographic data

A total of 2,185 patients, 1,197 men (54.8 %) and 988 women (45.2 %), were included with a mean age of 67.1 (17.0) years (50.2 % aged ≥ 70 years). From the sample, 7.6 % were included from small hospitals (< 200 beds), 15.4 % at medium-sized hospitals (200-500 beds), and 76.9 % at large hospitals (> 500 beds). Most were emergency admissions (71.9 %). Two out of every three patients included (65.7 %) had a medical disease and only 34.3 % a surgical disease, the most common being cardiac (35.7 %) and respiratory (28.4 %) conditions. Upon admission, mean BMI was 26.9 (5.6) kg/m^2; 2.8 % of patients had a BMI of < 18.5 kg/m^2 and 24 % of patients had a BMI ≥ 30 kg/m^2. The demographic characteristics and the distribution of patients according to type of admission, disease, and comorbidities are shown in tables I and II.

Screening for and diagnosis of malnutrition

The risk of malnutrition was 29.7 % (15.9 % high risk and 13.8 % medium risk) according to the MUST test. In patients ≥ 70 years of age risk was 33.1 % (18 % high and 15.1 % medium) ($p < 0.001$). Malnutrition was observed in 29.7 % of patients according to the GLIM criteria (12.5 % severe and 17.2 % moderate). In patients aged ≥ 70 years malnutrition was observed in 34.8 % (14.7 % severe and 20.1 % moderate) ($p < 0.001$). Figure 1 shows the prevalence of malnutrition by age group. Agreement between screening and diagnosis (MUST and GLIM) revealed a good kappa index ($k = 0.703$; $p < 0.001$) with 0.907 sensitivity and 0.779 specificity. In 82 % of patients a similar level of malnutrition was observed with both criteria. This agreement was higher in the non-malnutrition group with MUST screening (90.7 %) compared to that achieved in the moderate (63.5 %) or severe (59.7 %) groups.

Association between clinical variables and malnutrition

The analysis of the prevalence of malnutrition according to age, gender, type, and department upon hospital admission showed a significantly higher risk of malnutrition for elderly patients (aged ≥ 70) as compared to other subjects (aged < 70), and for women as compared to men. Also, subjects admitted as emergency cases presented a higher risk of malnutrition than those whose hospital admission was scheduled. Malnutrition prevalence rate was higher in patients admitted to medical departments than in those admitted to surgical departments. Neither the size of the hospital nor the chronology of the disease (acute/chronic) were related to the prevalence of malnutrition (Table III).

The clinical conditions significantly associated upon admission with a higher prevalence of malnutrition were dysphagia (47.6 %; $p < 0.001$), cognitive impairment (43.4 %; $p < 0.001$), cancer (39.1 %; $p < 0.001$), gastrointestinal disease (37.7 %; $p < 0.001$), diabetes (34.8 %; $p < 0.004$), and cardiovascular disease (33.4 %; $p < 0.004$). Patients aged ≥ 65 years had more comorbidities ($p < 0.001$), except for oncological disease (more frequent in the 55-64-years range). Patients with polypharmacy (reporting using ≥ 7 drugs in patients ≤ 65 years old; or ≥ 5 drugs in patients ≥ 65 years old upon admission) had a greater prevalence of malnutrition ($p < 0.001$).

Malnutrition was associated with an increase in length of hospital stay ($p < 0.001$) and death (10.4 %; $p < 0.001$) (Table IV).

The multivariate analysis, however, ruled out age as an independent factor and only showed the following as independent risk factors for malnutrition: being female (OR: 1.396 [95 % CI: 1.127 to 1.730]; $p = 0.002$), BMI (OR: 1.160 [95 % CI: 1.182 to 1.138]; $p < 0.001$), medical vs surgical diseases (OR: 1.384 [95 % CI: 1.517 to 1.216]; $p < 0.001$), diabetes (OR: 1.492 [95 % CI: 1.145 to 1.945]; $p = 0.003$), cancer (OR: 1.494 [95 % CI: 1.169 to 1.909]; $p = 0.001$), gastrointestinal disorders (OR: 1.493 [95 % CI: 1.176 to 1.896]; $p = 0.001$), and

number of drugs administered (OR: 1.054 [95 % CI: 1.027 to 1.082]; p < 0.001) (Table V).

