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Original Article

Effect of risk of malnutrition on 30-day mortality among older patients with acute heart failure in Emergency Departments

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ABSTRACT

Background: Little is known about the prevalence and impact of risk of malnutrition on short-term mortality among seniors presenting with acute heart failure (AHF) in emergency setting. The objective was to determine the impact of risk of malnutrition on 30-day mortality risk among older patients who attended in Emergency Departments (EDs) for AHF.

Material and methods: We performed a secondary analysis of the OAK-3 Registry including all consecutive patients ≥65 years attending in 16 Spanish EDs for AHF. Risk of malnutrition was defined by the Mini Nutritional Assessment Short Form (MNA-SF) < 12 points. Unadjusted and adjusted logistic regression models were used to assess the association between risk of malnutrition and 30-day mortality.

Results: We included 749 patients (mean age: 85 (SD 6); 55.8% females). Risk of malnutrition was observed in 594 (79.3%) patients. The rate of 30-day mortality was 8.8%. After adjusting for MEESSI-AHF risk score clinical categories (model 1) and after adding all variables showing a significantly different distribution among groups (model 2), the risk of malnutrition was an independent factor associated with 30-day mortality (adjusted OR by model 1 = 3.4; 95%CI 1.2–9.7; $p = .020$ and adjusted OR by model 2 = 3.1; 95%CI 1.1–9.0; $p = .033$) compared to normal nutritional status.

Conclusions: The risk of malnutrition assessed by the MNA-SF is associated with 30-day mortality in older patients with AHF who were attended in EDs. Routine screening of risk of malnutrition may help emergency physicians in decision-making and establishing a care plan.

1. Introduction

Heart failure (HF) is an age-associated chronic disease in which multiple episodes of worsening HF are commonly presented [1]. These episodes are frequent causes of visits to Emergency Departments (EDs) and most cases are hospitalised [1,2]. This unstable phase of the disease is associated with poor short-term outcomes [2].

Malnutrition is a state resulting from lack of intake or uptake of nutrition that leads to altered body composition and body cell mass with subsequent diminished physical and mental function and impaired clinical outcomes of disease [3]. The prevalence of malnutrition increases with age and the number of comorbidities [4]. With respect to HF, a recent meta-analysis showed a prevalence of risk of malnutrition ranging from 16% to 90%, being particularly high among patients with acute HF (AHF) (75–90%) [5]. Moreover, malnutrition is significantly associated with higher rates of morbidity and mortality in HF [5] and has been described as a short- [6] and long-term prognostic factor in patients with AHF requiring hospitalisation [7–9]. In addition, a recent trial has demonstrated that nutritional intervention in malnourished hospitalised patients with HF reduces long-term all-cause mortality and readmission for worsening of HF [10].

The vast majority of hospitalisations for AHF are admitted through EDs, although one quarter of patients attended for AHF in EDs are discharged directly home [2]. This highlights the pivotal importance of the prognostic assessment by emergency physicians in order to make decisions regarding hospital admission and discharge planning [11]. Currently, screening for malnutrition is recommended for hospital ward admission in older patients [4] and is often not taken into account during emergency care. Besides, little is known about the prevalence and impact of risk of malnutrition on short-term mortality among older patients presenting to EDs with AHF. Thus, there is a need to explore the risk of malnutrition as a modifiable prognostic factor in order to establish routine screening of malnutrition in the emergency setting among older patients with AHF.

The aim of this study was to evaluate the impact of risk of malnutrition on 30-day mortality in older patients with AHF attended in Spanish EDs.

2. Material and methods

2.1. Design, setting and participants

We performed a secondary analysis of a multipurpose, prospective, observational, multicenter cohort study (OAK-3 Registry).

A description of the OAK Registry has been published previously [12–14]. Briefly, this registry was initiated in 2011 and every 2–3 years it carries out a 2-month recruitment period of all patients ≥65 years old diagnosed with AHF in Spanish EDs participating in the project. To date, 3 recruitment phases (OAK-1: November–December in 2011 (2 months, 3 EDs); OAK-2: January–February in 2014 (2 months, 3 EDs); OAK-3: January–February in 2016 (2 months, 16 EDs) have been carried out. Patients were initially selected by attending emergency physicians considering clinical, electrocardiographic and radiological findings, and if available, natriuretic peptide levels and bedside ultrasound features. The exclusion criteria were a diagnosis of ST segment elevation acute myocardial infarction concomitant with AHF and non-consent to participate in the study. A trained investigator in each centre, who was not responsible for the care of the patient, performed a brief geriatric assessment during the first attendance in the ED from 8 to 22 h on work days (Monday to Friday). Routine interventions, treatments and disposition were entirely based on the decision-making of the attending emergency physician. The principal investigator of each centre reviewed all the eligible cases and finally included those fulfilling the diagnostic criteria of the HF guidelines of the European Society of Cardiology [15].

