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## Prognostic value of the ESPEN consensus and guidelines for malnutrition: prediction of post-discharge clinical outcomes in older inpatients

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## Nutrition in Clinical Practice

### Prognostic value of the ESPEN consensus and guidelines for malnutrition: Prediction of post-discharge clinical outcomes in older inpatients

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Keywords:	Geriatrics < Life Cycle, Nutrition assessment < Nutrition, Rehabilitation < Research and Diseases, Weight loss < Research and Diseases, Postacute, Readmissions, Mortality
Abstract:	<p><b>Introduction:</b> Our study aimed to determine whether malnutrition and nutrition-related conditions using the European Society for Clinical Nutrition and Metabolism (ESPEN) consensus were associated with functional status, institutionalization, readmissions, and mortality in older patients at 3-month follow-up.</p> <p><b>Methods:</b> A cohort of 102 consecutive deconditioned patients was assessed at three months postdischarge from postacute care. Inclusion criteria were age <math>\geq 70</math> years, scores of Mini-Mental Status Examination <math>\geq 21/30</math>, and admission for rehabilitation after an acute non-disabling disease. Malnutrition as defined by ESPEN consensus and nutrition-related conditions (frailty, sarcopenia, overweight/obesity, nutrient deficiency, and cachexia) were assessed, and related to postdischarge clinical outcomes at 3-month follow-up.</p> <p><b>Results:</b> Of 95 included patients (84.5<math>\pm</math>6.5 years; 63.2% women), 31 (32.6%) had unintentional weight loss and 19 (20%) fulfilled malnutrition criteria defined by the ESPEN consensus. Nutrition-related conditions were frequent: 94 (99%) patients had frailty, 44 (46.3%) sarcopenia, 58 (61.1%) overweight/obesity, and 59 (62.1%) nutrient deficiency. Sarcopenia reduced functional status at 3-month follow-up (median difference: -25.5; 95%CI -46.4 to -4.3, <math>p=0.008</math>). Institutionalization was related to unintentional weight loss in univariate analysis (OR= 3.9; 95%CI 1.3 to 12.4, <math>p=0.018</math>). Meeting the basic ESPEN definition of malnutrition was related to institutionalization in univariate (OR=3.4; 95% CI 1.0 to 11.3, <math>p=0.042</math>) but not multivariate analysis, and was not significantly associated with readmissions or mortality at 3-month follow-up.</p> <p><b>Conclusions:</b> Further research is needed on the potential value of the ESPEN consensus and guidelines to identify older patients at risk of worse functional status, institutionalization, readmissions, and mortality at 3-month follow-up postdischarge.</p>

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## 1 Prognostic value of the ESPEN consensus and guidelines for malnutrition:

### 2 Prediction of post-discharge clinical outcomes in older inpatients

#### 4 INTRODUCTION

5 Malnutrition is associated with poor functional status and increased mortality in older  
6 people (1)(2)(3). The main consequences of malnutrition and its related syndromes,  
7 such as frailty or sarcopenia, include increased risks of infections (4)(5), loss of  
8 independence (6), worsening health-related quality of life (7), and death (8)(9)(10)(11).  
9 Given the lack of consensual malnutrition guidelines, the European Society for Clinical  
10 Nutrition and Metabolism (ESPEN) recently made an effort to establish a definition of  
11 malnutrition that would be applicable in all adult age-ranges and healthcare settings,  
12 independent of etiology (1). The ESPEN consensus definition of malnutrition guidelines  
13 on definition and diagnoses has provided clinicians and researchers a practical tool for  
14 the hierarchical organization of nutrition disorders, nutrition-related conditions, and  
15 nutrition-related syndromes (2).

16 The ESPEN consensus definition of malnutrition has been applied in both acute  
17 (11)(12)(13) and postacute care (14)(15). In a large population of hospitalized older  
18 patients with diabetes, malnutrition lengthened the hospital stay, increased the  
19 probability of in-hospital death by a factor of 2.7, and decreased the probability of being  
20 discharged home rather than to an institution (13). Early management of nutrition  
21 disorders and nutrition-related conditions (1), once detected, could improve the life  
22 course of patients (16)(17).

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3 23 The objective of this longitudinal study was to determine whether the malnutrition and  
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5 24 nutrition-related conditions diagnosed during hospitalization using the ESPEN  
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7 25 consensus definition were associated with post-discharge clinical outcomes (functional  
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9 26 status assessed by Barthel index, institutionalization, hospital readmissions, and  
10  
11 27 mortality) among older patients at 3-month follow-up.  
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## 28 **METHODS**

### 29 **Design**

30 Cohort study of postacute inpatients who participated in a larger prospective study on  
31 malnutrition and sarcopenia (14). The Strengthening the Reporting of Observational  
32 Studies in Epidemiology (STROBE) Statement (18) was followed (Additional file 1).

### 33 **Setting**

34 The study was conducted in a postacute geriatric rehabilitation care unit in a **university**  
35 **hospital**. The unit focuses specifically on a 2-week period of rehabilitation and  
36 functional recovery, after which patients are expected to be discharged home.

### 37 **Participants**

38 Consecutive patients aged  $\geq 70$  years hospitalized in the postacute geriatric rehabilitation  
39 care unit due to functional loss resulting from a non-disabling medical disease were  
40 included from January to August 2011. Patients with general and/or cognitive conditions  
41 (Mini-Mental State Examination score  $< 21/30$ ) that prevented completion of the  
42 diagnostic tests or absence of information regarding weight loss in the previous year  
43 were excluded.

### 44 **Procedure**

45 All inpatients were screened for risk of malnutrition at admission by the Mini-  
46 Nutritional Assessment Short-Form (MNA-SF) (19)(20). The diagnosis of malnutrition  
47 as defined by the ESPEN consensus was then retrospectively applied in all patients  
48 identified as at risk of malnutrition (MNA-SF scores  $\leq 11$ ). The ESPEN definition pro-

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3 49 poses two alternative ways to diagnose malnutrition: body mass index (BMI) <18.5  
4  
5 50 kg/m<sup>2</sup> (alternative 1) or unintentional weight loss (>10% indefinite of time, or >5% over  
6  
7 51 the last 3 months) combined with age-related BMI (BMI <20 kg/m<sup>2</sup> in <70 years, or  
8  
9 52 <22 kg/m<sup>2</sup> in ≥70 years) or fat-free mass index (<17 kg/m<sup>2</sup> in men and 15 kg/m<sup>2</sup> in  
10  
11 53 women) (1). **Unintentional weight loss** was obtained from medical records. If data for  
12  
13 54 the last 3 months were unavailable, weight loss was assessed by patient and caregiver  
14  
15 55 interview or from weight data recorded in the medical record during the last year. **BMI**  
16  
17 56 was calculated from height and weight (kg/m<sup>2</sup>): height was measured in all patients able  
18  
19 57 to stand safely, otherwise a knee height equation (21) was applied; body weight was  
20  
21 58 measured to the nearest 0.1 kg. **Fat-free mass** (FFM), expressed in kg, was measured  
22  
23 59 by bioimpedance (Bodystat 1500, Bodystat Ltd., Isle of Man British Isles) as previously  
24  
25 60 described (14)(22). The FFM values were divided by height squared to obtain the **fat-**  
26  
27 61 **free mass index** (FFMI), expressed in kg/m<sup>2</sup> and compared with those of the reference  
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29 62 population (23).  
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32  
33 63 **Nutrition-related conditions** (sarcopenia, frailty, overweight/obesity, and nutrient  
34  
35 64 deficiency) were also considered (1). The term “nutrition-related syndrome” was used to  
36  
37 65 refer to a condition included in the definition, such as sarcopenia and frailty that is also  
38  
39 66 identified as a geriatric syndrome. **Sarcopenia** was assessed following The European  
40  
41 67 Working Group on Sarcopenia in Older People (EWGSOP) criteria: low muscle mass in  
42  
43 68 presence of low muscle function or low physical performance (24) assessed with  
44  
45 69 bioimpedance analysis, isometric handgrip dynamometry, and gait speed in a 4-m walk  
46  
47 70 test as previously described (14)(22). Gait speed was considered 0 m/s in bedridden  
48  
49 71 patients unable to stand. **Frailty** was assessed by the Frailty Phenotype (25) in presence

