Nutrición Hospitalaria

Original

Prevalence of malnutrition and its etiological factors in hospitals

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Abstract

Background: Malnutrition among inpatients is highly prevalent, and has a negative impact on their clinical outcome. The Working Group for the Study of Malnutrition in Hospitals in Catalonia was created to generate consensus guidelines for the prevention and/or treatment of malnutrition in hospitals in Catalonia, Spain.

Aims: The objectives of the study were to determine the prevalence of malnutrition on admission to hospital in Catalonia and to assess relationships between malnutrition, social and demographic data, overall costs, and mortality.

Methods: Prospective and multicenter study conducted with 796 patients from 11 hospitals representative of the hospitalized population in Catalonia. Nutritional status was evaluated using the Nutritional Risk Screening 2002 method.

Results: Overall, 28.9% of the patients are malnourished or at nutritional risk. Elderly patients, non-manual workers, those admitted to hospital as emergencies and with higher co-morbidities had higher risk of malnutrition. The type of hospital (second level vs. tertiary or University referral) to which they were admitted was also a factor predisposing to malnutrition. Length of hospital stay was longer in malnourished patients (10.5 *vs.* 7.7 days, p < 0.0001). The need for a convalescent home on leaving hospital was higher as well as the risk of mortality (8.6% malnourished *vs.* 1.3% non-malnourished, p < 0.0001).

Conclusions: The prevalence of malnutrition is high in patients on admission to hospital in our community, resulting in elevated overall costs and higher risk of mortality. Age, social class and characteristics of the Unit and the Hospital are the main factors involved in hospital malnutrition.

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Key words: *Hospital malnutrition. Malnourishment. Nutritional status. Nutritional screening. Nutritional Risk Screening (NRS).*

PREVALENCIA DE MALNUTRICIÓN Y SUS FACTORES ETIOLÓGICOS EN HOSPITALES

Resumen

Introducción: La desnutrición en los pacientes ingresados en el hospital es altamente prevalente, e impacta negativamente en su evolución clínica. El Grupo de Trabajo para el Estudio de la Desnutrición Hospitalaria en Cataluña se creó para general Guías de consenso para prevenir y/o tratar la desnutrición en los hospitales de Cataluña, España.

Objetivos: Los objetivos del estudio fueron determinar la prevalencia de desnutrición al ingreso en los hospitales de Cataluña, y evaluar la relación entre desnutrición, datos sociales y demográficos, coste relacionado con la enfermedad y mortalidad.

Métodos: Estudio prospectivo y multicéntrico realizado en 796 pacientes ingresados en 11 hospitales representativos de la población hospitalizada en Cataluña. El estado nutricional se evaluó utilizando la herramienta Nutritional Risk Screening 2002.

Resultados: De forma global, 28,9% de los pacientes estaban desnutridos en el momento del ingreso. Los pacientes más ancianos, trabajadores no manuales, ingresados en el hospital procedentes de Urgencias y con más comorbilidades son los que presentaron mayor prevalencia de desnutrición. El tipo de hospital (Segundo nivel versus Tercer Nivel) también fue un factor predisponente a la desnutrición. La estancia hospitalaria fue mayor en los pacientes desnutridos (10,5 *vs* 7,7 días, p < 0,0001). La necesidad de centro de convalecencia al alta hospitalaria fue mayor en los pacientes desnutridos, así como la mortalidad (8,6% desnutridos *vs* 1,3% normonutridos, p < 0,0001).

Conclusiones: La prevalencia de desnutrición es elevada en los pacientes ingresados en el hospital en nuestra comunidad, lo que resulta en mayores costes sanitarios y mayor mortalidad. La edad, clase social y características del Servicio y del Hospital son los principales factores involucrados en la presencia de desnutrición hospitalaria.

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Palabras clave: *Desnutrición hospitalaria. Desnutrición. Estado nutricional. Cribado nutricional. Nutritional Risk Screening (NRS).*

Abbreviations

NRS: Nutritional Risk Screening.
CCI: Charlson co-morbidity index.
BMI: Body Mass Index.

Introduction

Malnutrition is a very frequent condition among hospital inpatients in industrialized countries. Studies conducted over the past few years have identified malnutrition in 25–50% of the hospitalized population.[1-6] The observed variation in prevalence between studies results, mainly, from the methodology used for diagnosing malnutrition, and on the type of patient population under study (medical or surgical pathologies; emergency *versus* scheduled intervention).

