Original article

Mini nutritional assessment is a better predictor of mortality than subjective global assessment in heart failure out-patients

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SUMMARY

Background & aims: There is no consensus on the best method for nutritional screening and assessment in patients with heart failure (HF). This study aimed to determine which nutritional assessment method had the highest prognostic significance for patients with HF treated in outpatient clinics. We also aimed to identify a fast, reliable screening method for detecting malnutrition in these patients.
Methods: This prospective study included 151 subjects that attended an outpatient HF clinic at a university hospital. All patients completed three nutritional screening tools: the Malnutrition Universal Screening Tool (MUST), the MNA-short form (MNA-SF), and the Malnutrition Screening Tool (MST), and then, two nutritional assessment questionnaires: the Subjective Global Assessment (SGA) and the Mini Nutritional Assessment® (MNA). Patients were followed-up for 2 years. The primary endpoint was all-cause mortality.
Results: Malnutrition or nutritional risk was identified in 15.9% of patients with the SGA and in 25.1% of patients with the MNA. Age, New York Heart Association (NYHA) functional class, and MNA were the only independent all-cause death predictors after adjusting for age, gender, NYHA functional class, body mass index, Barthel index, 25-hydroxyvitamin D concentrations, treatment with angiotensin converting enzyme inhibitors or angiotensin II receptor blockers, and treatment with beta-blockers. The SGA could not independently predict all-cause mortality in a multivariate analysis that included the same covariates. The MNA-SF had the best sensitivity, specificity, and kappa coefficient for screening malnutrition, based on the MNA and the SGA as references, compared to the other screening methods.
Conclusions: In our cohort, malnutrition assessed by MNA, but not by SGA, was an independent predictor of mortality. MNA-SF showed remarkable sensitivity and specificity; thus, it might be a valuable tool for rapidly identifying malnutrition risk in outpatients with HF.

1. Introduction

The reported prevalence of malnutrition in patients with HF varies widely among different studies (25-60%) depending on the method of nutritional assessment used, whether the patients were hospitalized, and the functional class of HF studied [1–3]. Regardless of the method of nutritional assessment used, many studies showed that malnutrition was an independent predictor of mortality [1,4,5]. Currently, there is no consensus on the best method for assessing nutritional status in these patients, based on its ability to determine the prognostic significance of malnutrition. Structured nutritional assessment tests such as Subjective Global Assessment (SGA) or Mini Nutritional Assessment, as well as the

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combination of analytical and anthropometric parameters have been used for the diagnosis of malnutrition in patients with HF. However, previous studies have shown that nutritional assessment methods that are almost exclusively based on biochemical and immunological markers are not the most suitable for patients with HF [6]. To our knowledge there are no studies that compare MNA vs. SGA in relation to prognostic significance in HF out-patients. In the other hand, in order to detect patients at nutritional risk that would require a more thorough nutritional assessment a systematic nutritional screening is essential in all subjects. However, we lack a widely accepted screening method for the HF population. The European Society of Clinical Nutrition and Metabolism (ESPEN) recommends the use of the Malnutrition Universal Screening Tool (MUST) for outpatient clinics and the MNA-Short Form (MNA-SF) for testing older patients [7]. On the other hand, the Malnutrition Screening Tool (MST) has been validated in acute hospital settings, in oncology outpatient clinics, and in residential aged patient care settings [8–10].

The purpose of the current study was to determine which nutritional assessment method showed the best prognostic power in patients with HF treated in outpatient clinics. In addition, we aimed to identify a rapid, reliable method of screening for malnutrition in patients with HF. As secondary aims we wanted to evaluate the influence of nutritional status on physical disability and QoL, among other clinical and analytical parameters, in a real-life cohort of ambulatory patients with HF.