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3 72 of three of the following criteria: weight loss, weakness, exhaustion, slow walking  
4  
5 73 speed, and low physical activity. **Overweight and obesity** were considered following  
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7 74 World Health Organization recommendations: BMI 25-30 kg/m<sup>2</sup> and ≥30 kg/m<sup>2</sup>,  
8  
9 75 respectively. **Nutrient deficiency** was noted for total proteins, total cholesterol,  
10  
11 76 triglycerides, homocysteine-related markers (folic acid and B12 vitamin), iron profile  
12  
13 77 (serum iron, ferritin), and altered values of thyroid-stimulating hormone, ionogram  
14  
15 78 (sodium, potassium), and renal profile (creatinine, urea and glomerular filtration rate  
16  
17 79 from the equation developed by the Modification of Diet in Renal Diseases Study).  
18  
19 80 Diagnostic criteria for **cachexia** (wasting disease) in adults were applied. These  
20  
21 81 included weight loss of at least 5% in previous 12 months or less, in the presence of  
22  
23 82 underlying illness and three of the following criteria: decreased muscle strength, fatigue  
24  
25 83 (defined as physical and/or mental weariness resulting from exertion), anorexia (total  
26  
27 84 caloric intake <20 kcal/kg body weight/day or <70% of usual food intake), low FFMI,  
28  
29 85 or abnormal biochemistry (hemoglobin <12 g/dl or low serum albumin <3.2 g/dl) (26).  
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### 34 **Outcome variables**

35  
36 87 Main outcome variables were **functional status** assessed by Barthel index,  
37  
38 88 **institutionalization, readmissions, and mortality**. Functional status was recorded after  
39  
40 89 discharge by an investigator blinded to the study, obtained by telephone interview with  
41  
42 90 the patient or caregiver. **Institutionalization, readmissions, and mortality were collected**  
43  
44 91 **from caregiver telephone interview and medical records at 3-month follow-up. After**  
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46 92 **follow-up was completed, survival was assessed annually for the whole cohort in the**  
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48 93 **same way.** Data on sex, age, comorbidity (Charlson index), cognitive status (Short  
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3 94 Portable Mental Status Questionnaire) (27), and instrumental activities of daily living  
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5 95 (Lawton index) were obtained from medical records.  
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## 8 96 **Ethics**

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10 97 National and international research ethics guidelines were followed (28), including the  
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12 98 Deontological Code of Ethics, Declaration of Helsinki, and Spain's confidentiality law  
13  
14 99 concerning personal data (*Ley Orgánica* 15/1999, 13 December, *Protección de Datos de*  
15  
16 100 *Carácter Personal*). Written informed consent to participate was signed by all  
17  
18 101 participants and the study was approved by the local Clinical Ethics Committee.  
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## 21 102 **Statistical analysis**

22  
23 103 Descriptive analysis of the sample used percentages with frequency distributions for  
24  
25 104 categorical variables and means with standard deviation for quantitative continuous  
26  
27 105 variables. Univariate analysis was used to check clinical and functional characteristics  
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29 106 of the study participants according to the diagnosis of malnutrition as defined by  
30  
31 107 ESPEN consensus. Qualitative variables were compared by Chi-square or Fisher exact  
32  
33 108 test, as appropriate and quantitative variables by Student *t* test. As histograms and Q-Q  
34  
35 109 plot showed that Barthel Index at 3 months was not normally distributed, median  
36  
37 110 regression was applied to check median differences (MD) with 95% confidence interval  
38  
39 111 (CI). The analysis of factors associated with institutionalization was performed using  
40  
41 112 binary logistic regression. These associations were expressed by odds ratios (OR).  
42  
43 113 Associations with post-discharge readmissions and mortality were evaluated by Cox  
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45 114 regression. Kaplan-Meier curves for readmissions and for mortality, by malnutrition,  
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47 115 were compared using the corresponding log-rank test at 3-month follow-up. Univariate  
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3 116 and multivariate analyses were performed for all outcomes to examine possible  
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5 117 associations with covariables. Furthermore, the proportional hazards assumption was  
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7 118 checked for each Cox model; there was no evidence of any violation from proportional  
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9 119 hazards. P-values <0.05 were considered significant. Statistical analysis was performed  
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11 120 using R for Windows (V.3.1.3).  
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## 121 RESULTS

122 Of 102 eligible patients discharged from the unit during the study period, 95 met  
123 inclusion criteria (mean age 84.5 (SD 6.5) years, 63.2% women). Of the 31 (32.6%)  
124 patients with unintentional weight loss, 19 (20%) fulfilled the criteria for a diagnosis of  
125 malnutrition as defined by the ESPEN consensus. Nutrition-related conditions were  
126 frequent: 94 (99%) patients met Fried criteria for frailty, 44 (46.3%) for sarcopenia, 58  
127 (61.1%) for overweight/obesity, 59 (62.1%) had nutrient deficiency, and 20 (21.1%)  
128 patients had cachexia. Clinical and functional characteristics of the study participants  
129 during their stay in the postacute care unit and at 3-month follow-up are detailed in  
130 **Table 1**. Post-discharge clinical outcomes in patients with malnutrition and other  
131 nutrition-related conditions are described in **Table 2**.

132 **Tables 3 to 6** show univariate and multivariate analysis according to clinical outcomes  
133 (Barthel index, institutionalization, readmissions, and mortality) at 3-month follow-up.  
134 Sarcopenia was the only nutrition-related syndrome that affected Barthel index at 3-  
135 month follow-up, both in univariate analysis (median difference [MD]= -25; 95% CI: -  
136 43.2 to -6.8; p= 0.008) and in multivariate analysis (MD= -25.5; 95%CI: -46.6 to -4.3;  
137 p= 0.019) (**Table 3**).

138 As shown in **Table 4**, age and sex showed a significant association with  
139 institutionalization in the multivariate analysis. Institutionalization was also related to  
140 unintentional weight loss in univariate analysis (OR= 3.9; 95%CI: 1.3 to 12.4; p= 0.018)  
141 and showed a strong trend in multivariate analysis (OR= 5.5; 95%CI: 0.9 to 31.6; p=  
142 0.058). Similarly, malnutrition was significantly associated with institutionalization in

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3 143 univariate analysis (OR= 3.4; 95% CI: 1.0 to 11.3; p= 0.042), but the association was  
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5 144 not maintained under multivariate analysis.  
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8 145 At 3-month follow-up, 18 patients had been readmitted; there were no differences in  
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10 146 readmissions by clinical characteristics, malnutrition, and other nutrition-related  
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12 147 conditions (p >0.05) (**Table 5**). Readmissions also did not differ by malnutrition as  
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14 148 defined by the ESPEN consensus (log rank p-value= 0.685), as shown in **Figure 1**.  
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17 149 Finally, neither malnutrition nor nutrition-related conditions were related to any  
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19 150 differences in mortality in the analysis performed (**Table 6**). Age and comorbidity were  
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21 151 the only variables affecting mortality under multivariate analysis. The Kaplan-Meier  
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23 152 curve showed no differences in mortality by malnutrition diagnosis, as defined by the  
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25 153 ESPEN consensus (log rank p-value= 0.533) (**Figure 2**).  
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3 154 **DISCUSSION**  
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6 155 This cohort study assessed the association of malnutrition and nutrition-related  
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8 156 conditions with clinical outcomes in older patients at 3 months postdischarge from a  
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10 157 postacute care unit. We found that applying malnutrition criteria as defined by the  
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12 158 ESPEN consensus had no additional value in predicting poor mid-term outcomes in the  
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14 159 studied sample of geriatric patients. Instead, unintentional weight loss (i.e., one of the  
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16 160 subscores of the consensus definition) was associated with an increased likelihood of  
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18 161 postdischarge institutionalization, and sarcopenia was associated with poorer functional  
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20 162 status at 3-month follow-up.  
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24 163 The prognostic value of malnutrition as defined by the recently published ESPEN  
25  
26 164 consensus and guidelines has not been explored thoroughly. To the authors' knowledge,  
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28 165 the only study reporting an association between malnutrition as defined by the ESPEN  
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30 166 consensus and clinical outcomes was carried out in an acute care setting and was limited  
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32 167 to analyzing the length of hospital stay (13). Nutrition disorders diagnosed by ESPEN  
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34 168 consensus and guidelines are associated with worse functional prognosis during  
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36 169 postacute rehabilitation care (15), but there were no studies on this association after  
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38 170 discharge. Data from our study showed that the association between malnutrition and  
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40 171 functional status did not persist at 3 months postdischarge, a result that was unexpected.  
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42 172 A likely explanation for malnutrition's lack of predictive value for post-discharge  
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44 173 clinical outcomes is that nutritional deficiencies were correctly addressed during  
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46 174 hospitalization, and the expected poor outcomes due to the presence of malnutrition  
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3 175 were effectively cancelled in these patients after the multidisciplinary intervention  
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5 176 performed as part of usual post-discharge therapy.  
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8 177 Unlike malnutrition as defined by the ESPEN consensus, malnutrition-related  
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10 178 syndromes such as sarcopenia or frailty seem to have a negative impact on functional  
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12 179 status and rehabilitation outcomes in various settings, including postacute care  
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14 180 (22)(29)(30)(31). This observation held true for the present sample, in which the  
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16 181 presence of sarcopenia was associated with a lower score on the Barthel index after 3  
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18 182 months (14).  
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21 183 Unintentional weight loss was related to institutionalization. In a previous study,  
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23 184 unintentional weight loss was also related to worse clinical outcomes during hospital  
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25 185 stay (poor functional rehabilitation outcomes and longer length of stay) (15). Other  
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27 186 studies have considered weight loss prior to admission the most powerful predictor of  
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29 187 poor functional outcomes (32) and frailty (33). Unintentional weight loss has been  
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31 188 proposed as a key indicator to assess formal nutrition because of its validity, feasibility,  
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33 189 efficiency, and availability for every population and level of healthcare assistance (34).  
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35 190 Given that unintentional weight loss is a strong predictor of negative outcomes  
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37 191 (1)(33)(35)(36), objective anthropometric measurements (weight and height) should be  
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39 192 registered in the medical record in order to detect eventual weight loss in patients'  
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41 193 follow-up as part of the comprehensive geriatric assessment (37). This factor appears to  
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43 194 be an accessible, feasible and low-cost indicator of malnutrition itself in older adults  
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45 195 (33)(37)(38)(39). In the process of creating a consensus on malnutrition diagnostic  
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47 196 criteria, now being developed by the Global Leadership Initiative on Malnutrition  
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3 197 (GLIM) (34)(40), it would be desirable that unintentional weight loss be included as a  
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5 198 part of this universal tool, suitable for older people.