For the present study, we selected patients from the OAK-3 Registry who had undergone risk of malnutrition assessment and in whom data related to vital status during the first 30 days after the index visit was available.

2.2. Measurements

The screening of malnutrition was performed by an investigator from each centre according to the Mini Nutritional Assessment Short Form (MNA-SF) [16]. This scale includes 6 items (Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties? (0–2 points); Weight loss

during the last 3 months (0–3 points); Mobility (0–2 points); Has suffered psychological stress or acute disease in the past 3 months (0 or 2 points); neuropsychological problems (0–2 points)?; the body mass index (BMI) was calculated using realistic measurements of height and weight reported by patient or caregiver (0–3 points). Risk of malnutrition was defined according to MNA-SF criteria as the presence of < 12 points. The data were self-reported by patients, or by relatives or caregivers for patients unable to provide this information within the first hours of ED arrival.

Emergency physicians collected socio-demographic data (age, gender and living in a nursing home), medical history (active smoking, arterial hypertension, diabetes mellitus, ischaemic heart disease, chronic renal failure, cerebrovascular disease, atrial fibrillation, heart valve disease, peripheral artery disease, chronic obstructive pulmonary disease, hepatic cirrhosis, dementia, depression, cancer, previous diagnosis of HF), grade of comorbidity (Charlson index; severe comorbidity if Charlson index ≥3 points), baseline cardio-respiratory status (New York Heart Association [NYHA] class), left ventricular ejection fraction (LVEF)(preserved ejection fraction if LVEF > 50%), baseline functional status (Barthel index [BI]; severe functional dependence if BI ≤60 points), chronic treatment (diuretics, angiotensin-converting enzyme inhibitors [ACE−I], angiotensin receptor blocker [ARB] and beta-blockers [BB]), clinical data at ED (systolic blood pressure, cardiac and respiratory rates, oxygen saturation measured by pulse oximetry, NYHA class, low output symptoms, episode associated with acute coronary syndrome or infection, delirium by Confusion Assessment Method [CAM] and BI at admission), electrocardiographic data at ED (atrial fibrillation, left ventricular hypertrophy, left bundle branch block, pace-maker rhythm), analytical data at ED (hemoglobin, glucose, creatinine, sodium, potassium, NT-proBNP, and elevated troponin) and treatment at ED (oxygen, non-invasive ventilation, intravenous loop diuretics, intravenous nitroglycerin, inotropic or vasopressor treatment, ACE−I, ARB, BB and digoxin), category of Multiple Estimation of risk based on the Emergency department Spanish Score In patients with AHF (MEESSI-AHF) risk score (low, intermediate, high and very high risk categories) and final destination (hospital admission).

2.3. Outcomes

The main outcome was all-cause mortality within 30 days after attending the ED which was obtained by review of the clinical history of each patient or by a telephone call to either a patient or a relative 31 to 60 days after the first ED visit.

2.4. Statistical analyses

Quantitative variables were expressed as mean and standard deviation (SD) or median and interquartile ranges (IQR) and categorical variables as absolute numbers and percentages. The sample was divided into two groups: 1) risk of malnutrition (0–11 points of MNA-SF); 2) normal nutritional status (12–14 points of MNA-SF). For univariate comparisons, the Student's *t*-test was used for the quantitative variables if presenting a normal distribution (determined using the Kolmogorov-Smirnov test) or with the non-parametric test of the median for non-normally distributed variables. The Chi-square or the Fisher exact test was used for categorical variables. The impact of risk of malnutrition was assessed using both unadjusted and adjusted logistic regression, estimating odds ratios (ORs) and their 95% confidence interval (95% CI) for 30-day mortality.

A first adjustment was carried out for the MEESSI risk score clinical categories, as this scale classifies patients according to the risk of death during the following 30 days after an index AHF episode in the ED. It is made up of the following 13 variables: BI at admission, age, systolic blood pressure, NYHA class IV, potassium, NT-proBNP, troponin, low output symptoms, respiratory rate, oxygen saturation, acute coronary syndrome, creatinine and hypertrophy on electrocardiogram. Further details for the development and previous validation of the MEESSI risk score have been published elsewhere, and the online calculator can be found in http://meessi-ahf.risk.score-calculator-ica-semes.portalsemes.org [17–19]. A multiple imputation technique using chained equations was used to produce 50 imputed data sets replacing the missing values in the 13 variables included in the MEESSI risk score. A second adjustment was performed adding all variables showing a significantly different distribution among groups ($p < .10$) in the univariate analysis.