2. Methods

2.1. Study design

This observational prospective study included all subjects that attended an outpatient HF clinic at a university hospital from June to December 2013. All patients had an established diagnosis of HF, according to European Society of Cardiology guidelines [11]. The criteria for a referral from clinical practice to the HF unit have been described previously [12,13]. We excluded patients with cancer, acquired immune deficiency syndrome (AIDS), liver cirrhosis, and chronic renal failure that required hemodialysis. Demographic and clinical data were prospectively collected at enrollment. Patients were followed-up for 2 years. The primary endpoint was all-cause mortality at 2 years. The study was approved by the local Ethics Committee, and informed consent was obtained from each patient. The investigation conformed to the principles outlined in the Declaration of Helsinki.

2.2. Nutritional screening and assessment

All subjects were evaluated at baseline by 3 nutritional screening methods: MNA-SF [14], MUST [15], and MST [8]. Regardless of the result of the screening, the same day, patients underwent 2 nutritional assessments with the Spanish versions of the MNA [16] and SGA [17] questionnaires. The data to complete the tests were obtained by a physical exam and a personal interview conducted by a trained nutritionist. To compare the different screening methods, we used MNA and SGA as gold standards.

Cachexia was evaluated by two different methods. In the one hand, according to Anker definition, we identified patients with cardiac cachexia as those with a non-intentional and non-edematous weight loss >7.5% of the premorbid normal weight, which occurred over a time period of <6 months [18]. In the other hand, we also evaluated cachexia using the new definition and terminology provided by the European Society of Clinical Nutrition and Metabolism (ESPEN) guidelines, that considers the term cachexia as a synonym of chronic Disease Related Malnutrition

(DRM) with inflammation. The diagnostic criteria are: malnutrition combined with simultaneous presence of an underlying disease and elevated serum CRP concentrations (>5 mg/L) and/or reduced serum concentrations of albumin (<35 g/L) [19]. To identify malnutrition for this definition we used MNA results.

No specific actions were designed for this study regarding nutritional management. When a malnourished patient was identified, action was taken by the nutritionist that was assessing nutritional status, and tailored recommendations were given.

2.3. Physical disability and quality of life

To assess physical disability, we used a standardized geriatric scale known as the Barthel Index [20], which evaluates the degree of dependence on assistance for performing the basic activities of daily living (range 0–100).

QoL was assessed with a HF-specific QoL questionnaire, known as the Minnesota Living with Heart Failure Questionnaire (MLWHFQ) [21,22]. We used the Spanish version, which has been widely used and was prospectively validated [23–26]. Consisting of 21 questions, the MLWHFQ evaluates the impact of HF on the physical, psychological, and social aspects of patients' lives. Responses range from 0 (no limitation) to 5 (maximal limitation). Thus, global scores range from 0 to 105, and higher scores reflect worse QoLs. When necessary, depending on the patient's reading and writing capabilities, a HF clinic nurse assisted the patient in completing the questionnaire [23], without altering the patient's response or interfering with the patient's independence.

2.4. Other clinical and analytical parameters

Patient HF clinical status was based on the New York Heart Association (NYHA) functional class and the duration of HF.

Patient physical status was evaluated with the Hand Grip Strength test, performed three times bilaterally with the Jamar® dynamometer (in the second handle position). For this test, the individual was positioned with the shoulder adducted to zero degrees of rotation, the elbow flexed to 90°, and the wrist in the neutral position. The average of the 3 measurements was used for the analyses [27].

For a comprehensive assessment of nutritional status we included blood measurements of 25-hydroxyvitamin D levels, cholesterol, albumin, and the total lymphocyte count. Blood samples were collected by venipuncture, between 8:00 and 08:30 AM, after an overnight fast. Total cholesterol and albumin were extracted and measured immediately, with routine clinical chemistry. The plasma 25-hydroxyvitamin D concentration was measured with the Liaison 25-hydroxyvitamin D total assay (Diasorin Inc, Still-water, MN, USA), a competitive chemiluminescent immunoassay, on the Liaison Diasorin automated analyzer. The intra-assay and inter-assay coefficient variations were <6.3 and 9.1%, respectively; the assay sensitivity was 4 ng/mL. Vitamin D status was considered a categorical variable, and categories were defined with thresholds within the total concentration range of 25-Hydroxyvitamin D. We classified deficiency as a concentration below 20 ng/mL (50 nmol/L); insufficiency as a concentration of 20–29 ng/mL (50–72 nmol/L), and sufficiency as a concentration ≥30 ng/mL (72 nmol/L), according to recommendations from the Endocrine Society Guidelines [28].