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8 199 The key point of malnutrition and malnutrition-related syndromes that has aroused great  
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10 200 interest for the scientific community is their reversibility, when properly identified and  
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12 201 managed. In the therapeutic approach to malnutrition, frailty, and sarcopenia, the most  
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14 202 effective strategies to prevent and treat malnutrition and nutrition disorders seem to be  
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16 203 an adequate nutrient intake, nutritional supplementation, and physical exercise  
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18 204 (29)(41)(42)(43).

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21 205 Some limitations may have influenced the results of our study. The criteria for  
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23 206 admission to the postacute short-term rehabilitation program constitute an initial  
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25 207 selection bias for studies conducted in rehabilitation settings: patients with good initial  
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27 208 recovery in the acute care ward as well as those whose physical, cognitive, or functional  
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29 209 status prevents them from following a rehabilitation program are excluded. In addition,  
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31 210 patients who require a rehabilitation program longer than two weeks are usually sent to  
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33 211 other intermediate care settings (14)(22). Therefore, the population is narrowly selected,  
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35 212 by definition. It is not surprising that frailty and risk of malnutrition were present in all  
36  
37 213 the sample, given that functional loss resulting from an acute recent process is one of  
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39 214 the admission criteria in the postacute care unit. The MNA-SF has been validated for  
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41 215 use in Spanish translation and has been recommended as a screening tool by the Spanish  
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43 216 Geriatrics and Gerontology Society (20), but the use of the full MNA questionnaire  
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45 217 might have improved specificity. On the other hand, malnutrition as defined by the  
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47 218 ESPEN consensus is partially based on anthropometric measurements, such as height,  
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3 219 which can be challenging in patients who are unable to stand (12 patients, 13.6%) and  
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5 220 require the substitution of knee height; furthermore, height measurement does not take  
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7 221 into account possible kyphosis or vertebral osteoporotic degenerative changes (44).  
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9 222 These factors might interfere with the accuracy of BMI, FFMI, basic definition of  
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11 223 malnutrition, and sarcopenia or cachexia diagnosis. Finally, the relatively small sample  
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13 224 size and the overlap between malnutrition and its related conditions should also be  
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15 225 considered a potential study limitation.

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18 226 The diagnostic criteria proposed by the Academy of Nutrition and Dietetics and  
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20 227 American Society for Parenteral and Enteral Nutrition (AND/ASPEN) have also been  
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22 228 shown to be a reliable tool in the assessment of malnutrition. Both ASPEN/AND and  
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24 229 ESPEN criteria have their pros and cons. The categories of malnutrition and the  
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26 230 approach to distinguishing the malnutrition context (acute illness or injury, chronic  
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28 231 illness, and social or environmental circumstances) are strong points of the  
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30 232 ASPEN/AND criteria; however, this is a complex tool using subjective assessment  
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32 233 skills rather than objective body composition measures (45). Conversely, the ESPEN  
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34 234 consensus definition is based on objective anthropometric measurements (BMI and  
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36 235 FFMI), but some of them have limited availability in clinical settings and are overly  
37  
38 236 restrictive. Further research is required in order to achieve a unified consensus suitable  
39  
40 237 to all populations and settings worldwide (1)(40)(46)(47).

#### 41 42 43 44 45 238 **Conclusions**

46  
47 239 Malnutrition as defined by the ESPEN consensus could not predict functional status,  
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49 240 institutionalization, readmissions, and mortality at 3 months after discharge from a  
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3 241 postacute care unit. In contrast, unintentional weight loss, i.e. one of the subscores of  
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5 242 the consensus definition, was associated with an increased likelihood of postdischarge  
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7 243 institutionalization, and sarcopenia was associated with poorer functional status at 3-  
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9 244 month follow-up. Further research with larger samples, multicenter cohorts, and more  
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11 245 extended follow-up is required to clarify **the clinical value of diagnosing malnutrition**  
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13 246 **using the ESPEN consensus** and its ability to predict long-term adverse clinical  
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16 247 outcomes.

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12  
13 253 **Conflict of interest**  
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15  
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29 259 **REFERENCES**  
30

- 31  
32 260 1. Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al.  
33 261 Diagnostic criteria for malnutrition - An ESPEN Consensus Statement. *Clin Nutr*.  
34 262 2015 Jun;34(3):335–40.  
35 263 2. Cederholm T, Barazzoni R, Austin P, Ballmer P, Biolo G, Bischoff SC, et al.  
36 264 ESPEN guidelines on definitions and terminology of clinical nutrition. *Clin Nutr*.  
37 265 2017 Feb;36(1):49–64.  
38 266 3. Morley JE. Novel Approaches to Nutrition in Older Persons. Preface. *Clin*  
39 267 *Geriatr Med*. 2015 Aug;31(3):xiii – xiv.  
40 268 4. Carlsson M, Haglin L, Rosendahl E, Gustafson Y. Poor nutritional status is  
41 269 associated with urinary tract infection among older people living in residential  
42 270 care facilities. *J Nutr Health Aging*. 2013 Feb 27;17(2):186–91.  
43 271 5. Phillips SM, Dickerson RN, Moore FA, Paddon-Jones D, Weijs PJM. Protein  
44 272 Turnover and Metabolism in the Elderly Intensive Care Unit Patient. *Nutr Clin*  
45 273 *Pract*. 2017 Apr;32(1\_suppl):112S – 120S.  
46 274 6. Wakabayashi H, Sashika H. Malnutrition is associated with poor rehabilitation  
47 275 outcome in elderly inpatients with hospital-associated deconditioning a  
48 276 prospective cohort study. *J Rehabil Med*. 2014 Mar;46(3):277–82.  
49 277 7. Rasheed S, Woods RT. Malnutrition and quality of life in older people: A  
50  
51