DISCUSSION

To our understanding, SeDREno is the largest reported multicenter study in Europe, conducted in Spanish hospitals, in which the GLIM criteria were used to analyze the prevalence of malnutrition in the general population of adult patients admitted to hospital. The large number of patients from 17 hospitals and the cross-sectional design of nutritional assessment, according to real-life practice, support the validity of this study. Prospective information (average length of stay and mortality) was obtained from the patients' medical records upon discharge, and so there was no intervention other than the standard clinical practice at each of the participating centers.

Disease-related malnutrition is currently a major challenge for hospital health care. Its high prevalence and its implications at a clinical and economic level, with increased morbidity rates, lengths of hospital stay, and readmission rates (2,3,6,10,12,19), mean that this problem must be addressed from the time of admission.

ESPEN advises screening with NRS-2002 (20); however, the screening test performed in our study was the MUST (validated by the BAPEN for outpatient, hospitalized, and institutionalized adult patients), according to standard practice and in accordance with the recommendations for screening the adult population drafted by the Multidisciplinary Consensus on the Approach to Hospital Malnutrition in Spain, 2011 (21). In our study, having considered the sum of medium and high risks (MUST = 1 + MUST = 2) as positive risk of malnutrition, as in other publications (22,23), screening results matched those obtained with GLIM criteria. This coincidence is a casual result as they are not exactly the same patients, and only in 82 % of cases do the risk of malnutrition and the degree of malnutrition with GLIM criteria coincide. In the remainder there were

differences in the detection of degree of severity, which was higher with MUST, as would be expected of a screening test.

This high agreement between MUST screening and GLIM criteria is in line with recent results published by Bellanti et al., which showed that MUST is a better tool than Subjective Global Assessment (SGA) and NRS-2002 for detecting malnutrition in hospitalized elderly patients diagnosed using the new GLIM criteria (22).

The risk of malnutrition upon admission observed in this study is similar to that of other Spanish studies that used the MUST screening tool and showed a prevalence of 26.9 % (24), 28.8 % (7) and 31.5 % (25). These rates are higher than those found in other European populations. A study in the Netherlands (19) , where the screening of patient nutritional status upon admission has been standard practice since 2007, data were collected from 564,063 hospitalized patients over a seven-year period, observing a prevalence of malnutrition between 13.7 % and 14.9 % using the Short Nutrition Assessment Questionnaire (SNAQ ≥ 3) or the Malnutrition Universal Screening Tool (MUST ≥ 2), respectively, similar to the figures obtained in our study, where 15.9 % of the population had a high risk of malnutrition, as evaluated using the MUST tool.

The prevalence of malnutrition was six points higher than that obtained 10 years earlier in the PREDyCES study (3), but similar to other, more recent studies on a hospitalized Spanish adult population (7). This suggests that the use of different tools is not sufficient to justify the increased prevalence. In other studies using GLIM criteria, the prevalence of malnutrition was different according to countries, but higher than in ours. Thus, in a study conducted in Brazil in 601 admitted patients the prevalence of malnutrition was 41.6 %, according to GLIM criteria (26) . In Japan, the study by Matsumoto et al. in 409 hospitalized patients over one month showed a prevalence of malnutrition using GLIM criteria of 33 % (27), which is the same figure found in a multicenter study in Canada, where retrospectively

applying GLIM criteria to a sample of 784 patients revealed a prevalence of malnutrition of 33.29 % (28) .

Regardless of the tools orthe criteria used, virtually all published studies on hospital malnutrition have identified age as a factor associated with an increased prevalence of DRM (3,19,29,30). A review by Elia and Stratton highlights that age itself is a better predictor of poor prognosis than any screening test for malnutrition (31). In all concomitant diseases the prevalence of malnutrition increased with age, except for cancer patients. Both when using MUST and GLIM, the prevalence of malnutrition in our study increased with age, affecting one in every three patients aged ≥ 70 years. This effect could partly justify the increase in the prevalence of malnutrition as compared to the PREDyCES® study, since the proportion of people aged over 65 years and over 70 years in the studied population was higher (≥ 65 years: 55 % vs 60 %; ≥ 70 years 43 % vs 50 %). Spain's population pyramid is continuing its ageing process with a progressive increase in mean age and the proportion of population over the age of 65 (from 16.6 % in 2009 to 19.4 % in 2019) (18), although it remains slightly below the average for the EU (20.3 %) (32).