A stratified analysis looking for interaction was planned in advance for the following variables: age, sex, diabetes mellitus, LVEF, MEESSI-AHF risk model clinical categories, and final destination after ED care. We considered differences to be statistically significant if the two-tailed p value was < 0.05, and the 95% CI of the OR excluded 1. The analyses were performed with the statistical package SPSS 24.0 (IBM, New Castle, NY, USA).

2.5. Ethics

The OAK Registry complies with the Declaration of Helsinki and has been approved by the Ethical Committees of all the participating centres. All patients provided signed informed consent to participate in the study.

3. Results

Of the 1100 (68.1%) older patients in the OAK-3 Register, 749 were included in the present study, excluding 351 cases due to the lack of nutritional assessment. Supplementary table 1 shows the comparison between the included and non-included patients.

The patients had a mean age of 85 (SD 6) years, 417 (55.8%) were female, 473 (64.3%) patients had severe comorbidity, and 500 (66.8%) had a previous diagnosis of HF. Further data regarding baseline and acute clinical status, electrocardiogram, laboratory, and management in the ED are shown in Table 1.

Five hundred and ninety-four (79.3%) patients were classified as being at risk of malnutrition, and 155 (20.7%) patients were considered to have a normal nutritional status. Fig. 1 represents the frequency of the 6 items of the MNA-SF in both the whole sample and in the two groups of nutritional status. Table 1 shows the univariate analysis according to malnutrition status. The patients with risk of malnutrition were commonly older and female, and they more frequently had dementia, severe baseline functional dependence, severity data of acute episode (higher low output symptoms, heart rate and levels of NT-proBNP, and lower room air pulse oximetry and BI at admission) and hospital admission, and a lower frequency of diabetes mellitus. Supplementary fig. 1 shows the impact of risk of malnutrition on the different MEESSI-AHF risk score clinical categories.

Sixty-six (8.8%) patients died within 30 days after being attended in EDs. The 30-day mortality was 4-fold higher in older patients at risk of malnutrition in comparison with those with a normal nutritional status (10.4% vs 2.6%; $p = .002$). After adjusting for the MEESSI-AHF risk score clinical categories (model 1) and after adding other variables that showed a significantly different distribution among groups (model 2), the presence of risk of malnutrition remained independently associated with 30-day mortality compared to normal nutritional status (Table 2). Table 3 shows the association between each MNA-SF item and 30-day mortality.

Fig. 2 presents a stratified analysis of association between the risk of malnutrition and 30-day mortality. We did not find any interaction between risk of malnutrition and age, sex, diabetes mellitus, LVEF, MEESSI-AHF risk model clinical categories, and the final destination after ED care with respect to 30–day mortality.

Table 1
Characteristics of the patients and univariate analysis by risk of malnutrition.