In general, malnourished patients have higher rates of morbidity,[7,8] mortality,[8,9] hospital readmission[8] as well as a greater need for convalescent homes on leaving hospital. As a consequence, there are increased costs for healthcare and social services provision[8]. Hence, scientific societies have encouraged the use of guidelines and nutritional screening methods for early intervention.[10]

The etiology of hospital malnutrition is complex. The underlying illness for which the patient is hospitalized is an important factor in the presentation of malnutrition, but it is incorrect to consider that the malnutrition is inherent in the disease and, as such, not treatable. This has been demonstrated in numerous nutritional intervention studies in different pathologies in which the malnutrition was partly reversible.[11]

In 2006 a working group (Group for the Study of Malnutrition in Hospitals in Catalonia) was set-up in Spain. It was composed of healthcare professionals from different areas of clinical nutrition, and the objective was to generate consensus guidelines for the prevention and/or treatment of malnutrition in hospitals in Catalonia (Autonomous Community with approximately 7 million inhabitants in the Mediterranean region of northeast Spain).

This multicenter study conducted with patients from different healthcare segments of the Community was aimed to assess the nature of inpatient malnutrition in Catalonia and to establish relationships between possible factors predisposing to malnutrition and the consequences on various healthcare economic indicators, as well as on morbidity and mortality. Hence, the aims of the present study were: a) to determine the prevalence of malnutrition in patients admitted to representative hospitals in Catalonia; and b) to assess the relationships between malnutrition, social and demographic parameters (age, gender, socio-economic group), length of hospital stay (LOS), the need for additional healthcare resources on discharge, and mortality.

Materials and methods

Patients

Multicenter prospective and observational study with 11 participating hospitals (7 tertiary level and 4 secondary level) in Catalonia with a total of 4179 beds. The population under study is assumed to be representative of the overall hospitalized population in Catalonia since the reference population of these participating hospitals covers approximately 5 of the 7 million inhabitants of Catalonia.

The sample selection was stratified by hospital size and by hospital units so that no single hospital unit would be under or over-represented. Critical patients were excluded from the study, as were pediatric patients and pregnant women.

Patients were selected randomly from the previous day's admissions and, in the case of weekend admissions, within a maximum of 48-72 hours. Data were collected at each participating hospital by qualified personnel with previous experience in nutritional evaluation methods. A centralized database was set-up and the data were evaluated by a single research specialist. Participation in the study was voluntary, and informed consent was obtained in all cases. The study was approved by the local Ethics Committee.

Variables studied

Social and demographic variables: age, gender and socio-economic group. The classification proposed by the Spanish Society of Epidemiology and the Spanish Society of Family & Community Medicine was used to determine socio-economic status.[12] This validated classification for the Catalonian population[13] is based on an evaluation of the patient's occupation, employment and education level and classifies individuals into 5 social strata. Social classes I, II, and III are: management, degree-level educated professionals and office workers, or those in management support roles, while class IV includes skilled or semi-skilled workers and class V contains un-skilled laborers.

Anthropometric variables: Height was measured with subjects standing when possible, using a stadiometer and measured to the nearest 0.1 cm. In patients who are unable to stand upright, an estimation of height was done using the length of the ulna (distance from the olecranon to the styloid).[14] Weight was measured with patients wearing light clothes using a mechanical calibrated scale, and measured to the nearest 0.1 kg. When not possible to obtain a weight measurement, we used the last known weight recalled by the patient or his/her family and, where absent, the weight was estimated by the researcher. Body Mass Index (BMI) was calculated as body weight (in kg) divided by the height (in m^2).

Variables relating to hospital admission: a) Reason for admission to hospital: diagnosis based on the Inter-

national Classification of Diseases ICD-9; b) Type of admission (scheduled or emergency; admission for medical or surgical pathology); c) Charlson co-morbidity index (CCI) which enables the complexity of the patient's pathology to be evaluated through his/her co-morbid conditions. This validated index is closely related to mortality associated with co-morbidities;[15] d) LOS; and e) Patient destination following discharge from hospital (own home, nursing home, or death).

Nutritional screening: Nutritional screening is carried out using the *Nutritional Risk Screening 2002* (NRS-2002) method. This questionnaire is recommended by the European Society for Clinical Nutrition and Metabolism (ESPEN) because it can be applied to all patients admitted to hospital, and is easy to use.[10] This two-part screening system was applied to all the participating patients within the first 72 hours of admission to hospital. Patients who responded in the negative to the first four questions were considered normo-nourished. Patients who responded in the affirmative to any of the initial screening questions went on to complete the full nutritional risk analysis. If they scored ³3 they were considered malnourished, or in a situation of nutritional risk.