2.5. Statistical analysis

Categorical variables are expressed as frequencies and percentages. Continuous variables are expressed as the mean ± standard deviation or the median and 25th–75th percentiles. The normality

Table 1
Demographic and clinical characteristics of patients with HF that died or survived during the follow-up period.

Characteristics	Total, N = 151	Dead, N = 21	Alive, N = 130	p Value
Age (y)	68.6 ± 10.9	79.24 ± 6.8	66.9 ± 10.5	<0.001
Male (%)	72.2	61.9	73.8	ns
BMI (kg/m^2)	27.8 ± 5	25.9 ± 5.5	28.1 ± 4.9	0.015
NT-pro BNP (pg/mL)	706.5 (245.2–1832.5)	2680 (1350–5680)	556 (205–1400)	<0.005
NYHA classification (%)				
I	4	0	4.6	
II	83.4	66.7	86.2	0.014
III[a]	12.6	33.3	9.2	
Duration of disease (years)	6.4 (3.4–11)	7 (3.8–13.7)	6.4 (3.4–6.4)	ns
Medication (%)				
ACEI or ARB	84.8	66.7	87.7	0.013
Beta blocker	88.7	90.4	88.4	ns
Statin	68.2	71.4	67.6	ns
MNA (%)				
Normal	74.8	47.6	79.2	
At risk of MN or MN	25.2	52.4	20.5	0.004
SGA (%)				
Normal	84.1	66.7	86.9	
At risk of MN or MN	15.9	33.3	13.1	0.047
Cachexia				
Anker definition (%)	5.6	5.9	5.6	ns
Chronic DRM-I (%)	0.7	0	0.8	ns
Hand grip strength, SD	−0.4 (−1.07 to 0.07)	−0.3 (−1.5 to 0.0)	−0.4 (−0.95 to 0.09)	ns
Serum albumin (g/dL)	42.5 ± 3.0	41.9 ± 2.4	42.6 ± 3.0	ns
Total cholesterol (mg/dL)	169.4 ± 40.9	153.71 ± 41.01	171.9 ± 40.53	ns
Lymphocyte (count/mL)	1600 (1300–2100)	1300 (950–1550)	1700 (1300–2190)	0.001
Hemoglobin (g/dL)	13.1 ± 1.6	12.49 ± 2.0	13.22 ± 1.5	ns
Vitamin D (ng/mL)	17.1 ± 8.6	13.21 ± 6.3	17.7 ± 8.7	0.026
Vitamin D category (%)				
Normal (%) (≥30 ng/mL)	9.3	0	10.7	ns
Insufficiency (20–29 ng/mL)	22.1	10.5	23.9	ns
Deficiency (<20 ng/mL)	68.6	89.4	65.2	ns
Barthel index	94 ± 14.2	87.6 ± 22.3	95.4 ± 12.2	0.005

Categorical values are expressed as the percentage (%) of patients; continuous values are expressed as the mean ± SD or the median (25th–75th percentiles), as indicated. BMI = body mass index; NT-pro BNP = N-terminal pro B-type natriuretic peptide; NYHA = New York Heart Association; ACEI = angiotensin converting enzyme inhibitor; ARB = angiotensin II receptor blockers; MNA = Mini Nutritional Assessment; SGA = Subjective Global Assessment; ns: not statistically significant.