	Total	Risk of malnutrition	Normal nutrition status	*p*-Value	Missing values (%)
	(*N* = 749) n (%)	(*N* = 594) n (%)	(*N* = 155) n (%)		
Socio-demographic data					
Age, years [mean (SD)][a]	85 (6.0)	85 (5.9)	82 (5.7)	< 0.001	0 (0)
Female sex	417 (55.8)	357 (60.3)	60 (38.7)	< 0.001	2 (0.3)
Living in a nursing home	56 (7.9)	48 (8.5)	8 (5.5)	0.226	39 (5.2)
Medical history					
Active smoking	34 (6.2)	28 (6.5)	6 (4.9)	0.511	199 (26.6)
Hypertension	668 (89.2)	524 (88.2)	144 (92.9)	0.094	0 (0)
Diabetes mellitus	330 (44.1)	250 (42.1)	80 (51.6)	0.033	0 (0)
Ischemic heart disease	219 (29.2)	167 (28.1)	52 (33.5)	0.185	0 (0)
Chronic kidney disease	265 (35.4)	202 (34.0)	63 (40.6)	0.124	0 (0)
Cerebrovascular disease	120 (16.0)	98 (16.5)	22 (14.2)	0.486	0 (0)
Atrial fibrillation	415 (55.4)	330 (55.6)	85 (54.8)	0.873	0 (0)
Heart valve disease	223 (29.8)	178 (30.0)	45 (29.0)	0.811	1 (0.1)
Peripheral artery disease	106 (14.2)	83 (14.0)	23 (14.8)	0.783	0 (0)
Chronic obstructive pulmonary disease	211 (28.2)	165 (27.8)	46 (29.7)	0.640	0 (0)
Hepatic cirrhosis	11 (1.5)	9 (1.5)	2 (1.3)	0.834	1 (0.1)
Dementia	117 (15.6)	107 (18.0)	10 (6.5)	< 0.001	0 (0)
Cancer	124 (16.6)	96 (16.2)	28 (18.1)	0.576	1 (0.1)
Previous diagnosis of heart failure	500 (66.8)	399 (67.3)	101 (65.2)	0.617	1 (0.1)
Severe comorbidity (Charlson index ≥3)	473 (64.3)	369 (63.2)	104 (68.4)	0.230	13 (1.7)
Baseline status					
NYHA III-IV class	174 (23.8)	138 (23.9)	36 (23.5)	0.920	19 (2.5)
Preserved ejection fraction	369 (69.6)	288 (69.4)	81 (70.4)	0.813	219 (29.2)
Severe functional dependence (BI ≤60)	179 (24.8)	157 (27.5)	22 (14.6)	< 0.001	11 (1.5)
Chronic treatment					
Loop diuretics	510 (68.2)	396 (66.7)	114 (74.0)	0.081	1 (0.1)
Beta-blockers	329 (44.4)	256 (43.6)	73 (47.4)	0.399	8 (1.1)
ACE-I or ARA	432 (57.8)	341 (57.4)	91 (59.1)	0.706	1 (0.1)
Clinical data at ED					
Systolic blood pressure, mmHg [mean (SD)][a]	140 (27.1)	140 (27.7)	142(24.8)	0.473	8 (1.1)
Heart rate, bpm [mean (SD)]	86 (24.5)	87 (25.2)	83 (21.3)	0.042	3 (0.4)
Respiratory rate, rpm [mean (SD)][a]	22 (6.2)	22.2 (6.3)	21.0 (5.6)	0.094	194 (25.9)
Room-air pulse oximetry, % [mean (SD)][a]	92 (6.3)	92 (6.5)	93 (5.2)	0.027	15 (2.0)
NYHA IV class[a]	301 (40.6)	239 (40.6)	62 (40.3)	0.931	7 (0.9)
Low output symptoms[a]	124 (16.6)	107 (18.0)	17 (11.0)	0.037	2 (0.3)
Episode associated with ACS[a]	6 (0.8)	4 (0.7)	2 (1.3)	0.440	12 (1.6)
Episode associated with infection	285 (38.7)	226 (38.6)	59 (38.8)	0.967	12 (1.6)
Barthel index at admission [mean (SD)][a]	63 (27.6)	60 (27.6)	74 (25.1)	< 0.001	14 (1.9)
Delirium at admission	70 (9.3)	64 (10.8)	6 (3.9)	0.009	0 (0.0)
Body mass index [mean (SD)]	22.3 (4.3)	21.5 (4.2)	25.4 (3.3)	< 0.001	0 (0.0)
Electrocardiographic data at ED					
Atrial fibrillation	365 (50.3)	293 (51.0)	72 (48.0)	0.519	24 (3.2)
Left ventricular hypertrophy[a]	25 (3.4)	21 (3.7)	4 (2.7)	0.556	24 (3.2)
Left bundle branch block	57 (7.9)	44 (7.7)	13 (8.7)	0.681	24 (3.2)
Pacemaker rhythm	102 (14.1)	81 (14.1)	21 (14.0)	0.972	25 (3.3)
Laboratory data at ED					
Hemoglobin, g/L [mean (SD)]	11.8 (1.9)	11.8 (1.9)	11.8 (2.0)	0.773	13 (1.7)
Glucose, mg/dl [mean (SD)]	149 (87)	151 (93)	143 (63)	0.331	19 (2.5)
Creatinine, mg/dl [mean (SD)][a]	1.4 (0.9)	1.4 (0.9)	1.5 (0.8)	0.147	15 (2.0)
Sodium, mEq/L [mean (SD)]	138 (4.7)	138 (4.8)	139 (4.3)	0.144	22 (2.9)
Potassium, mEq/L [mean (SD)][a]	4.4 (0.7)	4.4 (0.7)	4.4 (0.8)	0.473	34 (4.5)
NT-proBNP, pg/mL [median (IQR)][a]	3986 (1904–8161)	4311 (2051–8959)	2688 (1479–5850)	0.001	195 (26.9)
Elevated troponin[a]	221 (61.2)	182 (62.3)	39 (56.5)	0.373	388 (51.8)
Treatment at ED					
Oxygen	565 (76.2)	452 (76.9)	113 (73.9)	0.435	8 (1.1)
Non-invasive ventilation	42 (5.7)	35 (6.0)	7 (4.6)	0.512	8 (1.1)
Intravenous loop diuretic	660 (89.1)	526 (89.5)	134 (87.6)	0.508	8 (1.1)
Intravenous nitroglycerin	61 (8.2)	47 (8.0)	14 (9.2)	0.643	8 (1.1)
Inotropic or vasopressor treatment	7 (0.9)	5 (0.9)	2 (1.3)	0.603	8 (1.1)
Digoxin	102 (13.8)	88 (15.0)	14 (9.2)	0.063	8 (1.1)
Beta-blockers	106 (14.3)	90 (15.3)	16 (10.5)	0.127	8 (1.1)
ACE-I or ARA	136 (18.4)	113 (19.2)	23 (15.0)	0.234	8 (1.1)
Risk score category by MEESSI-AHF[b]				0.002	0 (0)
Low risk	263 (35.1)	195 (32.8)	68 (43.9)		
Intermediate risk	341 (45.5)	269 (45.3)	72 (46.5)		