Statistical methods

Sample size estimation

To estimate the prevalence of malnutrition in our population we drew on data from other similar studies,[8] considering an expected malnutrition prevalence approximately 40%. With an expectation of around 10% non-responders to the questionnaires and with an alpha risk of 5% and a precision of ± 5%, it was estimated that 409 individuals would need to be studied. It was decided that 800 patients would be enrolled in order to achieve appropriate precision when estimating prevalence in population subgroups and, as well, sufficient numbers of study subjects to explore relationships between malnutrition and the possible etiological factors (secondary objective).

Analysis and presentation of results

The results are expressed as median and inter-quartile range. Comparisons between groups were with the Chi-squared test and the U-Mann-Whitney test, depending on the type of variable. A multiple logistic regression model was used to explore the risk of malnutrition in relation to the factors in the study considered determinants of the malnutrition.

For the purposes of the present analyses, socio-economic status was reassigned into 2 groups: a) manual workers (to include socio-economic categories IV and V); and b) non-manual workers (to include categories I, II and III).

The diagnoses at hospitalization were according to the pathology from the CIE-9 MC classification: a) infections, b) hematological diseases, c) neoplasms, d) vascular disease, e) endocrine disorders, f) respiratory diseases, g) digestive pathology, h) minor surgery, i) cardiologic diseases, j) neuropathology, k) genitourinary pathology, l) locomotive system abnormalities, and m) other pathologies. The onco-hematological group of pathologies was subsequently analyzed separately due to its distinct characteristics. The different types of hospitals (secondary *vs.* tertiary level of assistance) were compared to assess whether there were any relationships between type of hospital and the types of patients attended-to. Multivariate analysis was performed using the presence of malnutrition as the dependent variable and with age, socio-economic status, type of admission (emergency or scheduled), healthcare treatment (medical or surgical), hospital type (secondary or tertiary), the CCI index and the diagnosis that led to the hospital admission as co-variables.

The data were processed using the SPSS (version 15.0).

Results

Results of the overall sample

A total of 796 patients could be included in the analyses (table I), admitted to the participating hospitals over the 24-72 hour period prior to the nutritional screening. Causes for exclusion from the analyses were incomplete nutritional screening (n = 2), 1 patient < 18 years of age and 1 patient pregnant. Table II summarizes the general characteristics of the patients in the study. The results of the nutritional screening using NRS-2002 shown that 28.9% of all patients included in the study were positive and considered as malnourished or at nutritional risk.

Table I
Distribution of the patient sample by hospital

Hospital	Beds (n)	Sample included (n)
Tertiary level hospitals (University referral)		
Hospital Arnau de Vilanova (Lleida)	305	55
Hospital Universitari de Bellvitge (Barcelona)	759	124
Hospital Clínic (Barcelona)	650	108
Hospital Dos de Maig (Barcelona)	161	34
Hospital Germans Trias i Pujol (Badalona)	457	95
Hospital Vall D'Hebron (Barcelona)	553	114
Hospital Josep Trueta (Girona)	279	54
Secondary level hospitals (District General)		
Hospital Universitari de San Joan (Reus)	242	51
Hospital Parc Taulí (Sabadell)	404	84
Hospital General d'Igualada (Igualada)	151	32
Hospital San Joan de Deu (Manresa)	217	45
Total	4,179	796

Table II
General characteristics of the patients included in the study

Characteristic	N
Age; years, mean (range)	62.3 (17-95)
Gender; male/female, %	55.2/44.8
Socio-economic group; "Non-manual" workers, %	26.6
I, %	4.6
II, %	4.3
III, %	17.7
Socio-economic group; "Manual" workers, %	73.4
IVa	40.9
V, %	32.5
Weight; kg, median (range)	71 (28-181)
Height; m, median (range)	1.63 (1.35-1.97)
BMI; kg/m², median (range)	26.4 (11.4-63.3)
Diagnosis/pathology	
Locomotive system, %	8.4
Cardiac, %	12.5
Digestive, %	13.1
Endocrine, %	5.2
Genitourinary, %	6.6
Hematological, %	2.1
Neoplasia, %	16.7
Neurological, %	3.4
Respiratory, %	7.4
Minor surgery, %	5.7
Circulation system, %	4.1
Others, %	7.9
Type of admission to hospital	
Emergency, %	53.6
Scheduled, %	39.4
Pathology	
Medical, %	49.0
Surgical, %	51.0
Charlson Co-morbidity Index, median (range)	1.88 (0-10)
Hospital stay (days), median (range)	8.62 (1-78)
Patient Destination on discharge from hospital	
Home, %	91.3
Convalescent home, %	5.3
Death, %	3.4