It should be noted that, unlike other studies like the PREDyCES (3), the statistical significance of age as an independent risk factor for malnutrition disappeared in the multivariate analysis model when other factors such as comorbidities or the number of drugs taken were included, suggesting that its influence on the increased risk of malnutrition is partly due to these other factors whose frequency also increases with age.

The most common comorbidities in the population studied were heart, respiratory, and gastrointestinal diseases, diabetes, and oncological conditions, with a higher prevalence of malnutrition in patients with dysphagia, cognitive impairment, cancer, gastrointestinal diseases, diabetes, and cardiovascular disease. Like age, dysphagia, a clinical condition associated with a higher prevalence of malnutrition identified in other studies as an independent risk factor, lost its

statistical significance in the regression model when other factors were included, such as the comorbidities that are associated with it.

Regarding diabetes, it is notable that the prevalence found in the SeDREno study (34.8 %) was somewhat higher than in the PREDyCES (30.1 %) (3) and other previously published studies (21.2 % in the VIDA study), although in the latter, one of the inclusion criteria was patients aged ≥ 65 years admitted exclusively to internal medicine wards (2). Because diabetes has been shown to be a risk factor, this increased presence in the studied population, along with the age and diagnostic criteria used, may have influenced the increase in DRM when compared to data from 10 years ago.

Our study has several strengths: it is the Spanish and European real-life study with the largest sample of hospitalized adult patients to analyze malnutrition according to the new GLIM criteria. Data were recorded at hospitals of different sizes and in a wide geographical area (17 hospitals in five autonomous communities), including all kinds of diseases and departments, which enables speaking of a general population as opposed to many of the published studies that analyze populations with specific characteristics or comorbidities.

It should be noted that there is an increasing number of publications that evaluate agreement between DRM risk screening (MUST and others) and GLIM diagnostic criteria. This kind of approach ultimately aims to confirm whether there is a real need to conduct screening prior to diagnosis, as it does not seem to make sense for diagnostic criteria to be less demanding than screening. Thus, the search for agreement between screening tools and GLIM criteria is a subject of current interest. Our study also has some potential limitations. The fact that it was conducted in the northern part of the country does not allow extrapolation to the state-wide population as the PREDyCES study does. However, the patient sample is larger (2,185 patients compared to 1,706 in the PRDEyCES). Moreover, in both, the percentage of men in the study population was the same, and mean BMI was only slightly higher in the SeDREno study. On the other hand,

although the difference in mean age was four years, the ageing of the Spanish population should be taken into account as it has increased by 2.6 years in the last 10 years with an increase in the population segment over 65 years of age, which has risen from 16.6 % to 19.40 % (18). Another limitation of our study is the fact that we did not assess the loss of muscle mass to evaluate malnutrition in accordance with the GLIM criteria. At the time of conducting the study, it was not routine practice to assess muscle mass, which is the reason for not including it as a criterion. However, aware of this bias, it was proposed as an improvement and muscle mass evaluation was included in the following edition of the study (SeDREno-2 study), conducted in 2020 (not yet published).

Another source of bias could be that some patients' weight loss in the last three to six months was actually not measured, but was estimated or reported. It should be noted that this is a real-life study and, as such, it reflects everyday reality, where we sometimes deal with patients whose clinical condition prevents taking a measurement of their weight for various reasons — for example, if they cannot get out of bed or stand.

CONCLUSION

The results of our study again show a high prevalence of disease-related malnutrition in hospitalized patients, and its increase in Spain over the last 10 years, in line with the ageing of the population. In the SeDREno study nearly one in three patients was malnourished. Taking into account the consequences of malnutrition in both clinical and economic terms, the systematic evaluation of the nutritional status of patients upon admission and during their hospital stay by means of simple screening tools should be considered a priority, as it would allow early detection and the implementation of nutritional interventions that would benefit both patients and, in economic terms, the healthcare system.