[a] No patient was in NYHA functional class IV. MN = malnutrition. DRM-I = disease related malnutrition with inflammation.

of a distribution was assessed with the normal Q-Q plot. Statistical differences between groups were assessed with the chi-square and Fischer exact tests, for categorical variables, and with student t tests, for continuous variables. To assess the prognostic significance of the nutritional assessment tools, we created two separate multivariable Cox regression models (backward stepwise), with all-cause death as the dependent variable and the MNA or SGA score as the independent variable. Variables that showed statistical significance in the univariate analyses were taken as independent covariates; we also

included several clinically relevant variables as covariates (age, gender, NYHA functional class, BMI, 25-hydroxyvitamin D concentration, Barthel index, treatment with angiotensin converting enzyme inhibitors or angiotensin II receptor blockers, and treatment with beta-blockers). Cox survival curves were plotted to ascertain the relationship between the baseline presence of malnutrition and mortality.

To compare the different screening methods, we used MNA and SGA as gold standards. We compared them in terms of sensitivity,

Table 2
Cox regression analysis results for factors potentially related to the 2-year, all-cause mortality.

Factor	2-year all-cause death					
	Univariate			Multivariate		
	HR	95%CI	p-Value	HR	95%CI	p-Value
Age	**1.13**	**1.07–1.20**	**<0.001**	**1.16**	**1.08–1.25**	**<0.001**
Sex	1.64	0.68–3.96	0.27	—	—	—
BMI	0.90	0.81–1.00	0.05	—	—	—
NYHA class	**3.94**	**1.64–9.47**	**0.02**	**7.64**	**2.16–27**	**0.002**
MNA (MN or risk of MN)	**3.60**	**1.53–8.48**	**0.003**	**4.56**	**1.55–13.4**	**0.006**
SGA	**2.66**	**1.08–6.60**	**0.034**	—	—	—
Barthel index[a]	**0.41**	**1.19–0.93**	**0.03**	**4.35**	**1.06–17.9**	**0.04**
25(OH)Vitamin D	**0.92**	**0.86–0.99**	**0.03**	—	—	—
ACEI or ARB	**0.29**	**0.12–0.69**	**0.006**	—	—	—
Beta blockers	0.82	0.19–3.53	0.79	—	—	—

Bold values indicate factors significantly related to mortality.
BMI = body mass index; NYHA = New York Heart Association; MNA = Mini Nutritional Assessment; MN = malnutrition; ACEI = angiotensin converting enzyme inhibitor; ARB = angiotensin II receptor blockers. p-Values were based on Cox regression analysis.

[a] Log(n)-transformed.

specificity, predictive values, reasons of verisimilitude, kappa correlation index, and the area under the receptor-operating characteristic (ROC) curve. Positive predictive values were calculated by dividing true positives by all positive values; negative predictive values were calculated by dividing true negatives by all negative values; precision was calculated by dividing true positives and true negatives by all results; sensitivity was calculated by dividing true positives by true positives and false negatives; and specificity was calculated by dividing true negatives by true negatives and false positives. Statistical analyses were performed with IBM SPSS Statistics 20.0 (IBM SPSS Inc, Chicago, IL). A two-sided p-value <0.05 was considered significant.

3. Results

3.1. Nutritional assessment and survival

We prospectively enrolled 151 consecutive ambulatory patients with HF. Table 1 shows baseline demographic, clinical, and analytical data for the total studied population, and for patients that had died ($N = 21$; 13.9%) or survived at the end of the 2-year follow-up. Malnutrition or nutritional risk was identified in 15.9% of patients with the SGA and 25.1% of patients with the MNA, administered at baseline. Cardiac cachexia was present in 5.6% of subjects by Anker and cols definition. When we analyzed chronic DRM with inflammation/cachexia by ESPEN definition, this was present in only 0.7% of our patients. Mortality did not differ between patients with and without cachexia identified by Anker or ESPEN definitions. Low circulating 25-hydroxyvitamin D levels were observed in 90.7% of patients; 68.6% had vitamin D deficiency and 22.1% had vitamin D insufficiency. Subjects that died during follow-up had a lower mean 25-hydroxyvitamin D concentration at baseline compared to those that survived (13.21 ± 6.3 ng/mL vs. 17.7 ± 8.7 ng/mL; $p = 0.026$). None of the patients that died had vitamin D sufficiency.