Table III
Characteristics of the overall sample using the NRS-2002 assessment

|	NRS-2002 positives	NRS-2002 negatives	P
Age, years, mean ± SD	68.5 ± 16	59.6 ± 17	0.001
Charlson index, mean ± SD	2.78 ± 2.1	1.5 ± 1.7	< 0.0001
Type of admission, %			
Medical	39.0	61.0	
Surgical	19.6	80.4	< 0.0001
Type of Admission; %			
Scheduled	22.3	78.7	
Emergency	34.3	65.7	< 0.0001
Socio-economic group; %			
"Manual" workers	26	74	
"Non-manual" workers	34	66	0.003
Hospital stay, days, mean ± SD	10.5 ± 9.5	7.7 ± 7.8	< 0.0001
Destination on discharge; %			
Home	83.6	94.4	
Convalescent home	7.8	4.3	< 0.0001
Death	8.6	1.3	
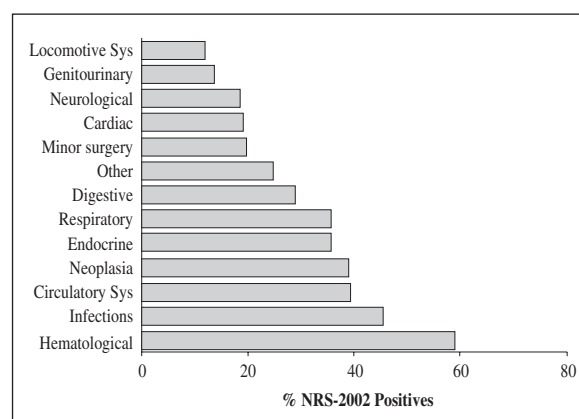
Fig. 1.—Patients with positive NRS-2002 on admission to hospital classified according to the clinical cause for admission.

Full screening data analyses indicated that patients with positive screening were older and had a greater number of associated co-morbidities (higher CCI). More individuals with positive screening were admitted for medical conditions, via the emergency units, and more individuals were from the higher socio-economic groups (including social and economic subclasses I, II and III) (table III). LOS was significantly longer in patients who screened positive (10.5 ± 9.5 days *vs.* 7.7 ± 7.8 days, p < 0.0001). The mortality rate was also higher in patients who screened positive (8.6% *vs.* 1.3%, p < 0.0001).

Figure 1 depicts the percentage positive screening outcomes on the NRS-2002 segregated with respect to the diagnosis for admission to hospital. Patients with blood disorders and infectious diseases showed a higher prevalence of malnutrition on the NRS-2002 scale.

Analysis of the NRS-2002 segregated by hospital type showed that third level hospitals accounted for 31.4% of the positive screening results compared to 19.3% in second level hospitals (p = 0.002). For this reason, we performed the analysis of the outcome segregated with respect to hospital type.

Outcomes segregated with respect to hospital type

There were no differences with regard to age, BMI or gender distributions between second and third level hospitals. However, in the third level hospitals there was a greater number of manual workers and of patients with more complex healthcare needs (higher score on the CCI) (p < 0.001). No differences were noted in relation to

Table IV
Characteristics of the patient sample classified by hospital type

Characteristic	Second level hospital (District General)	Third level Hospital (University referral)	P
Age, years, mean ± SD	64.3 ± 18.7	61.8 ± 17	NS
BMI, mean ± SD	26.7 ± 5.2	26.3 ± 5.5	NS
Gender			
Female, %	49.7	50.3	NS
Male, %	50.3	49.7	
Socio-economic group			
"Manual" workers, %	80.0	69.0	0.003
"Non-manual" workers, %	20.0	31.0	
Charlson index	1.58	1.94	0.039
Type of admission			
Emergency, %	70.0	54.5	< 0.0001
Scheduled, %	30.0	45.5	
Type of admission			
Medical, %	49.7	48.6	NS
Surgical, %	50.3	51.4	
Destination on discharge			
Home, %	88.8	91.9	
Convalescent home, %	10.0	4.1	0.004
Death, %	1.3	4.0	
Hospital stay, days; mean ± SD	8.7 ± 7.0	8.6 ± 8.7	NS
NRS-2002			
Positive, %	19.3	31.8	0.002
Negative, %	80.7	68.2	

Differences with respect to the type of patients treated at the different types of hospital are in table V. In secondary as well as third level hospitals, emergency admissions and medical treatments have a higher prevalence of malnutrition. Likewise, the need for a convalescent home was significantly higher in patients who screened positive in second level hospitals. Mortality however was much higher in positively screened patients admitted to third level hospitals. Multivariate analysis was performed using the presence of malnutrition on the NRS-20002 questionnaire as the dependent variable and age, socio-economic status, type of treatment (medical/surgical), type of admission (scheduled/emergency), CCI, hospital type (secondary/tertiary) and onco-hematological diagnosis as the independent variables. The results are summarized in table VI. The risk of malnutrition measured with the NRS-2002 screening test increases with age, in the presence of co-morbidities, and is higher in patients admitted for medical treatment to third level hospitals with onco-hematological diseases and who belong to the non-manual worker socio-economic category.