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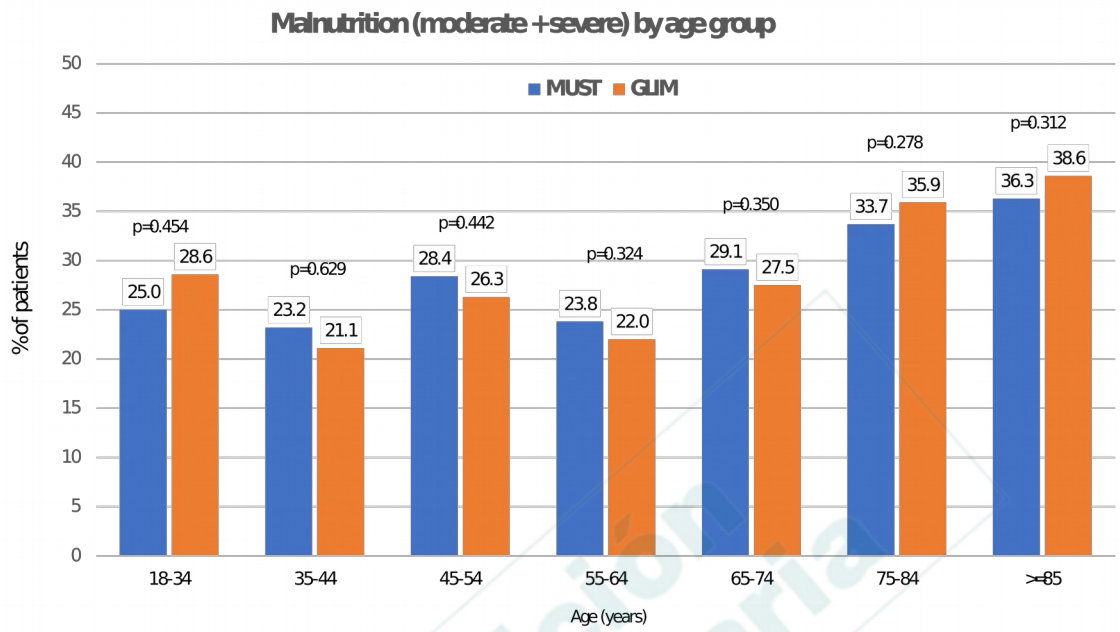
Fig. 1. Prevalence of malnutrition by age group according to MUST screening (high and medium risk) or GLIM criteria (moderate and severe).



p-value: values of statistical significance in the comparison of prevalence between MUST screening and GLIM criteria. McNemar's Chi-squared test.

Table I. Demographic characteristics of the patients

Variables	n (%)
Gender	
Males	1,197 (54.8 %)
Females	988 (45.2 %)
Age (years)	
mean (SD)	67.1 (17.0)
Age group (young/old patients)	
< 65 years	868 (39.7)
≥ 65 years	1,317 (60.3)
< 70 years	1,088 (49.8)
≥ 70 years	1,097 (50.2)
BMI at admission (kg/m^2)	
mean (SD)	26.9 (5.6)
BMI groups (kg/m^2)	
< 18.5	61 (2.8)
18.5-19.9	77 (3.5)
20-24.9	721 (33.0)
25-29.9	802 (36.7)
≥ 30	524 (24.0)
Residence	
home	2,070 (94.7)
nursing home	101 (4.6)
Other	14 (0.6)
Personal status	
married/living with a partner	1,231 (56.3)
widowed	461 (21.1%)
single	342 (15.7%)
divorced or separated	151 (6.9%)

Table II. Distribution of patients according to type of admission, disease, and co-morbidities

Variable	n (%)
Hospital admission type	
Planned	613 (28.1)
Emergency	1,572 (71.9)
Department	
Medical	1435 (65.7)
Surgical	750 (34.3)
Comorbidities	
Cardiac disease	781 (35.7)

Respiratory disease	621 (28.4)
Digestive disease	512 (23.4)
Diabetes	503 (23.0)
Oncological disease	466 (21.3)
Renal disease	347 (15.9)
Dysphagia	212 (9.7)
Cognitive impairment	166 (7.6)

Table III. Prevalence of malnutrition (MUST and GLIM) according to patient characteristics, type of admission, primary admitting department, and comorbidity