- 1  
2  
3 278 systematic review and meta-analysis. *Ageing Research Reviews*. 2013. p. 561–6.  
4 279 8. Agarwal E, Ferguson M, Banks M, Batterham M, Bauer J, Capra S, et al.  
5 280 Malnutrition and poor food intake are associated with prolonged hospital stay,  
6 281 frequent readmissions, and greater in-hospital mortality: results from the  
7 282 Nutrition Care Day Survey 2010. *Clin Nutr*. 2013 Oct;32(5):737–45.  
8 283 9. Cerri AP, Bellelli G, Mazzone A, Pittella F, Landi F, Zambon A, et al. Sarcopenia  
9 284 and malnutrition in acutely ill hospitalized elderly: Prevalence and outcomes.  
10 285 *Clin Nutr*. Churchill Livingstone; 2015 Aug;34(4):745–51.  
11 286 10. Landi F, Calvani R, Tosato M, Martone AM, Ortolani E, Saveria G, et al. Anorexia  
12 287 of Aging: Risk Factors, Consequences, and Potential Treatments. *Nutrients*. 2016  
13 288 Jan 27;8(2):69.  
14 289 11. Jiang J, Hu X, Chen J, Wang H, Zhang L, Dong B, et al. Predicting long-term  
15 290 mortality in hospitalized elderly patients using the new ESPEN definition. *Sci*  
16 291 *Rep*. 2017 Dec 22;7(1):4067.  
17 292 12. Rojer AGM, Kruizenga HM, Trappenburg MC, Reijnierse EM, Sipilä S, Narici M  
18 293 V, et al. The prevalence of malnutrition according to the new ESPEN definition in  
19 294 four diverse populations. *Clin Nutr*. 2016 Jun 20;35(3):758–62.  
20 295 13. Sanz-París A, Gómez-Candela C, Martín-Palmero Á, García-Almeida JM,  
21 296 Burgos-Pelaez R, Matía-Martin P, et al. Application of the new ESPEN definition  
22 297 of malnutrition in geriatric diabetic patients during hospitalization: A multicentric  
23 298 study. *Clin Nutr*. 2016 Dec 8;35(6):1564–7.  
24 299 14. Sánchez-Rodríguez D, Marco E, Ronquillo-Moreno N, Miralles R, Vázquez-Ibar  
25 300 O, Escalada F, et al. Prevalence of malnutrition and sarcopenia in a post-acute  
26 301 care geriatric unit: Applying the new ESPEN definition and EWGSOP criteria.  
27 302 *Clin Nutr*. 2016 Sep 9;36(5):1339–44.  
28 303 15. Sánchez-Rodríguez D, Marco E, Annweiler C, Ronquillo-Moreno N, Tortosa A,  
29 304 Vázquez-Ibar O, et al. Malnutrition in postacute geriatric care: Basic ESPEN  
30 305 diagnosis and etiology based diagnoses analyzed by length of stay, in-hospital  
31 306 mortality, and functional rehabilitation indexes. *Arch Gerontol Geriatr*.  
32 307 2017;73:169–76.  
33 308 16. Cruz-Jentoft AJ, Kiesswetter E, Drey M, Sieber CC. Nutrition, frailty, and  
34 309 sarcopenia. *Aging Clin Exp Res*. 2017 Feb 2;29(1):43–8.  
35 310 17. Wakabayashi H, Sakuma K. Rehabilitation nutrition for sarcopenia with  
36 311 disability: a combination of both rehabilitation and nutrition care management. *J*  
37 312 *Cachexia Sarcopenia Muscle*. 2014 Dec;5(4):269–77.  
38 313 18. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP.  
39 314 The Strengthening the Reporting of Observational Studies in Epidemiology  
40 315 (STROBE) statement: guidelines for reporting observational studies. *Lancet*.  
41 316 2007 Oct 20;370(9596):1453–7.  
42 317 19. Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, et al.  
43 318 Validation of the Mini Nutritional Assessment short-form (MNA-SF): a practical  
44 319 tool for identification of nutritional status. *J Nutr Health Aging*. 2009  
45 320 Nov;13(9):782–8.  
46 321 20. Camina-Martín MA, de Mateo-Silleras B, Malafarina V, Lopez-Mongil R, Niño-  
47 322 Martín V, López-Trigo JA, et al. Nutritional status assessment in geriatrics:

- 1  
2  
3 323 Consensus declaration by the Spanish society of geriatrics and gerontology  
4 324 nutrition work group. *Maturitas*. 2015 Jul;81(3):414–9.
- 5 325 21. Chumlea WC, Roche AF, Steinbaugh ML. Estimating stature from knee height  
6 326 for persons 60 to 90 years of age. *J Am Geriatr Soc*. 1985 Feb;33(2):116–20.
- 7 327 22. Sánchez-Rodríguez D, Marco E, Miralles R, Fayos M, Mojal S, Alvarado M, et  
8 328 al. Sarcopenia, physical rehabilitation and functional outcomes of patients in a  
9 329 subacute geriatric care unit. *Arch Gerontol Geriatr*. 2014 Jan;59(1):39–43.
- 10 330 23. Schutz Y, Kyle UUG, Pichard C. Fat-free mass index and fat mass index  
11 331 percentiles in Caucasians aged 18-98 y. *Int J Obes Relat Metab Disord*. 2002  
12 332 Jul;26(7):953–60.
- 13 333 24. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al.  
14 334 Sarcopenia: European consensus on definition and diagnosis. *Age Ageing*.  
15 335 2010;39(April):412–23.
- 16 336 25. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al.  
17 337 Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*.  
18 338 2001 Mar;56(3):M146–56.
- 19 339 26. Evans WJ, Morley JE, Argilés J, Bales C, Baracos V, Guttridge D, et al.  
20 340 Cachexia: A new definition. *Clin Nutr*. 2008 Dec;27(6):793–9.
- 21 341 27. Pfeiffer E. A short portable mental status questionnaire for the assessment of  
22 342 organic brain deficit in elderly patients. *J Am Geriatr Soc*. 1975 Oct;23(10):433–  
23 343 41.
- 24 344 28. Muller MJ, Soares M. The ethics of research publication. *Eur J Clin Nutr*. 2017  
25 345 May;71(5):569.
- 26 346 29. Litchford MD. Counteracting the Trajectory of Frailty and Sarcopenia in Older  
27 347 Adults. *Nutr Clin Pract*. 2014 Aug 9;29(4):428–34.
- 28 348 30. Morley JE. Nutritional supplementation and sarcopenia: the evidence grows. *J*  
29 349 *Am Med Dir Assoc*. 2015 Sep 1;16(9):717–9.
- 30 350 31. Landi F, Bernabei R, Russo A, ZuccalÀ G, Onder G, Carosella L, et al. Predictors  
31 351 of Rehabilitation Outcomes in Frail Patients Treated in a Geriatric Hospital. *J Am*  
32 352 *Geriatr Soc*. 2002 Apr;50(4):679–84.
- 33 353 32. Lee L-C, Tsai AC. Mini-Nutritional-Assessment (MNA) without body mass  
34 354 index (BMI) predicts functional disability in elderly Taiwanese. *Arch Gerontol*  
35 355 *Geriatr*. 2012 May;54(3):e405–10.
- 36 356 33. Fougère B, Morley JE. Editorial: Weight Loss is a Major Cause of Frailty. *J Nutr*  
37 357 *Health Aging*. 2017 Nov 22;21(9):933–5.
- 38 358 34. Jensen GL, Cederholm T. Global Leadership Initiative on Malnutrition: Progress  
39 359 Report From ASPEN Clinical Nutrition Week 2017. *JPEN J Parenter Enteral*  
40 360 *Nutr*. 2017 Apr 1;148607117707761.
- 41 361 35. Wirth R, Streicher M, Smoliner C, Kolb C, Hiesmayr M, Thiem U, et al. The  
42 362 impact of weight loss and low BMI on mortality of nursing home residents -  
43 363 Results from the nutritionDay in nursing homes. *Clin Nutr*. 2016 Aug  
44 364 19;35(4):900–6.
- 45 365 36. Cheng FW, Gao X, Jensen GL. Weight Change and All-Cause Mortality in Older  
46 366 Adults: A Meta-Analysis. *J Nutr Gerontol Geriatr*. 2015 Oct 2;34(4):343–68.
- 47 367 37. DiMaria-Ghalili RA. Integrating Nutrition in the Comprehensive Geriatric

- 1  
2  
3 368 Assessment. *Nutr Clin Pract*. 2014 Aug 2;29(4):420–7.  
4 369 38. Russell MK. Functional assessment of nutrition status. *Nutr Clin Pract*. 2015 Apr  
5 370 13;30(2):211–8.  
6 371 39. Wijnhoven HAH, van Zon SKR, Twisk J, Visser M. Attribution of causes of  
7 372 weight loss and weight gain to 3-year mortality in older adults: results from the  
8 373 Longitudinal Aging Study Amsterdam. *J Gerontol A Biol Sci Med Sci*. 2014 Oct  
9 374 1;69(10):1236–43.  
10 375 40. Cederholm T, Jensen GL. To create a consensus on malnutrition diagnostic  
11 376 criteria: A report from the Global Leadership Initiative on Malnutrition (GLIM)  
12 377 meeting at the ESPEN Congress 2016. *Clin Nutr*. 2017 Feb;36(1):7–10.  
13 378 41. Deutz NEP, Bauer JM, Barazzoni R, Biolo G, Boirie Y, Bosy-Westphal A, et  
14 379 al. Protein intake and exercise for optimal muscle function with aging:  
15 380 recommendations from the ESPEN Expert Group. *Clin Nutr*. 2014  
16 381 Dec;33(6):929–36.  
17 382 42. de van der Schueren MAE, Wijnhoven HAH, Kruijenga HM, Visser M. A critical  
18 383 appraisal of nutritional intervention studies in malnourished, community dwelling  
19 384 older persons. *Clin Nutr*. 2016 Oct;35(5):1008–14.  
20 385 43. Cruz-Jentoft AJ, Landi F, Schneider SM, Zúñiga C, Arai H, Boirie Y, et al.  
21 386 Prevalence of and interventions for sarcopenia in ageing adults: a systematic  
22 387 review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS).  
23 388 *Age Ageing*. 2014 Nov;43(6):748–59.  
24 389 44. Gavrilidou NN, Pihlsgård M, Elmståhl S. High degree of BMI misclassification  
25 390 of malnutrition among Swedish elderly population: Age-adjusted height  
26 391 estimation using knee height and demispan. *Eur J Clin Nutr*. 2015  
27 392 May;69(5):565–71.  
28 393 45. Hand RK, Murphy WJ, Field LB, Lee JA, Parrott JS, Ferguson M, et al.  
29 394 Validation of the Academy/A.S.P.E.N. Malnutrition Clinical Characteristics. *J*  
30 395 *Acad Nutr Diet*. 2016 May;116(5):856–64.  
31 396 46. Cederholm T, Jensen GL. To Create a Consensus on Malnutrition Diagnostic  
32 397 Criteria. *JPEN J Parenter Enteral Nutr*. 2017 Mar 17;41(3):311–4.  
33 398 47. White J V., Guenter P, Jensen G, Malone A, Schofield M, Academy Malnutrition  
34 399 Work Group, et al. Consensus Statement: Academy of Nutrition and Dietetics and  
35 400 American Society for Parenteral and Enteral Nutrition: Characteristics  
36 401 Recommended for the Identification and Documentation of Adult Malnutrition  
37 402 (Undernutrition). *J Parenter Enteral Nutr*. 2012 May 1;36(3):275–83.  
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## 1                   **Prognostic value of the ESPEN consensus and guidelines for malnutrition:**