Discussion

Malnutrition on admission to hospital is highly prevalent, and the causes are very complex. The results of our study show that, of a representative Catalonian inpatient population, approximately 30% are malnourished on admission to hospital. The present study is one of few that have evaluated the underlying relationship between complexity of patient pathology or the level of healthcare treatment received and the risk of presenting with malnutrition.

The results of our study enable us to affirm that malnutrition is more likely to be present when the

mean LOS between tertiary and secondary hospitals, although differences were evident in respect to destination on discharge: patients from second level hospitals needed nursing homes more frequently, but also they have a lower overall mortality rate (table IV).

Table V
Patients positive on NRS-2002 assessment segregated with respect to hospital-relevant data

Hospital type	Variable		NRS-2002 positive	NRS-2002 negative	p
Tertiary level (University referral)	Type of treatment	Medical	41.9	58.0	p < 0.0001
		Surgical	22.3	77.6	
	Type of admission	Scheduled	23.5	76.4	p < 0.0001
		Emergency	38.6	61.3	
	Destination on discharge	Home	84.1	95.6	p = 0.0001
		Convalescent home	6.5	3.0	
		Death	9.5	1.4	
Secondary level (District General)	Type of treatment	Medical	28.7	71.2	P = 0.002
		Surgical	9.8	90.1	
	Type of admission	Scheduled	14.6	85.4	p = 0.315
		Emergency	21.4	78.5	
	Destination on discharge	Home	80.6	90.7	P = 0.23
		Convalescent Home	16.1	8.5	
		Death	3.2	0.8	

Table VI
Multiple regression analysis of the factors predisposing to a positive assessment on NRS-2002

Independent variables	Odds Ratio	95% CI	Significance P
Age	1.031	1.01-1.04	< 0.0001
Socio-economic group (Manual worker)	0.63	0.4-0.9	0.0015
Admission type (Emergency)	1.39	0.9-2	0.08
Treatment (Medical)	1.82	1.2-2.6	0.001
Type of Hospital (Secondary level)	0.45	0.28-0.7	0.001
Charlson index	1.26	1.1-1.3	< 0.0001
Diagnosis (Hemato-oncological)	2.16	1.47-3.1	< 0.0001

patient is admitted via the emergency route or admitted in medical units.

Among the studies which have evaluated the relationship between the type of hospital admission and risk of malnutrition, three Spanish studies are worthy of note and which also show that patients admitted through the emergency route are at higher risk of malnutrition. Planas et al.,[8] in a study conducted at a single tertiary level hospital, showed that malnutrition was present in 51.5% of all patients admitted to hospital through the emergency department compared to 44% of patients admitted for scheduled treatment.

Similarly Lobo et al.,[16] in a study conducted in a university hospital, observed malnutrition in 52% of patients admitted through the emergency department compared to 33% of scheduled admissions.

Recently, a large multicentric study has been conducted in Spain (Predyces, Prevalence of hospital malnutrition and associated costs in Spain),[17] and demonstrated a prevalence of hospital malnutrition of 23% of patients at admission, higher in older patients, with a diagnosis of neoplasia, respiratory or cardiovascular disease, and admitted in medical departments. Furthermore, the LOS was higher in malnourished patients, as well the hospital costs.

The results of our present study also confirm previous findings of a higher prevalence of malnutrition in medical treatment units of hospitals, compared to surgical units.[8,16]

The prevalence of hospital malnutrition observed in our study is similar to that observed in the majority of international studies.[1-9] It is of note that this situation has shown no improvement over the years, despite more awareness of the problem as well as the development and implementation of nutritional support techniques capable of preventing and reversing malnutrition.

The first step towards reversing malnutrition in hospitals is the implementation of effective initial nutritional screening that is capable of identifying those patients who ought to receive a more complete nutritional evaluation.[18] In the year 2002, the European Society for Clinical Nutrition and Metabolism (ESPEN) developed the Nutritional Risk Screening 2002 tool and recommended nutritional support based on the severity of the malnutrition and on the increase in nutritional requirements due to the illness under consideration.[10,19] The ESPEN recommends this nutritional screening method which takes into account the age of the patient and the severity of the illness. It can be carried out on almost all patients admitted to hospital,[10] and is precise and accurate.[20]