The multivariate analysis (Table 2) included age, sex, NYHA functional class, BMI, Barthel index, 25-hydroxyvitamin D concentrations, treatment with angiotensin converting enzyme inhibitors or angiotensin II receptor blockers, and treatment with beta-blockers. The only independent all-cause death predictors were age (HR 1.16, 95%CI: 1.08−1.25; $p < 0.001$), NYHA functional class (HR 7.63, 95%CI: 2.16−26.96; $p = 0.002$), Barthel index (HR 4.34, 95%CI: 1.05−17.88; $p = 0.042$), and MNA (HR 4.55, 95%CI: 1.55−13.37; $p = 0.006$). Figure 1A shows survival curves for patients with HF, grouped according to the MNA categories. Even after adjusting for other risk factors (age, sex, NYHA functional class, and Barthel index), malnutrition, and the risk of malnutrition were independently associated with lower survival compared to sufficient nutrition (Fig. 1B). Although malnutrition and the risk of malnutrition identified with the SGA were also significantly associated with all-cause mortality in the univariate analysis (HR 2.66, 95%CI: 1.08−6.60; $p = 0.034$), they did not remain significant independent variables in the multivariate analysis, which included the same covariates (Table 2).

3.2. Screening for malnutrition in patients with heart failure

MNA-SF had the best sensibility, specificity and kappa coefficient related to MNA and SGA when compared with the other screening methods (MUST and MST) (see Fig. 2). Tables 3 and 4 show the predictive values, along with precision, sensitivity, and specificity of the different nutritional screenings for being malnourished or at risk of malnutrition assessed by the MNA and SGA.
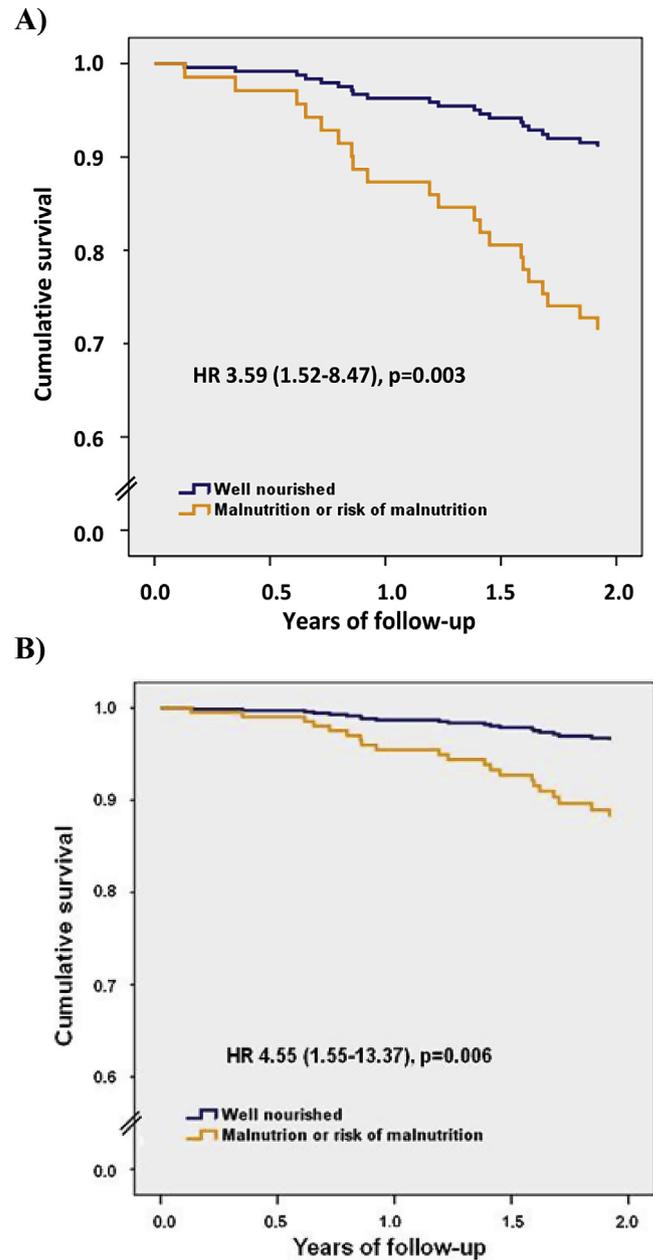