(*continued on next page*)

Table 1 (*continued*)

	Total	Risk of malnutrition	Normal nutrition status	*p*-Value	Missing values (%)
	(*N* = 749) n (%)	(*N* = 594) n (%)	(*N* = 155) n (%)		
High risk	83 (11.1)	72 (12.1)	11 (7.1)		
Very high risk	62 (8.3)	58 (9.8)	4 (2.6)		
Hospital admission	625 (83.4)	507 (85.4)	118 (76.1)	0.006	0 (0)
30-day mortality	66 (8.8)	62 (10.4)	4 (2.6)	0.002	0 (0)

SD: standard deviation; IQR: interquartile range; NYHA: New York Heart Association; BI: Barthel index; ACE−I: angiotensin-converting enzyme inhibitors; ARB: angiotensin receptor blocker; bpm: beat per minute; rpm: respirations per minute; ACS: acute coronary syndrome.

[a] Variables included in MEESSI-AHF risk score.

[b] Using multiple imputation.

4. Discussion

The present study shows that the risk of malnutrition is a prognostic factor independently associated with 30-day mortality among older patients with AHF who are attended in EDs. These findings suggest that the risk of malnutrition should be screened in older patients with AHF regardless of being admitted to a hospital ward or discharged from EDs.

Previous studies have reported that the risk of malnutrition is both a short- and long-term prognostic factor in admitted patients with AHF [5–9,20]. However, our findings provide additional evidence to show that the risk of malnutrition is a poor short-term prognostic factor in older patients with AHF attended in EDs. Although previous studies have shown that nutritional assessment by the MNA [7], Nutritional Risk Index [21], Controlling Nutritional Status score [8,22], and a combination of albumin and lymphocyte count [23] have predictive value for poor outcomes in patients admitted with AHF, none of these tools has been carried out in emergency settings.

It is well known that nutritional status is closely associated with the degree of frailty [24–26] and with sarcopenia [27]. A population-based cohort study (Singapore Longitudinal Ageing Study) showed that two out of three seniors at risk of malnutrition are prefrail or frail subjects [24]. A recent study carried out in 473 older patients admitted to a comprehensive geriatric assessment centre reported that the presence of malnutrition was strongly associated with muscle mass and strength and frailty, and therefore, the MNA tool could simultaneously identify malnutrition, frailty and sarcopenia [27]. In our study, patients with risk of malnutrition were commonly older and female and more frequently had dementia, severe baseline functional dependence, severity data of acute episode, and hospital admission. In contrast, we found a lower frequency of diabetes mellitus. Previous studies have reported that diabetes mellitus is associated with a higher probability of being at nutritional risk [28,29], although this fact has not been confirmed in patients with AHF [7]. Furthermore, patients with diabetes usually have a higher BMI compared with non-diabetics [30], and therefore the MNA-SF could underestimate the risk of malnutrition in diabetic patients due to the relevant weight given to this item. Taking this into account, we may be identifying a prognostic factor related to multidimensional frailty, not included in current risk models (such as the MEESSI-AHF risk score that considers acute functional status measured by the Barthel index), that could be used to select a group of patients who could benefit from multidimensional assessment and dietary and other appropriate interventions [31,32].

Guidelines, proposed by the European Society of Cardiology for treating acute HF, recommend the need to monitor body weight and prevent malnutrition in HF patients [33]. However, there are no specific nutritional recommendations for at-risk older patients attended with AHF. Malnutrition is a potentially reversible syndrome, and should, therefore, be identified and treated early in order to improve patient outcomes and quality of life [4]. It is well known that protein and energy supplementation reduces mortality and probably the risk of complications in older patients with malnutrition [34]. Regarding AHF, a randomised, multicentre, controlled clinical trial carried out in 120 malnourished patients hospitalised for HF demonstrated that an individualised nutritional intervention during 6 months reduces the risk