### 2                   **Prediction of post-discharge clinical outcomes in older inpatients**

#### 4                   **INTRODUCTION**

5                   Malnutrition is associated with poor functional status and increased mortality in older  
6                   people (1)(2)(3). The main consequences of malnutrition and its related syndromes,  
7                   such as frailty or sarcopenia, include increased risks of infections (4)(5), loss of  
8                   independence (6), worsening health-related quality of life (7), and death (8)(9)(10)(11).

9                   Given the lack of consensual malnutrition guidelines, the European Society for Clinical  
10                  Nutrition and Metabolism (ESPEN) recently made an effort to establish a definition of  
11                  malnutrition that would be applicable in all adult age-ranges and healthcare settings,  
12                  independent of etiology (1). The ESPEN consensus definition of malnutrition guidelines  
13                  on definition and diagnoses has provided clinicians and researchers a practical tool for  
14                  the hierarchical organization of nutrition disorders, nutrition-related conditions, and  
15                  nutrition-related syndromes (2).

16                The ESPEN consensus definition of malnutrition has been applied in both acute  
17                (11)(12)(13) and postacute care (14)(15). In a large population of hospitalized older  
18                patients with diabetes, malnutrition lengthened the hospital stay, increased the  
19                probability of in-hospital death by a factor of 2.7, and decreased the probability of being  
20                discharged home rather than to an institution (13). Early management of nutrition  
21                disorders and nutrition-related conditions (1), once detected, could improve the life  
22                course of patients (16)(17).

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3 23 The objective of this longitudinal study was to determine whether the malnutrition and  
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5 24 nutrition-related conditions diagnosed during hospitalization using the ESPEN  
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7 25 consensus definition were associated with post-discharge clinical outcomes (functional  
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9 26 status assessed by Barthel index, institutionalization, hospital readmissions, and  
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11 27 mortality) among older patients at 3-month follow-up.  
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## 28 **METHODS**

### 29 **Design**

30 Cohort study of postacute inpatients who participated in a larger prospective study on  
31 malnutrition and sarcopenia (14). The Strengthening the Reporting of Observational  
32 Studies in Epidemiology (STROBE) Statement (18) was followed (Additional file 1).

### 33 **Setting**

34 The study was conducted in a postacute geriatric rehabilitation care unit in a university  
35 hospital. The unit focuses specifically on a 2-week period of rehabilitation and  
36 functional recovery, after which patients are expected to be discharged home.

### 37 **Participants**

38 Consecutive patients aged  $\geq 70$  years hospitalized in the postacute geriatric rehabilitation  
39 care unit due to functional loss resulting from a non-disabling medical disease were  
40 included from January to August 2011. Patients with general and/or cognitive conditions  
41 (Mini-Mental State Examination score  $< 21/30$ ) that prevented completion of the  
42 diagnostic tests or absence of information regarding weight loss in the previous year  
43 were excluded.

### 44 **Procedure**

45 All inpatients were screened for risk of malnutrition at admission by the Mini-  
46 Nutritional Assessment Short-Form (MNA-SF) (19)(20). The diagnosis of malnutrition  
47 as defined by the ESPEN consensus was then retrospectively applied in all patients  
48 identified as at risk of malnutrition (MNA-SF scores  $\leq 11$ ). The ESPEN definition pro-



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3 49 poses two alternative ways to diagnose malnutrition: body mass index (BMI) <18.5  
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5 50 kg/m<sup>2</sup> (alternative 1) or unintentional weight loss (>10% indefinite of time, or >5% over  
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7 51 the last 3 months) combined with age-related BMI (BMI <20 kg/m<sup>2</sup> in <70 years, or  
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9 52 <22 kg/m<sup>2</sup> in ≥70 years) or fat-free mass index (<17 kg/m<sup>2</sup> in men and 15 kg/m<sup>2</sup> in  
10  
11 53 women) (1). **Unintentional weight loss** was obtained from medical records. If data for  
12  
13 54 the last 3 months were unavailable, weight loss was assessed by patient and caregiver  
14  
15 55 interview or from weight data recorded in the medical record during the last year. **BMI**  
16  
17 56 was calculated from height and weight (kg/m<sup>2</sup>): height was measured in all patients able  
18  
19 57 to stand safely, otherwise a knee height equation (21) was applied; body weight was  
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21 58 measured to the nearest 0.1 kg. **Fat-free mass** (FFM), expressed in kg, was measured  
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23 59 by bioimpedance (Bodystat 1500, Bodystat Ltd., Isle of Man British Isles) as previously  
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25 60 described (14)(22). The FFM values were divided by height squared to obtain the **fat-**  
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27 61 **free mass index** (FFMI), expressed in kg/m<sup>2</sup> and compared with those of the reference  
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29 62 population (23).

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33 63 **Nutrition-related conditions** (sarcopenia, frailty, overweight/obesity, and nutrient  
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35 64 deficiency) were also considered (1). The term “nutrition-related syndrome” was used to  
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37 65 refer to a condition included in the definition, such as sarcopenia and frailty that is also  
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39 66 identified as a geriatric syndrome. **Sarcopenia** was assessed following The European  
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41 67 Working Group on Sarcopenia in Older People (EWGSOP) criteria: low muscle mass in  
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43 68 presence of low muscle function or low physical performance (24) assessed with  
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45 69 bioimpedance analysis, isometric handgrip dynamometry, and gait speed in a 4-m walk  
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47 70 test as previously described (14)(22). Gait speed was considered 0 m/s in bedridden  
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49 71 patients unable to stand. **Frailty** was assessed by the Frailty Phenotype (25) in presence

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3 72 of three of the following criteria: weight loss, weakness, exhaustion, slow walking  
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5 73 speed, and low physical activity. **Overweight and obesity** were considered following  
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7 74 World Health Organization recommendations: BMI 25-30 kg/m<sup>2</sup> and  $\geq 30$  kg/m<sup>2</sup>,  
8  
9 75 respectively. **Nutrient deficiency** was noted for total proteins, total cholesterol,  
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11 76 triglycerides, homocysteine-related markers (folic acid and B12 vitamin), iron profile  
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13 77 (serum iron, ferritin), and altered values of thyroid-stimulating hormone, ionogram  
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15 78 (sodium, potassium), and renal profile (creatinine, urea and glomerular filtration rate  
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17 79 from the equation developed by the Modification of Diet in Renal Diseases Study).  
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19 80 Diagnostic criteria for **cachexia** (wasting disease) in adults were applied. These  
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21 81 included weight loss of at least 5% in previous 12 months or less, in the presence of  
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23 82 underlying illness and three of the following criteria: decreased muscle strength, fatigue  
24  
25 83 (defined as physical and/or mental weariness resulting from exertion), anorexia (total  
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27 84 caloric intake <20 kcal/kg body weight/day or <70% of usual food intake), low FFMI,  
28  
29 85 or abnormal biochemistry (hemoglobin <12 g/dl or low serum albumin <3.2 g/dl) (26).  
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### 34 **Outcome variables**