In Spain, the Spanish Society for Parenteral and Enteral Nutrition (SENPE) also encourages the use of nutritional screening methods for patients on being admitted to hospital.[21] As demonstrated in different studies, whether assessed by clinical evaluation[8] or electronic database,[22,23] the prevalence of malnutrition is seen to be high. For example, using clinical methods, the prevalence of malnutrition on admission to hospital in a study conducted in a tertiary hospital in Andalucia (southern Spain) was around 46%.[16] The same prevalence of malnutrition of 46% was also reported by a hospital of similar characteristics in Catalonia (northeast Spain) using subjective global assessment (self-administered questionnaire) of nutritional status.[8] As a result of this high prevalence of hospital malnutrition, recently SENPE has promoted a multidisciplinary consensus on the approach to hospital malnutrition in Spain.[24] The initiative has the objective to establish recommendations that facilitates decision-making and action to prevent, to diagnose and to treat the disease-related malnutrition both in primary care setting and hospital admission. The consensus was obtained with the collaboration of 21 spanish scientific societies, and lays the groundwork for starting the fight against disease-related malnutrition.

In our study we used a randomly selected population sample from second as well as third level hospitals. This ensures a representative distribution of the hospitalized population in Catalonia. The two different hospital types provided care for patients with different levels of pathology complexity. Also, there were differences in the types of admission (scheduled or emergency). These two variables have an impact on the percentage of malnourished patients noted on admission to hospital and, as well, on the post-discharge-from-hospital pathways: a greater need for nursing homes by patients receiving treatment at second level hospitals, and a higher mortality in patients having received treatment at third level units.

The majority of studies published to-date have been conducted with single-centered patient populations, without taking into account details pertaining to the characteristics of the population receiving attention by the hospital. This makes comparisons of prevalence data difficult.

As in the present study seeking to determine the prevalence of malnutrition in hospitals, some international projects have studied populations from different types of hospital with different levels of healthcare treatment. As such, comparing the data with that of the

present study is possible. In Germany, Pirlich et al.[25] compared the prevalence of malnutrition on admission to hospital using the Subjective Global Assessment in 7 University hospitals and 6 non-University hospitals. The overall prevalence of malnutrition was very similar to that observed in our study (27%), albeit the University hospitals had a significantly lower prevalence of malnutrition in comparison to the non-University hospitals (20.2% *vs.* 36.8 %, p < 0.001). This could be because the non-University hospitals provided care for the less serious-ill patients, despite being significantly older (70 *vs.* 56 years in the University hospitals). In our study, no significant differences were noted with respect to the mean age of patients receiving attention from the different healthcare providers. However, there were differences in the complexity of the patient pathologies. Two of the independent risk factors for malnutrition status on admission to hospital in the study by Pirlich et al. coincided with those detected in our study i.e. age and cancer.

In our study, in both types of healthcare facility (second and third level), LOS was significantly longer in patients who were NRS-2002 positive (10.5 *vs.* 7.7 days in patients who were NRS-2002 negative, p < 0.0001). As in other studies[8,9] mortality was also significantly higher in those patients who were NRS-2002 positive at the beginning of the study, and underlines the importance of identifying those individuals who require effective nutritional support.

We included the influence of social class (or socio-economic status) on the prevalence of malnutrition on admission to hospital since this variable has not been studied sufficiently, to-date. We noted that non-manual workers had a higher risk of malnutrition on admission to hospital than manual workers. This could be explained by the prevalence of obesity tending to be higher among the manual worker social classes (p = 0.05, data not shown) and, in obese patients, involuntary loss of weight is underestimated (albeit this has not as yet been confirmed). Recently,[26] illiteracy and civil status have been described as risk factors for malnutrition on admission to hospital i.e. higher in illiterate patients (OR: 2.45, 95% CI: 1.52-3.96) and in single, divorced and widowed patients (OR: 1.55, 95% CI: 1.02-2.35). The level of formal academic education was also related to the risk of malnutrition on hospitalization, but social class, most closely related to occupation, was not evaluated.[27]

Patients with oncology-related diagnoses are confirmed as a group at risk of malnutrition within the hospital. Other studies have identified this association. Planas et al.[8] found that cancer diagnosis increased the risk of non-scheduled patient re-admission, whilst Pirlich[24] et al., reported a higher risk of malnutrition in cancer patients (OR: 1.509, 95% CI: 1.180-1.930).