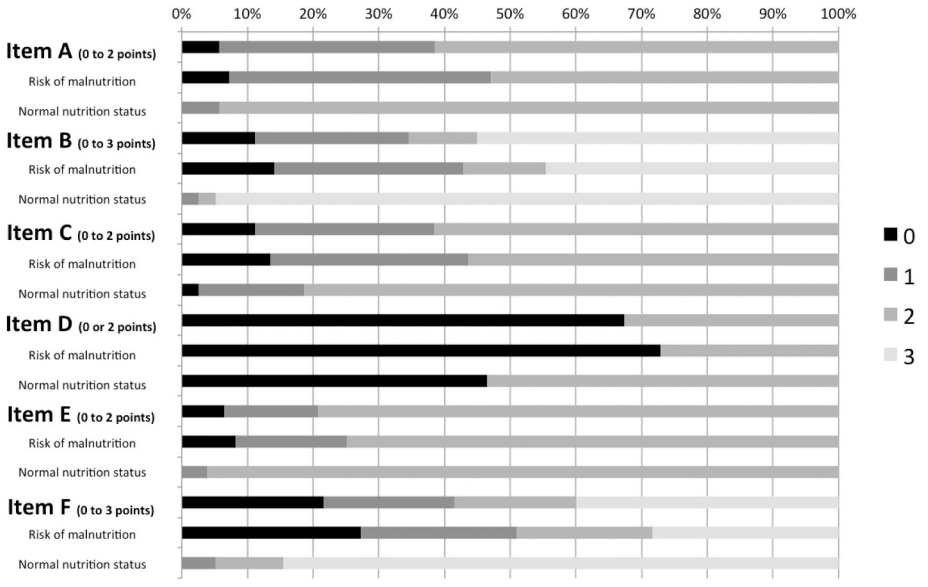

Fig. 1. Frequency of the 6 item Mini Nutritional Assessment in older patients with acute heart failure and in two groups according to nutritional status. Item A: "Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?": 0 = severe decrease in food intake; 1 = moderate decrease in food intake; 2 = no decrease in food intake; Item B: "Weight loss during the last 3 months": 0 = weight loss > 3 kg; 1 = does not know; 2 = weight loss between 1 and 3 kg; 3 = no weight loss; Item C: "Mobility": 0 = bed or chair bound; 1 = able to get out of bed / chair but does not go out; 2 = goes out; Item D: "Has suffered psychological stress or acute disease in the past 3 months?": 0 = yes; 2 = no; Item E: "Neuropsychological problems": 0 = severe dementia or depression; 1 = moderate dementia; 2 = no psychological problems; Item F: "Body Mass Index (BMI) ": 0 = BMI < 19; 1 = BMI 19 to < 21; 2 = BMI 21 to < 23; 3 = BMI 23 or greater.

Table 2
Multivariate analysis of impact of risk of malnutrition on 30-day mortality.

	Odds ratio	95% confidence interval	p-Value
Risk of malnutrition	4.40	1.57 to 12.3	0.005
Risk of malnutrition adjusted for model 1	3.43	1.21 to 9.70	0.020
Risk of malnutrition adjusted for model 2	3.14	1.10 to 9.02	0.033

1. Model 1: OR adjusted for MEESSI-AHF risk score clinical categories.
2. Model 2: OR adjusted for MEESSI-AHF risk score clinical categories adding all variables showing a significantly different distribution among groups (female sex, hypertension, diabetes mellitus, heart rate, chronic loop diuretic, delirium at admission and digoxin treatment at ED) except for variables included in Mini Nutritional Assessment (mobility and neuropsychological problems).

Table 3
Association between Mini Nutritional Assessment Short Form items and 30-day mortality.

	Odds ratio	95% confidence interval	p-Value
Item A			
No decrease in food intake	Ref		
Moderate decrease in food intake	1.9	1.1 to 3.3	0.017
Severe decrease in food intake	2.8	1.1 to 6.8	0.024
Item B			
No weight loss	Ref		
Weight loss between 1 and 3 kg	1.8	0.8 to 4.0	0.151
Does not know	1.5	0.8 to 2.8	0.226
Weight loss > 3 kg	2.3	1.1 to 4.7	0.025
Item C			
Goes out	Ref		
Able to get out of bed / chair but does not go out	1.7	0.9 to 3.2	0.070
Bed or chair bound	4.7	2.5 to 8.9	< 0.001
Item D			
No	Ref		
Yes	2.2	1.3 to 3.7	0.002
Item E			
No psychological problems	Ref		
Moderate dementia	2.5	1.3 to 4.5	0.003
Severe dementia or depression	2.2	0.9 to 5.2	0.074
Item F			
BMI ≥23	Ref		
BMI 21 to < 23	1.4	0.7 to 2.8	0.294
BMI 19 to < 21	0.7	0.3 to 1.6	0.384
BMI < 19	1.2	0.6 to 2.3	0.586

Item A: Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?;Item B: Weight loss during the last 3 months; Item C: Mobility; Item D: Has suffered psychological stress or acute disease in the past 3 months?; Item E: Neuropsychological problems; Item F: Body Mass Index (BMI).

of death by any cause and the risk of readmission for worsening of HF at 1 year [10]. The effect of this nutritional intervention did not differ between patients with or without hypoalbuminemia [35] and was maintained at 2 years [36].