35  
36 87 Main outcome variables were **functional status** assessed by Barthel index,  
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38 88 **institutionalization, readmissions, and mortality**. Functional status was recorded after  
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40 89 discharge by an investigator blinded to the study, obtained by telephone interview with  
41  
42 90 the patient or caregiver. Institutionalization, readmissions, and mortality were collected  
43  
44 91 from caregiver telephone interview and medical records at 3-month follow-up. After  
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46 92 follow-up was completed, survival was assessed annually for the whole cohort in the  
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48 93 same way. Data on sex, age, comorbidity (Charlson index), cognitive status (Short  
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3 94 Portable Mental Status Questionnaire) (27), and instrumental activities of daily living  
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5 95 (Lawton index) were obtained from medical records.  
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## 8 96 **Ethics**

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10 97 National and international research ethics guidelines were followed (28), including the  
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12 98 Deontological Code of Ethics, Declaration of Helsinki, and Spain's confidentiality law  
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14 99 concerning personal data (*Ley Orgánica* 15/1999, 13 December, *Protección de Datos de*  
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16 100 *Carácter Personal*). Written informed consent to participate was signed by all  
17  
18 101 participants and the study was approved by the local Clinical Ethics Committee.  
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## 21 102 **Statistical analysis**

22  
23 103 Descriptive analysis of the sample used percentages with frequency distributions for  
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25 104 categorical variables and means with standard deviation for quantitative continuous  
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27 105 variables. Univariate analysis was used to check clinical and functional characteristics  
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29 106 of the study participants according to the diagnosis of malnutrition as defined by  
30  
31 107 ESPEN consensus. Qualitative variables were compared by Chi-square or Fisher exact  
32  
33 108 test, as appropriate and quantitative variables by Student *t* test. As histograms and Q-Q  
34  
35 109 plot showed that Barthel Index at 3 months was not normally distributed, median  
36  
37 110 regression was applied to check median differences (MD) with 95% confidence interval  
38  
39 111 (CI). The analysis of factors associated with institutionalization was performed using  
40  
41 112 binary logistic regression. These associations were expressed by odds ratios (OR).  
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43 113 Associations with post-discharge readmissions and mortality were evaluated by Cox  
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45 114 regression. Kaplan-Meier curves for readmissions and for mortality, by malnutrition,  
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47 115 were compared using the corresponding log-rank test at 3-month follow-up. Univariate  
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3 116 and multivariate analyses were performed for all outcomes to examine possible  
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5 117 associations with covariables. Furthermore, the proportional hazards assumption was  
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7 118 checked for each Cox model; there was no evidence of any violation from proportional  
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9 119 hazards. P-values <0.05 were considered significant. Statistical analysis was performed  
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11 120 using R for Windows (V.3.1.3).  
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3 121 **RESULTS**  
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6 122 Of 102 eligible patients discharged from the unit during the study period, 95 met  
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8 123 inclusion criteria (mean age 84.5 (SD 6.5) years, 63.2% women). Of the 31 (32.6%)  
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10 124 patients with unintentional weight loss, 19 (20%) fulfilled the criteria for a diagnosis of  
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12 125 malnutrition as defined by the ESPEN consensus. Nutrition-related conditions were  
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14 126 frequent: 94 (99%) patients met Fried criteria for frailty, 44 (46.3%) for sarcopenia, 58  
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16 127 (61.1%) for overweight/obesity, 59 (62.1%) had nutrient deficiency, and 20 (21.1%)  
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18 128 patients had cachexia. Clinical and functional characteristics of the study participants  
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20 129 during their stay in the postacute care unit and at 3-month follow-up are detailed in  
21  
22 130 **Table 1**. Post-discharge clinical outcomes in patients with malnutrition and other  
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24 131 nutrition-related conditions are described in **Table 2**.

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26  
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28 132 **Tables 3 to 6** show univariate and multivariate analysis according to clinical outcomes  
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30 133 (Barthel index, institutionalization, readmissions, and mortality) at 3-month follow-up.  
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32 134 Sarcopenia was the only nutrition-related syndrome that affected Barthel index at 3-  
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34 135 month follow-up, both in univariate analysis (median difference [MD]= -25; 95% CI: -  
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36 136 43.2 to -6.8; p= 0.008) and in multivariate analysis (MD= -25.5; 95%CI: -46.6 to -4.3;  
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38 137 p= 0.019) (**Table 3**).

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41 138 As shown in **Table 4**, age and sex showed a significant association with  
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43 139 institutionalization in the multivariate analysis. Institutionalization was also related to  
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45 140 unintentional weight loss in univariate analysis (OR= 3.9; 95%CI: 1.3 to 12.4; p= 0.018)  
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47 141 and showed a strong trend in multivariate analysis (OR= 5.5; 95%CI: 0.9 to 31.6; p=  
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49 142 0.058). Similarly, malnutrition was significantly associated with institutionalization in

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3 143 univariate analysis (OR= 3.4; 95% CI: 1.0 to 11.3; p= 0.042), but the association was  
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5 144 not maintained under multivariate analysis.  
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8 145 At 3-month follow-up, 18 patients had been readmitted; there were no differences in  
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10 146 readmissions by clinical characteristics, malnutrition, and other nutrition-related  
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12 147 conditions (p >0.05) (**Table 5**). Readmissions also did not differ by malnutrition as  
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14 148 defined by the ESPEN consensus (log rank p-value= 0.685), as shown in **Figure 1**.  
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16  
17 149 Finally, neither malnutrition nor nutrition-related conditions were related to any  
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19 150 differences in mortality in the analysis performed (**Table 6**). Age and comorbidity were  
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21 151 the only variables affecting mortality under multivariate analysis. The Kaplan-Meier  
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23 152 curve showed no differences in mortality by malnutrition diagnosis, as defined by the  
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25 153 ESPEN consensus (log rank p-value= 0.533) (**Figure 2**).  
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3 154 **DISCUSSION**  
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6 155 This cohort study assessed the association of malnutrition and nutrition-related  
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8 156 conditions with clinical outcomes in older patients at 3 months postdischarge from a  
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10 157 postacute care unit. We found that applying malnutrition criteria as defined by the  
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12 158 ESPEN consensus had no additional value in predicting poor mid-term outcomes in the  
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14 159 studied sample of geriatric patients. Instead, unintentional weight loss (i.e., one of the  
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16 160 subscores of the consensus definition) was associated with an increased likelihood of  
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18 161 postdischarge institutionalization, and sarcopenia was associated with poorer functional  
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20 162 status at 3-month follow-up.  
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24 163 The prognostic value of malnutrition as defined by the recently published ESPEN  
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26 164 consensus and guidelines has not been explored thoroughly. To the authors' knowledge,  
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28 165 the only study reporting an association between malnutrition as defined by the ESPEN  
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30 166 consensus and clinical outcomes was carried out in an acute care setting and was limited  
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32 167 to analyzing the length of hospital stay (13). Nutrition disorders diagnosed by ESPEN  
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34 168 consensus and guidelines are associated with worse functional prognosis during  
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36 169 postacute rehabilitation care (15), but there were no studies on this association after  
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38 170 discharge. Data from our study showed that the association between malnutrition and  
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40 171 functional status did not persist at 3 months postdischarge, a result that was unexpected.  
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42 172 A likely explanation for malnutrition's lack of predictive value for post-discharge  
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44 173 clinical outcomes is that nutritional deficiencies were correctly addressed during  
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46 174 hospitalization, and the expected poor outcomes due to the presence of malnutrition  
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3 175 were effectively cancelled in these patients after the multidisciplinary intervention  
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5 176 performed as part of usual post-discharge therapy.  
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8 177 Unlike malnutrition as defined by the ESPEN consensus, malnutrition-related  
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10 178 syndromes such as sarcopenia or frailty seem to have a negative impact on functional  
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12 179 status and rehabilitation outcomes in various settings, including postacute care  
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14 180 (22)(29)(30)(31). This observation held true for the present sample, in which the  
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16 181 presence of sarcopenia was associated with a lower score on the Barthel index after 3  
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18 182 months (14).  
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21 183 Unintentional weight loss was related to institutionalization. In a previous study,  
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23 184 unintentional weight loss was also related to worse clinical outcomes during hospital  
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25 185 stay (poor functional rehabilitation outcomes and longer length of stay) (15). Other  
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27 186 studies have considered weight loss prior to admission the most powerful predictor of  
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29 187 poor functional outcomes (32) and frailty (33). Unintentional weight loss has been  
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31 188 proposed as a key indicator to assess formal nutrition because of its validity, feasibility,  
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33 189 efficiency, and availability for every population and level of healthcare assistance (34).  
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35 190 Given that unintentional weight loss is a strong predictor of negative outcomes  
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37 191 (1)(33)(35)(36), objective anthropometric measurements (weight and height) should be  
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39 192 registered in the medical record in order to detect eventual weight loss in patients'  
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41 193 follow-up as part of the comprehensive geriatric assessment (37). This factor appears to  
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43 194 be an accessible, feasible and low-cost indicator of malnutrition itself in older adults  
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45 195 (33)(37)(38)(39). In the process of creating a consensus on malnutrition diagnostic  
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47 196 criteria, now being developed by the Global Leadership Initiative on Malnutrition  
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3 197 (GLIM) (34)(40), it would be desirable that unintentional weight loss be included as a  
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5 198 part of this universal tool, suitable for older people.  
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8 199 The key point of malnutrition and malnutrition-related syndromes that has aroused great  
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10 200 interest for the scientific community is their reversibility, when properly identified and  
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12 201 managed. In the therapeutic approach to malnutrition, frailty, and sarcopenia, the most  
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14 202 effective strategies to prevent and treat malnutrition and nutrition disorders seem to be  
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16 203 an adequate nutrient intake, nutritional supplementation, and physical exercise  
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18 204 (29)(41)(42)(43).  
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21 205 Some limitations may have influenced the results of our study. The criteria for  
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23 206 admission to the postacute short-term rehabilitation program constitute an initial  
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25 207 selection bias for studies conducted in rehabilitation settings: patients with good initial  
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27 208 recovery in the acute care ward as well as those whose physical, cognitive, or functional  
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29 209 status prevents them from following a rehabilitation program are excluded. In addition,  
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31 210 patients who require a rehabilitation program longer than two weeks are usually sent to  
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33 211 other intermediate care settings (14)(22). Therefore, the population is narrowly selected,  
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35 212 by definition. It is not surprising that frailty and risk of malnutrition were present in all  
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37 213 the sample, given that functional loss resulting from an acute recent process is one of  
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39 214 the admission criteria in the postacute care unit. The MNA-SF has been validated for  
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41 215 use in Spanish translation and has been recommended as a screening tool by the Spanish  
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43 216 Geriatrics and Gerontology Society (20), but the use of the full MNA questionnaire  
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45 217 might have improved specificity. On the other hand, malnutrition as defined by the  
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47 218 ESPEN consensus is partially based on anthropometric measurements, such as height,  
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3 219 which can be challenging in patients who are unable to stand (12 patients, 13.6%) and  
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5 220 require the substitution of knee height; furthermore, height measurement does not take  
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7 221 into account possible kyphosis or vertebral osteoporotic degenerative changes (44).  
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9 222 These factors might interfere with the accuracy of BMI, FFMI, basic definition of  
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11 223 malnutrition, and sarcopenia or cachexia diagnosis. Finally, the relatively small sample  
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13 224 size and the overlap between malnutrition and its related conditions should also be  
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15 225 considered a potential study limitation.