As has been highlighted in the literature, our study clearly demonstrates that malnutrition in hospital is not only associated with higher mortality but, even with successful treatment, is related to higher expenditure in the health services because of longer stays in hospital and more need for nursing homes on discharge from hospital. Several studies have shown the relationship between hospital malnutrition and the increase in morbi-mortality.[28] Similarly, malnutrition has also been associated with different economic markers such as prolonged hospital stay,[29,30] increased need for periods in nursing homes,[8] and a higher rate of re-admission.[16]

Our study has several limitations which need to be taken into account. Although the population studied is representative of the patient population in hospitals, the prevalence observed cannot be extrapolated to the long-stay hospitalized patient population. Another limitation is that the degree of patient pathology complexity was measured using the CCI. This index has been validated, and correlates well with mortality, hospital stay and the patient's destination on discharge from hospital.[15] It does, however, include certain pathologies and their grades which have changed radically in recent years in terms of treatment and prognosis (AIDS, for example) and, as such, the CCI system needs to be updated. Finally, in the analysis of causes of malnutrition, other emerging factors such as the tobacco habit, which has been described recently[26] as a risk factor for malnutrition on admission to hospital, had not been considered in the present study.

To summarize, our study demonstrates that the prevalence of malnutrition on admission to hospital in a representative sample of hospitals in Catalonia is approximately 30%. The typical profile of the patient with the highest risk of malnutrition is: elderly, non-manual worker with multiple co-morbidities, admitted to hospital via the emergency department for medical treatment in a third level hospital, and with a hemato-oncological diagnosis.

This study enables us to identify those individuals who are at a higher risk of suffering from malnutrition and the associated complications. Further studies are required to determine why there remains a low application of screening procedures and evaluation of nutritional status despite many tools have been developed and can be used to detect hospital malnutrition in early stages.

Appendix

Group for the Study on Malnutrition in Hospitals in Catalonia.

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Hospital Germans Trias i Pujol: Clara Joaquim, Eva Martínez, Montserrat Cachero, José Manuel Sánchez, Mª José Sendrós, Luis Restoy.

Corporació Sanitària Parc Tauli: Amelia Espallargas, Antonia Humanes, Marina Luengo, Coral Sauret.

Hospital Arnau de Vilanova: Joan Anton Schoenenberger, Silvia Gros.

Hospital Josep Trueta: Silvia Mauri, Anna Pibernat, Núria Pons, Neus Salleras.

Hospital Sant Joan de Reus: Antoni Rabassa, Francesc Marimon, Isabel Megias, Carme Martí.

Hospital de Manresa: Pilar Flotats.

Hospital Dos de Maig: Lluis Vila**.**

Hospital de Igualada: Judith Mayolas.