According to the current recommendations, assessment of nutritional status, including dietary information and anthropometric, biochemical and clinical data should be promptly performed in all at-risk patients to determine if the patient is truly malnourished, frail or sarcopenic [37], and to thereby support the development of an individualised nutritional and exercise care plan [38,39]. The decision about the need for a nutritional intervention plan must be determined in conjunction with the conditions detected (malnutrition, sarcopenia and/or frailty), the severity and aetiology of the acute episode, the presence of comorbid conditions, the degree of disability and the wishes and expectations of the patient. Emergency physicians and nurses should screen for the risk of malnutrition and provide this information in the transition-care pathway. This is especially important in older patients discharged from EDs due to the known benefits of transferring these patients to appropriate resources in the community [40]. In addition, dietary advice should be offered to these patients, in spite of the many barriers described, particularly in ED settings [41], to adequately promote a nutritional intervention (1–2 g of protein/kg body weight/day and 25–30 kcal/kg body weight/day) with dietary fortification until evaluation by a nutrition specialist [38]. Therefore, the present findings show that the risk of malnutrition should be screened not only in hospitalised patients [38,39,42] but also in older patients with AHF who are discharged home from EDs. This nutritional assessment should be a routine element of emergency care of older AHF patients. In order to achieve this goal, emergency physicians and nurses should receive training in nutrition screening and criteria for referring patients to a dietitian or nutrition service in the community [40].

The prevalence of risk of malnutrition was 79.3% among older patients presenting at EDs with AHF. This finding is within the range (75–90%) of previous studies in patients with AHF [5]. It is well known that the frequency of malnutrition depends on the site of evaluation and screening instruments used. Although there is no a clear recommendation about the instruments that must be used in malnutrition screening in HF patients [42], we used the MNA-SF to assess the risk of malnutrition similarly to previous studies carried out in EDs [37,43,44]. This tool was chosen considering the advanced age of the patients studied, the objective measurement provided, and the ease and short time needed for its completion. This last point is very important in the ED setting due to the limitation in personnel and time resources. The MNA-SF has shown a strong correlation with the full MNA version [16,45]. MNA-SF has a sensitivity of 97.9%, a specificity of 100%, and a diagnostic accuracy of 98.7% to predict malnutrition when the score scale was < 12 points [16]. The full MNA is recommended for the identification of patients at high nutritional risk, especially among older people, and it is an adequate instrument for the assessment of the nutritional status in patients with advanced or acute HF due to its good predictive capacity for mortality in HF [5].

We found that several MNA-SF items, such as reduction in food intake, weight loss > 3 Kg or having had psychological stress or acute disease in the past 3 months, severe reduced mobility or neuropsychological problems, were associated with 30-day-mortality. These variables have been previously described as a poor prognostic factor in older patients with AHF [31]. In contrast, the BMI had no effect on short-term prognosis. The obesity paradox (BMI > 30 kg/m^2) has been linked to a lower short-term mortality in patients with AHF [46]. This could be justified by the different BMI cut-offs used in the MNA-SF. In addition, the influence of fluid retention on the accuracy of human body measurements remains to be determined. In fact, our findings show that weight loss in the last 3 months is not a frequent symptom of malnutrition among at-risk older people with AHF.

The present study has several limitations. This was an exploratory analysis in a large multipurpose cohort, which could have limited the statistical power of the analysis. In addition, the sample size limited an analysis according to sub-scores in malnutrition risk group. Although significant clinical differences were not found between the patients included and not included, a selection bias cannot be ruled out. The assessment of risk of malnutrition was conducted according to MNA-SF by the use of self-reported responses. Several studies have used the MNA-SF to screen the risk of malnutrition in EDs [37,43,44]. The measurement of some components to calculate BMI requires specific