Fig. 1. Cox survival curves for patients with heart failure, grouped according to Mini Nutritional Assessment categories. Curves represent models that were (A) not adjusted and (B) adjusted for the following covariates: age, sex, New York Heart Association functional class, and the Barthel index. HR = Hazard ratio (95% confidence interval).

3.3. Influence of nutritional status on QoL, physical disability, and other clinical and analytical parameters

Table 5 shows that patients diagnosed as malnourished or at risk of malnutrition (based on the MNA) were more frequently physically disabled and had a worse QoL than those considered well nourished. Malnourishment and risk of malnutrition were also associated with lower BMI, hand grip strength, lymphocyte count, and lower hemoglobin levels. Vitamin D concentrations did not differ between malnourished and well-nourished groups. Nevertheless, no patients in the malnourished/at risk of malnutrition group had sufficient vitamin D levels.
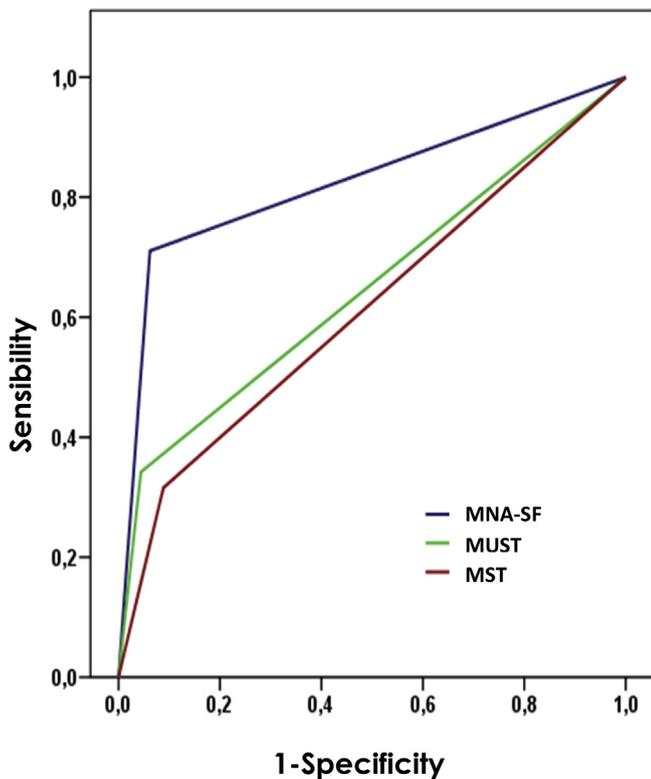
Fig. 2. Receiver operating characteristic curve analysis for comparing different screening methods with MNA as reference. Areas under the curves of sensitivity and specificity were compared. MNA-SF = Mini Nutritional Assessment short form; MUST = malnutrition universal screening tool; MST = malnutrition screening tool.

4. Discussion

In the present study we found that nutritional status, assessed by MNA, but not by SGA, was an independent predictor of survival in patients with HF that attended our outpatient clinic. To our knowledge this is the first study that compares MNA with SGA in relation to prognostic significance in heart failure out-patients. Bonilla-Palomas et al. also observed that malnutrition assessed by MNA is a good predictor of all-cause mortality among patients that were hospitalized and, more recently, in patients that attended an outpatient clinic [1,29]. Moreover, the patients we identified as malnourished or at risk of malnutrition, based on the MNA, were more often physically disabled and had a worse quality of life than well-nourished patients. To our knowledge, only one previous study has evaluated the relationship between malnutrition and QoL in patients with HF. That study found an inverse correlation between the MNA-SF and the MLHFQ score [30]. Some studies in

Table 3
Diagnostic evaluation of three different screening methods for detecting malnourishment or the risk of malnutrition, with the MNA as reference.