References

1. Kelly IE, Tessier S, Cahill A, Morris SE, Crumley A, McLaughlin D, McKee RF, Lean ME. Still hungry in hospital: identifying malnutrition in acute hospital admissions. *QJM* 2000; 93 (9): 93-98.
2. Waitzberg DL, Caiaffa WT, Correia MI. Hospital malnutrition: the Brazilian national survey (IBRANUTRI): a study of 4000 patients. *Nutrition* 2001; 17 (7-8): 573-580.
3. Kyle UG, Pirlich M, Schuetz T, Luebke HJ, Lochs H, Pichard C. Prevalence of malnutrition in 1760 patients at hospital admission: a controlled population study of body composition. *Clin Nutr* 2003; 22 (5): 473-481.
4. Wyszynski DF, Perman M, Crivelli A. Prevalence of hospital malnutrition in Argentina: preliminary results of a population-based study. *Nutrition* 2003; 19 (2): 115-119.
5. Kruizenga HM, Wierdsma NJ, van Bokhorst MA, de van der Schueren, Haollander HJ, Jonkers-Schuitema CF, van der Heijden E, Melis GC, van Staveren WA. Screening of nutritional status in The Netherlands. *Clin Nutr* 2003; 22 (2): 147-152.
6. Rassmussen HH, Kondrup J, Staun M, Ladefoged K, Kristensen H, Wengler A. Prevalence of patients at nutritional risk in Danish hospitals. *Clin Nutr* 2004; 23 (5): 1009-1015.
7. Braunschweig C, Gomez S, Sheean PM. Impact of declines in nutritional status on outcomes in adult patients hospitalized for more than 7 days. *J Am Diet Assoc* 2000; 100 (11): 1316-1322.
8. Planas M, Audivert S, Perez-Portabella C, Burgos R, Puiggros C, Casanelles JM, Rossello J. Nutritional status among adult patients admitted to an university-affiliated hospital in Spain at the time of genoma. *Clin Nutr* 2004; 23 (5): 1016-1024.
9. Middleton MH, Nazarenko G, Nivison-Smith I, Smerdely P. Prevalence of malnutrition and 12-month incidence of mortality in two Sydney teaching hospitals. *Intern Med J* 2001; 31 (8): 455-461.
10. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. ESPEN Guidelines for Nutrition Screening 2002. *Clin Nutr* 2003; 22 (4): 415-421.
11. Elia M, Zellipour L, Stratton RJ. To screen or not to screen for adult malnutrition? *Clin Nutr* 2005; 24: 867-84.
12. Working Group of the Spanish Society of Epidemiology and the Spanish Society of Family & Community Medicine. Proposal for a social class measure. *Aten Primaria* 2000; 25 (5): 350-363.
13. Coma A, Martí M, Fernández E. Education and Social Class based on occupation: their interaction as social and economic indicators in the study of social inequality through medical surveys. *Aten Primaria* 2003; 32 (4): 208-215.
14. Malnutrition Advisory Group BAPEN. The MUST Explanatory Booklet 2003. Todorovic V, Russell C, Stratton R, Ward J, Elia M published by BAPEN editorial, London 2003. Available at:http://www.bapen.org.uk/pdfs/must/must_explan.pdf
15. Charlson ME, Pompei P, Ales KL, McKenzie CR. A new method of classifying prognostic co-morbidity in longitudinal studies: development and validation. *J Chron Dis* 1987; 40 (5): 373-383.
16. Lobo G, Ruiz MD, Pérez de la Cruz A. Hospital malnutrition. Relationship with the length of stay and the readmisión rates. *Med Clin (Barc)* 2009; 132 (10): 377-384.
17. Planas M, Álvarez J, García de Lorenzo A, Celaya S, León M, García-Lorda P et al. The burden of hospital malnutrition in Spain: methods and development of the PREDyCES® study. *Nutr Hosp* 2010; 25 (6): 1020-4.
18. Anthony PS. Nutrition Screening Tools for hospitalized patients. *Nutr Clin Pract* 2008; 23 (4): 373-382.
19. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z, ESPEn Working Group. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. *Clin Nutr* 2003; 22 (3): 321-336.
20. Kle UG, Kossovsky MP, Karsegard VL, Pichard C. Comparison of tools for nutritional assessment and screening at hospital admission: a population study. *Clin Nutr* 2006; 25 (3): 409-417.
21. García de Lorenzo A, Álvarez J, Calvo MV, de Ulíbarri JI, del Río J, Galbán C, García-Luna PP, Peris P, La Roche F, León M, Planas M, Pérez de la Cruz A, Sánchez C, Villalobos JL. Conclusions of the II SENPE discussion forum on: hospital malnutrition. *Nutr Hosp* 2005; 20 (2): 82-87.
22. Villalobos JL, García-Almeida JM, Guzmán JM, Rioja R, Osorio Fernández D, Rodríguez-García LM, del Río Mata J, Ortiz García C, Gutiérrez Bédmar M. INFORNUT PROCESS: Validation of the filter phase FILNUT and comparison with other methods for the detection of early hospital hyponutrition. *Nutr Hosp* 2006; 21 (4): 491-504.
23. Ulibarri JI, Burgos R, Lobo G, Martínez MA, Pérez de la Cruz A, Villalobos JL et al.Recommendations for assessing the hyponutrition risk in hospitalised patients. *Nutr Hosp* 2009; 24 (4): 467-72.
24. García de Lorenzo A, Álvarez J, Planas M, Burgos R, Araujo K. Multidisciplinary consensos on the approach to hospital malnutrition in Spain. *Nutr Hosp* 2011; 26 (4): 701-10.
25. Pirlich M, Schütz T, Norman K, Gastell S, Lübke HJ, Bischoff SC, Bolder U, Frieling T, Güidenzoph H, Hahn K, Jauch KW, Schindler K, Stein J, Volkert D, Weimann A, Werner H, Wolf C, Zürcher G, Bauer P, Lochs H. . The German hospital malnutrition study. *Clin Nutr* 2006; 25: 563-572.
26. Amaral TF, Matos LC, Teixeira MA, Tavares MM, Álvares L. Undernutrition and associated factors among hospitalized patients. *Clin Nutr* 2010; 5: 580-5.
27. Norman K, Richard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr* 2008; 27: 5-15.
28. Kyle UG, Pirlich M, Schuetz T, Lochs H, Pichard C. Is nutritional depletion by Nutritional Risk Index associated with increased length of hospital stay? A population-based study. *Journal of Parenteral and Enteral Nutrition* 2004; 28: 99-104.
29. Kyle UG, Pirlich M, Lochs H, Schuetz T, Pichard C. Increased length of hospital stay in underweight and overweight patients at hospital admission: a controlled population study. *Clin Nutr* 2005; 24: 133-142.
30. Kyle U, Genton L, Pichard C. Hospital length of stay and nutritional status. *Curr Opin Clin Nutr Metab Care* 2005; 8: 397-402.
31. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003; 22: 235-239.