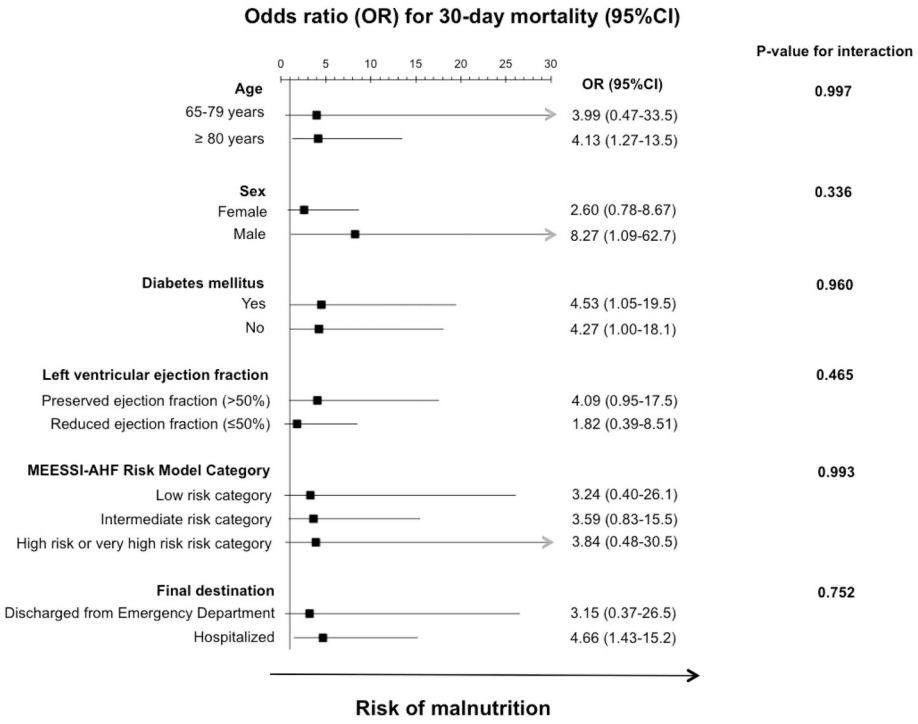

Fig. 2. Stratified analysis of risk of malnutrition with respect to 30-day mortality.

instruments which are time consuming and not very feasible in the EDs. Although calf girth is an alternative, self-reported height and weight data can be used as a valid tool to screen for risk of undernutrition in older patients without severe dementia [47]. Treatments prescribed at discharge were not controlled but rather were left to the criteria of the attending physician with no specific guidance, and this may have influenced outpatient outcomes. The information related to echocardiographic, biochemical parameters (serum albumin, cholesterol or c-reactive protein levels) or other plasma biomarker data may not be available, primarily because they are not routinely performed in all patients with AHF who are attended in Spanish EDs. However, this may make our results more realistic and ultimately easier to apply in real ED practice. Finally, as with any study done in a single country, caution should be used in extrapolating these findings to other countries. Moreover, EDs were not randomly selected but were participants in the OAK registry with special interest in AHF, and therefore the results may differ when applied to other EDs.

In conclusion, the risk of malnutrition assessed by the MNA-SF at ED arrival was associated with 30-day mortality in older patients with AHF attended in the EDs. Therefore, systematic nutritional screening could help to improve health care planning.

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Conflict of interests

The present study has been designed, performed, analysed and written exclusively by the authors independently of the pharmaceutical companies. FJMS has received advisory/consulting fees from, Novartis, MSD, Pfizer, The Medicine Company, Otsuka and research grants from the Spanish Ministry of Health and FEDER, Novartis, Abbot and Orion-Pharma. PLL has received advisory/consulting fees from Novartis, MSD, BoehringerIngelheim, Pfizer and Orion-Pharma and research grants: Abbot, Otsuka, Cardiorentis and Novartis. PH has received advisory/consulting fees from Novartis and research grants: Abbot, Otsuka, and Novartis. JJ has received advisory/consulting fees from Novartis and research grants: Abbot, Otsuka, and Novartis. HB has received research grants from AstraZeneca and advisory/speaky fees from Abbott, AstraZeneca, Bayer, BMS, Daiichi Sankyo, Eli Lilly, Menarini, Novartis, Pfizer, Sanofi and Servier. OM has received advisory/consulting fees from Novartis and The Medicine Company; research funding from Bayer Health Care, Thermofisher, Novartis, Orion-Pharma. The remaining authors do not have any conflict of interests to declare. PMM has received research grants and advisory/speaky fees from Abbott Nutrition, Nutricia, Nestlé HealthScience, Grifols, Fresenius, Vegenat and Spanish Ministry of Health and FEDER.

Author contributions

FJMS, FCT and PMM conceived the study and performed the analysis. FJMS and OM obtained research funding and supervised the conduct of Registry and data collection. XR and CFP provided statistical advice on study design and analysed the data. The remaining co-authors undertook recruitment of the participating centres and patients. FJMS drafted the manuscript, although all authors contributed substantially to its revision, particularly FCT and PMM. FJMS takes responsibility for the paper as a whole.

Sponsor's role

The sponsor contributed to funding the data manager and professional translator.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejim.2019.04.014.

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