Diagnostic parameter	MNA-SF (%)	MUST (%)	MST (%)
Positive predictive value	79.4	72.2	54.5
Negative predictive value	90.5	81.2	79.8
Sensitivity	71	34.2	31.5
Specificity	93.8	95.5	91.1
Kappa-value	0.67	0.36	0.26
p-Value	<0.001	<0.001	0.001

MNA = Mini Nutritional Assessment; MNA-SF = Mini Nutritional Assessment short form; MUST = malnutrition universal screening tool; MST = malnutrition screening tool.

Table 4
Diagnostic evaluation of three different screening methods for detecting malnourishment or the risk of malnutrition, with the SGA as reference.

Diagnostic parameter	MNA-SF (%)	MUST (%)	MST (%)
Positive predictive value	55.8	83.3	36.3
Negative predictive value	95.7	93.2	87.5
Sensitivity	79.1	62.5	33.3
Specificity	88.1	97.6	88.9
Kappa-value	0.66	0.65	0.23
p-Value	<0.001	<0.001	0.004

SGA = Subjective Global Assessment; MNA-SF = Mini Nutritional Assessment short form; MUST = malnutrition universal screening tool; MST = malnutrition screening tool.

other diseases have shown that interventions designed to improve nutritional status could lead to significant improvement in QoL [31]. Considering this, an accurate nutritional assessment and intervention might also be very useful for patients with HF. Nonetheless, future research should be used to confirm the links between different nutritional interventions and QoL.

In HF out-patients, other authors have reported different malnutrition rates than those found in this study, probably due to differences in the evaluation methods employed [32]. Comparing results from different malnutrition studies in these patients will continue to be difficult, until a gold standard for nutritional assessment is standardized for this population. As previously commented, nutritional assessment methods that are almost exclusively based on biochemical and immunological markers are not the most suitable for patients with HF. Indeed, alterations in albumin, lymphocytes, and cholesterol concentrations may be caused by changes in hydration and inflammation states, or they may occur secondary to treatment, such as statins [6].

For all the reasons mentioned above, the MNA might be a good method for assessing nutritional status in patients with HF, since its result has implications in the prognosis, QoL and physical disability of these patients. Moreover, the MNA questionnaire provides valuable information about the patient's dietary habits and data that can guide the nutritional treatment approach. Therefore, in our opinion, the MNA should be considered the gold standard for identifying malnutrition in this population.

However, due to the burden of care that currently exists in ambulatory patient HF units, it is necessary to establish a rapid, simple screening test that does not require prior training, which could be used in daily clinical practice. This screening test should identify patients at nutritional risk that might benefit from a more detailed nutritional evaluation. To the best of our knowledge, this was the first study to evaluate different methods for screening nutritional status in ambulatory patients with HF, compared to a reference nutritional assessment method that has shown to have a prognostic significance in HF patients. Based on the sensitivity and specificity of the screening tests, with the MNA and SGA as references, we found that the MNA-SF was a better screening method than the MUST or MST. Therefore, we consider that the evaluation of patients with HF should systematically include the MNA-SF. Patients identified as malnourished or at risk of malnutrition should then be referred to a specialized consultation to receive a more accurate assessment of nutritional status and to determine adequate nutritional support.

Cardiac cachexia defined by Anker and cols was identified as an independent risk factor for mortality in patients with HF [18]. However, this could not be demonstrated in our study, nor with cachexia defined by ESPEN as chronic DRM with inflammation. Since most of the subjects in our study were in NYHA class II, we observed a limited number of patients with cachexia, which could justify these findings. Furthermore, the difficulty of assessing non-

Table 5
Comparison of clinical and laboratory characteristics according to nutritional status, based on the MNA as reference.