	MUST			GLIM		
	Low	Medium + High	p-value	No malnutrition	Malnutrition	p-value
Total (n = 2185)	1537 (70.3)	648 (29.7)	-	1537 (70.3)	648 (29.7)	-
Gender						
Male (n = 1197)	848 (70.8)	349 (29.2)	0.573	863 (72.1)	334 (27.9)	0.048
Female (n = 988)	689 (69.7)	299 (30.3)		674 (68.2)	314 (31.8)	
Age						
< 65 years (n = 868)	650 (74.9)	218 (25.1)	< 0.001	661 (76.2)	207 (23.8)	0.001
≥ 65 years (n = 1317)	887 (67.4)	430 (32.6)		876 (66.5)	441 (33.5)	
Age						
< 70 years (n = 1088)	803 (73.8)	285 (26.2)	< 0.001	822 (75.6)	266 (24.4)	< 0.001
≥ 70 years (n = 1097)	734 (66.9)	363 (33.1)		715 (65.2)	382 (34.8)	
Residence						
Home	1476 (71.3)	594 (28.7)	< 0.001	1481 (71.5)	589 (28.5)	< 0.001
Nursing home	55 (54.5)	46 (45.5)		48 (47.5)	53 (52.5)	
Other	6 (42.9)	8 (57.1)		8 (57.1)	6 (42.9)	
Hospital size						
Small (< 200 beds)	121 (72.5)	46 (27.5)	0.808	119 (71.3)	48 (28.7)	0.959
Medium (200-500 beds)	238 (70.6)	99 (29.4)		236 (70.0)	101 (30.0)	
Large (> 500 beds)	1178 (70.1)	503 (29.9)		1182 (70.3)	499 (29.7)	
Type of admission						
Planned (n = 613)	484 (79.0)	129 (21.0)	< 0.001	484 (79.0)	129 (21.0)	< 0.001
Emergency (n = 1572)	1053 (67.0)	519 (33.0)		1053 (67.0)	519 (33.0)	
Department						

of admission						
Medical (n = 1435)	933 (65.0)	502 (35.0)	< 0.001	942 (65.6)	493 (34.4)	< 0.001
Surgical (n = 750)	604 (80.5)	146 (19.5)		595 (79.3)	155 (20.7)	
Chronology of disease						
Acute (n = 1551)	1118 (72.1)	433 (27.9)	0.005	1105 (71.2)	446 (28.8)	0.149
Chronic (n = 634)	419 (66.1)	215 (33.9)		432 (68.1)	202 (31.9)	
Diabetes mellitus						
No	1192 (70.9)	490 (29.1)	0.326	1209 (71.9)	473 (28.1)	0.004
Yes	345 (68.6)	158 (31.4)		328 (65.2)	175 (34.8)	
Cancer						
No	1257 (73.1)	462 (26.9)	< 0.001	1253 (72.9)	466 (27.1)	< 0.001
Yes	280 (60.1)	186 (39.9)		284 (60.9)	182 (39.1)	
Dysphagia						
No	1431 (72.5)	542 (27.5)	< 0.001	1426 (72.3)	547 (27.7)	< 0.001
Yes	106 (50.0)	106 (50.0)		111 (52.4)	101 (47.6)	
Heart disease						
No	998 (71.1)	406 (28.9)	0.310	1017 (72.4)	387 (27.6)	0.004
Yes	539 (69.0)	242 (31.0)		520 (66.6)	261 (33.4)	
Respiratory disease						
No	1118 (71.5)	446 (28.5)	0.064	1122 (71.7)	442 (28.3)	0.023
Yes	419 (67.5)	202 (32.5)		415 (66.8)	206 (33.2)	
Gastrointestinal disease						
No	1219 (72.9)	454 (27.1)	< 0.001	1218 (72.8)	455 (27.2)	< 0.001
Yes	318 (62.1)	194 (37.9)		319 (62.3)	193 (37.7)	
Cognitive impairment						

No	1446 (71.6)	573 (28.4)	< 0.001	1443 (71.5)	576 (28.5)	< 0.001
Yes	91 (54.8)	75 (45.2)		94 (56.6)	72 (43.4)	
Kidney disease						
No	1307 (71.1)	531 (28.9)	0.071	1295 (70.5)	543 (29.5)	0.789
Yes	230 (66.3)	117 (33.7)		242 (69.7)	105 (30.3)	

p-value: values of statistical significance in the comparison of nutritional status by patient characteristics. Pearson’s Chi-squared test.

Table IV. Patient characteristics according to nutritional status (GLIM criteria)

	Non-malnourished	**Malnourished**	**p**
Age (years), mean (SD)	65.8 (16.8)	69.9 (16.9)	< 0.001
Weight (kg), mean (SD)	76.8 (15.0)	65.9 (16.2)	< 0.001
BMI (kg/m^2), mean (SD)	28.0 (5.0)	24.3 (5.6)	< 0.001
Number of drugs, mean (SD)	5.5 (4.5)	6.8 (4.6)	< 0.001
Polypharmacy (%)	47.4	60.6	< 0.001
Widowed (%)	18.5	27.3	< 0.001
Hospitalization days, median (IQR)	5 (3-8)	6 (4-10)	< 0.001
Death (%)	3.5	10	< 0.001

SD: standard deviation; IQR: interquartile range. Comparison using Student's t-test or the Mann-Whitney U-test.

Table V. Univariate and multivariate logistic regression analysis

Variable	Univariate analysis		Multivariate analysis	
	OR [95 % CI]	p	OR [95 % CI]	p
Age (years)	1.015 [1.009-1.021]	< 0.001	-	0.304
Age (< 65 vs ≥ 65 years)	1.608 [1.325-1.951]	< 0.001	-	0.114
Age (< 70 vs ≥ 70 years)	1.651 [1.371-1.988]	< 0.001	-	0.190
Gender (males vs females)	1.204 [1.001-1.447]	0.048	1.396 [1.127-1.730]	0.002
BMI (kg/m^2)	0.845 [0.825-0.865]	< 0.001	0.840 [0.818-0.862]	< 0.001
BMI (< 30 kg/m^2 vs ≥ 30 kg/m^2)	0.437 [0.342-0.558]	< 0.001	-	0.568
Residence (home vs nursing home/others)	2.649 [1.815-3.866]	< 0.001	-	0.856
Type of admission (planned vs emergency)	1.849 [1.483-2.306]	< 0.001	-	0.489
Disease at admission (medical vs surgical)	0.498 [0.404-0.613]	< 0.001	0.616 [0.483-0.784]	< 0.001
Chronology of disease (acute vs chronic)	1.158 [0.948-1.415]	0.149	-	-
Diabetes (yes vs no)	1.364 [1.103-1.686]	0.004	1.492 [1.145-1.945]	0.003
Cancer (yes vs no)	1.723 [1.391-2.135]	< 0.001	1.494 [1.169-1.909]	0.001
Dysphagia (yes vs no)	2.372 [1.80-3.161]	< 0.001	-	0.159
Heart disease (yes vs no)	1.319 [1.092-1.594]	0.004	-	0.323
Respiratory disease (yes vs no)	1.260 [1.032-1.539]	0.024	-	0.348
Gastrointestinal disease (yes vs no)	1.620 [1.315-1.995]	< 0.001	1.493 [1.176-1.896]	0.001
Cognitive impairment (yes vs no)	1.919 [1.391-2.647]	< 0.001	-	0.872
Number of drugs administered	1.064 [1.043-1.085]	< 0.001	1.054 [1.027-1.082]	< 0.001
Polypharmacy (no vs yes)	1.708 [1.417-2.059]	< 0.001	-	0.804

Table VI. SeDREno study collaborators and number of patients recruited

Hospital	Researcher	Monitor	N patients	% patients
Hospital Universitario Donostia	Carmen Ripa	Larraitz Leunda	268	12.3
Complejo Hospitalario de Navarra	Ana Zugasti	Estrella Petrina	265	12.1
Hospital Universitario Cruces	Rebeca Sánchez	Estrella Diego	220	10.1
Hospital Universitario Central de Asturias	Francisco Villazón	Lorena Suárez	220	10.1
Hospital Universitario Valdecilla	Coral Montalbán	Ángela González	213	9.7
Hospital Universitario Araba	Carmen Fernández	Leire Garaizábal	190	8.7
Hospital Universitario Basurto	Laura Calles	Alba Zabalegui	155	7.1
Hospital San Pedro	Ángela Martín	Mª Jesús Chinchetru	150	6.9
Hospital Universitario de Cabueñes	María Riestra	Brenda Veiguela	111	5.1
Hospital Universitario Galdácano	Maddalen Dublang	Sara Valle Rodríguez-Navas	95	4.3
Hospital San Agustín	Josefa Rengel	Belinda Suárez Cuesta	66	3.0
Hospital Sierrallana	Margarita Díez	María Dolores Andreu	65	3.0
Hospital Reina Sofía	Javier Agorreta	Francisco Javier Basterra	41	1.9
Hospital de Zumárraga	José Luis Salsamendi	Mª Isabel Fernández González	41	1.9
Hospital de Mendaro	Ihintza Larrañaga	Olga Valbuena	40	1.8
Hospital García Orcoyen	María Luisa Abínzano	Vanesa Jarne	24	1.1
Hospital Oncológico Donostia	Olatz Olariaga	Ana Cristina Riestra	21	1.0