Characteristic	Malnutrition or at risk of malnutrition, $N = 32$	Well nourished, $N = 108$	p
BMI (kg/m^2)	25.4 ± 4.5	28.6 ± 4.9	<0.0001
Lymphocyte count	1350 (1000−2000)	1600 (1300−2100)	0.031
Hemoglobin (g/L)	12.5 ± 1.3	14.0 ± 5.9	0.011
Vitamin D (ng/mL)	14.69 ± 6.39	17.88 ± 9.07	0.10
Vitamin D category (%)			
Normal (%) (≥30 ng/mL)	0	12.03	
Insufficiency (20−29 ng/mL)	21.87	22.22	0.09
Deficiency (<20 ng/mL)	78.12	65.74	
Hand grip strength, SD	−1.0 ± 0.7	−0.4 ± 0.8	0.001
Functionally dependent (%) (BI < 100)	47.4	15.9	<0.0001
QoL (MLHFQ score)	37 (19−60)	22 (11−38)	0.002

Categorical values are expressed as the percentage (%) of patients; continuous values are expressed as the mean ± SD or the median (25th−75th percentiles), as indicated.
MNA = Mini Nutritional Assessment; BMI = body mass index; BI = Barthel index; QoL = quality of life; MLHFQ = Minnesota Living with Heart Failure Questionnaire.

edematous weight loss in patients with HF, could have played a role in our results when using Anker's definition.

We also found lower levels of 25-hydroxyvitamin D at baseline among patients that died during the follow-up compared to those that survived. Nevertheless, 25-hydroxyvitamin D concentrations were not associated with a poor prognosis, after adjusting for other clinical variables. This finding suggests that 25-hydroxyvitamin D levels in non-survivors were influenced by nutritional status. Although the 25-hydroxyvitamin D concentrations were not significantly different between malnourished and well-nourished subjects, sufficient 25-hydroxyvitamin D levels were found in none of the patients in the malnourished group and in 12.03% of the patients in the well nourished group. Other authors have reported similar prevalence of hypovitaminosis D in HF patients, even in sunny climates [33,34]. Moreover, some studies have shown that patients with both HF and a vitamin D deficiency had an exceedingly high risk of morbidity and mortality, including the occurrence of sudden cardiac death [35−37]. In our study population, the low number of patients with vitamin D sufficiency (9.3%) might have obscured the statistical significance of some of our findings. Nevertheless, given the increasing evidence of the negative effects of a vitamin D deficiency on cardiovascular risk, bone health, and muscle function, a systematic determination of 25-hydroxyvitamin D levels should be considered in patients with HF treated in outpatient clinics [38].

There were several limitations in our study. First, nutritional evaluations were performed only once, at the time of admission; therefore, we had no data on the changes in nutritional status during the study period. Second, the follow-up periods were only moderately long; therefore, further study is required for long-term observations. Third, in evaluating vitamin D status, we did not have data on parathormone values or bone mineral densitometry; thus, we could not draw more conclusions about the consequences of vitamin D deficiency. Patients that died during the follow up were less frequently treated with ACE inhibitors/ARBs. We double-checked our data, and all the patients that were not treated with these drugs had a contraindication for it and were treated instead with hydralazine and nitrates. Nevertheless, when we included ACE inhibitors/ARAII in the multivariate analysis, they were no longer independent survival predictors.

5. Conclusions

This study showed that malnutrition assessed by MNA, but not by SGA, was an independent predictor of mortality in HF outpatients, and also had implications in QoL and physical disability, thus, a nutritional assessment with MNA would be essential for evaluating ambulatory patients with HF. However, due to the burden of care that currently exists in ambulatory HF units, it is necessary to establish a rapid, simple nutritional screening test. This study showed that nutritional screening with the MNA-SF has remarkable sensitivity and specificity and therefore represents a valuable tool for rapid, reliable identification of the risk of malnutrition in HF out-patients. In conclusion, this study allows positioning the MNA and screening with the MNA-SF as preferred methods for daily use in patients with HF that receive outpatient treatments. Future research is needed to demonstrate the links between nutritional interventions and improvements in prognosis, QoL, and disability in HF patients.

Conflict of interest

The authors declare that there are no conflicts of interest.

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