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18 226 The diagnostic criteria proposed by the Academy of Nutrition and Dietetics and  
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20 227 American Society for Parenteral and Enteral Nutrition (AND/ASPEN) have also been  
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22 228 shown to be a reliable tool in the assessment of malnutrition. Both ASPEN/AND and  
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24 229 ESPEN criteria have their pros and cons. The categories of malnutrition and the  
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26 230 approach to distinguishing the malnutrition context (acute illness or injury, chronic  
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28 231 illness, and social or environmental circumstances) are strong points of the  
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30 232 ASPEN/AND criteria; however, this is a complex tool using subjective assessment  
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32 233 skills rather than objective body composition measures (45). Conversely, the ESPEN  
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34 234 consensus definition is based on objective anthropometric measurements (BMI and  
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36 235 FFMI), but some of them have limited availability in clinical settings and are overly  
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38 236 restrictive. Further research is required in order to achieve a unified consensus suitable  
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40 237 to all populations and settings worldwide (1)(40)(46)(47).

#### 41 42 43 44 45 238 **Conclusions**

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47 239 Malnutrition as defined by the ESPEN consensus could not predict functional status,  
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49 240 institutionalization, readmissions, and mortality at 3 months after discharge from a  
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3 241 postacute care unit. In contrast, unintentional weight loss, i.e. one of the subscores of  
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5 242 the consensus definition, was associated with an increased likelihood of postdischarge  
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7 243 institutionalization, and sarcopenia was associated with poorer functional status at 3-  
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9 244 month follow-up. Further research with larger samples, multicenter cohorts, and more  
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11 245 extended follow-up is required to clarify the clinical value of diagnosing malnutrition  
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13 246 using the ESPEN consensus and its ability to predict long-term adverse clinical  
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16 247 outcomes.

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12  
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29 259 **REFERENCES**  
30

- 31  
32 260 1. Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al.  
33 261 Diagnostic criteria for malnutrition - An ESPEN Consensus Statement. *Clin Nutr.*  
34 262 2015 Jun;34(3):335–40.  
35 263 2. Cederholm T, Barazzoni R, Austin P, Ballmer P, Biolo G, Bischoff SC, et al.  
36 264 ESPEN guidelines on definitions and terminology of clinical nutrition. *Clin Nutr.*  
37 265 2017 Feb;36(1):49–64.  
38 266 3. Morley JE. Novel Approaches to Nutrition in Older Persons. Preface. *Clin*  
39 267 *Geriatr Med.* 2015 Aug;31(3):xiii – xiv.  
40 268 4. Carlsson M, Haglin L, Rosendahl E, Gustafson Y. Poor nutritional status is  
41 269 associated with urinary tract infection among older people living in residential  
42 270 care facilities. *J Nutr Health Aging.* 2013 Feb 27;17(2):186–91.  
43 271 5. Phillips SM, Dickerson RN, Moore FA, Paddon-Jones D, Weijs PJM. Protein  
44 272 Turnover and Metabolism in the Elderly Intensive Care Unit Patient. *Nutr Clin*  
45 273 *Pract.* 2017 Apr;32(1\_suppl):112S – 120S.  
46 274 6. Wakabayashi H, Sashika H. Malnutrition is associated with poor rehabilitation  
47 275 outcome in elderly inpatients with hospital-associated deconditioning a  
48 276 prospective cohort study. *J Rehabil Med.* 2014 Mar;46(3):277–82.  
49 277 7. Rasheed S, Woods RT. Malnutrition and quality of life in older people: A  
50  
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- 1  
2  
3 278 systematic review and meta-analysis. *Ageing Research Reviews*. 2013. p. 561–6.  
4 279 8. Agarwal E, Ferguson M, Banks M, Batterham M, Bauer J, Capra S, et al.  
5 280 Malnutrition and poor food intake are associated with prolonged hospital stay,  
6 281 frequent readmissions, and greater in-hospital mortality: results from the  
7 282 Nutrition Care Day Survey 2010. *Clin Nutr*. 2013 Oct;32(5):737–45.  
8 283 9. Cerri AP, Bellelli G, Mazzone A, Pittella F, Landi F, Zambon A, et al. Sarcopenia  
9 284 and malnutrition in acutely ill hospitalized elderly: Prevalence and outcomes.  
10 285 *Clin Nutr*. Churchill Livingstone; 2015 Aug;34(4):745–51.  
11 286 10. Landi F, Calvani R, Tosato M, Martone AM, Ortolani E, Saveria G, et al. Anorexia  
12 287 of Aging: Risk Factors, Consequences, and Potential Treatments. *Nutrients*. 2016  
13 288 Jan 27;8(2):69.  
14 289 11. Jiang J, Hu X, Chen J, Wang H, Zhang L, Dong B, et al. Predicting long-term  
15 290 mortality in hospitalized elderly patients using the new ESPEN definition. *Sci*  
16 291 *Rep*. 2017 Dec 22;7(1):4067.  
17 292 12. Rojer AGM, Kruizenga HM, Trappenburg MC, Reijnierse EM, Sipilä S, Narici M  
18 293 V, et al. The prevalence of malnutrition according to the new ESPEN definition in  
19 294 four diverse populations. *Clin Nutr*. 2016 Jun 20;35(3):758–62.  
20 295 13. Sanz-París A, Gómez-Candela C, Martín-Palmero Á, García-Almeida JM,  
21 296 Burgos-Pelaez R, Matía-Martin P, et al. Application of the new ESPEN definition  
22 297 of malnutrition in geriatric diabetic patients during hospitalization: A multicentric  
23 298 study. *Clin Nutr*. 2016 Dec 8;35(6):1564–7.  
24 299 14. Sánchez-Rodríguez D, Marco E, Ronquillo-Moreno N, Miralles R, Vázquez-Ibar  
25 300 O, Escalada F, et al. Prevalence of malnutrition and sarcopenia in a post-acute  
26 301 care geriatric unit: Applying the new ESPEN definition and EWGSOP criteria.  
27 302 *Clin Nutr*. 2016 Sep 9;36(5):1339–44.  
28 303 15. Sánchez-Rodríguez D, Marco E, Annweiler C, Ronquillo-Moreno N, Tortosa A,  
29 304 Vázquez-Ibar O, et al. Malnutrition in postacute geriatric care: Basic ESPEN  
30 305 diagnosis and etiology based diagnoses analyzed by length of stay, in-hospital  
31 306 mortality, and functional rehabilitation indexes. *Arch Gerontol Geriatr*.  
32 307 2017;73:169–76.  
33 308 16. Cruz-Jentoft AJ, Kiesswetter E, Drey M, Sieber CC. Nutrition, frailty, and  
34 309 sarcopenia. *Aging Clin Exp Res*. 2017 Feb 2;29(1):43–8.  
35 310 17. Wakabayashi H, Sakuma K. Rehabilitation nutrition for sarcopenia with  
36 311 disability: a combination of both rehabilitation and nutrition care management. *J*  
37 312 *Cachexia Sarcopenia Muscle*. 2014 Dec;5(4):269–77.  
38 313 18. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP.  
39 314 The Strengthening the Reporting of Observational Studies in Epidemiology  
40 315 (STROBE) statement: guidelines for reporting observational studies. *Lancet*.  
41 316 2007 Oct 20;370(9596):1453–7.  
42 317 19. Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, et al.  
43 318 Validation of the Mini Nutritional Assessment short-form (MNA-SF): a practical  
44 319 tool for identification of nutritional status. *J Nutr Health Aging*. 2009  
45 320 Nov;13(9):782–8.  
46 321 20. Camina-Martín MA, de Mateo-Silleras B, Malafarina V, Lopez-Mongil R, Niño-  
47 322 Martín V, López-Trigo JA, et al. Nutritional status assessment in geriatrics:

- 1  
2  
3 323 Consensus declaration by the Spanish society of geriatrics and gerontology  
4 324 nutrition work group. *Maturitas*. 2015 Jul;81(3):414–9.
- 5 325 21. Chumlea WC, Roche AF, Steinbaugh ML. Estimating stature from knee height  
6 326 for persons 60 to 90 years of age. *J Am Geriatr Soc*. 1985 Feb;33(2):116–20.
- 7 327 22. Sánchez-Rodríguez D, Marco E, Miralles R, Fayos M, Mojal S, Alvarado M, et  
8 328 al. Sarcopenia, physical rehabilitation and functional outcomes of patients in a  
9 329 subacute geriatric care unit. *Arch Gerontol Geriatr*. 2014 Jan;59(1):39–43.
- 10 330 23. Schutz Y, Kyle UUG, Pichard C. Fat-free mass index and fat mass index  
11 331 percentiles in Caucasians aged 18–98 y. *Int J Obes Relat Metab Disord*. 2002  
12 332 Jul;26(7):953–60.
- 13 333 24. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al.  
14 334 Sarcopenia: European consensus on definition and diagnosis. *Age Ageing*.  
15 335 2010;39(April):412–23.
- 16 336 25. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al.  
17 337 Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*.  
18 338 2001 Mar;56(3):M146–56.
- 19 339 26. Evans WJ, Morley JE, Argilés J, Bales C, Baracos V, Guttridge D, et al.  
20 340 Cachexia: A new definition. *Clin Nutr*. 2008 Dec;27(6):793–9.
- 21 341 27. Pfeiffer E. A short portable mental status questionnaire for the assessment of  
22 342 organic brain deficit in elderly patients. *J Am Geriatr Soc*. 1975 Oct;23(10):433–  
23 343 41.
- 24 344 28. Muller MJ, Soares M. The ethics of research publication. *Eur J Clin Nutr*. 2017  
25 345 May;71(5):569.
- 26 346 29. Litchford MD. Counteracting the Trajectory of Frailty and Sarcopenia in Older  
27 347 Adults. *Nutr Clin Pract*. 2014 Aug 9;29(4):428–34.
- 28 348 30. Morley JE. Nutritional supplementation and sarcopenia: the evidence grows. *J*  
29 349 *Am Med Dir Assoc*. 2015 Sep 1;16(9):717–9.
- 30 350 31. Landi F, Bernabei R, Russo A, ZuccalÀ G, Onder G, Carosella L, et al. Predictors  
31 351 of Rehabilitation Outcomes in Frail Patients Treated in a Geriatric Hospital. *J Am*  
32 352 *Geriatr Soc*. 2002 Apr;50(4):679–84.
- 33 353 32. Lee L-C, Tsai AC. Mini-Nutritional-Assessment (MNA) without body mass  
34 354 index (BMI) predicts functional disability in elderly Taiwanese. *Arch Gerontol*  
35 355 *Geriatr*. 2012 May;54(3):e405–10.
- 36 356 33. Fougère B, Morley JE. Editorial: Weight Loss is a Major Cause of Frailty. *J Nutr*  
37 357 *Health Aging*. 2017 Nov 22;21(9):933–5.
- 38 358 34. Jensen GL, Cederholm T. Global Leadership Initiative on Malnutrition: Progress  
39 359 Report From ASPEN Clinical Nutrition Week 2017. *JPEN J Parenter Enteral*  
40 360 *Nutr*. 2017 Apr 1;148607117707761.
- 41 361 35. Wirth R, Streicher M, Smoliner C, Kolb C, Hiesmayr M, Thiem U, et al. The  
42 362 impact of weight loss and low BMI on mortality of nursing home residents -  
43 363 Results from the nutritionDay in nursing homes. *Clin Nutr*. 2016 Aug  
44 364 19;35(4):900–6.
- 45 365 36. Cheng FW, Gao X, Jensen GL. Weight Change and All-Cause Mortality in Older  
46 366 Adults: A Meta-Analysis. *J Nutr Gerontol Geriatr*. 2015 Oct 2;34(4):343–68.
- 47 367 37. DiMaria-Ghalili RA. Integrating Nutrition in the Comprehensive Geriatric

- 1  
2  
3 368 Assessment. *Nutr Clin Pract*. 2014 Aug 2;29(4):420–7.  
4 369 38. Russell MK. Functional assessment of nutrition status. *Nutr Clin Pract*. 2015 Apr  
5 370 13;30(2):211–8.  
6 371 39. Wijnhoven HAH, van Zon SKR, Twisk J, Visser M. Attribution of causes of  
7 372 weight loss and weight gain to 3-year mortality in older adults: results from the  
8 373 Longitudinal Aging Study Amsterdam. *J Gerontol A Biol Sci Med Sci*. 2014 Oct  
9 374 1;69(10):1236–43.  
10 375 40. Cederholm T, Jensen GL. To create a consensus on malnutrition diagnostic  
11 376 criteria: A report from the Global Leadership Initiative on Malnutrition (GLIM)  
12 377 meeting at the ESPEN Congress 2016. *Clin Nutr*. 2017 Feb;36(1):7–10.  
13 378 41. Deutz NEP, Bauer JM, Barazzoni R, Biolo G, Boirie Y, Bosy-Westphal A, et  
14 379 al. Protein intake and exercise for optimal muscle function with aging:  
15 380 recommendations from the ESPEN Expert Group. *Clin Nutr*. 2014  
16 381 Dec;33(6):929–36.  
17 382 42. de van der Schueren MAE, Wijnhoven HAH, Kruijzena HM, Visser M. A critical  
18 383 appraisal of nutritional intervention studies in malnourished, community dwelling  
19 384 older persons. *Clin Nutr*. 2016 Oct;35(5):1008–14.  
20 385 43. Cruz-Jentoft AJ, Landi F, Schneider SM, Zúñiga C, Arai H, Boirie Y, et al.  
21 386 Prevalence of and interventions for sarcopenia in ageing adults: a systematic  
22 387 review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS).  
23 388 *Age Ageing*. 2014 Nov;43(6):748–59.  
24 389 44. Gavrilidou NN, Pihlsgård M, Elmståhl S. High degree of BMI misclassification  
25 390 of malnutrition among Swedish elderly population: Age-adjusted height  
26 391 estimation using knee height and demispan. *Eur J Clin Nutr*. 2015  
27 392 May;69(5):565–71.  
28 393 45. Hand RK, Murphy WJ, Field LB, Lee JA, Parrott JS, Ferguson M, et al.  
29 394 Validation of the Academy/A.S.P.E.N. Malnutrition Clinical Characteristics. *J*  
30 395 *Acad Nutr Diet*. 2016 May;116(5):856–64.  
31 396 46. Cederholm T, Jensen GL. To Create a Consensus on Malnutrition Diagnostic  
32 397 Criteria. *JPEN J Parenter Enteral Nutr*. 2017 Mar 17;41(3):311–4.  
33 398 47. White J V., Guenter P, Jensen G, Malone A, Schofield M, Academy Malnutrition  
34 399 Work Group, et al. Consensus Statement: Academy of Nutrition and Dietetics and  
35 400 American Society for Parenteral and Enteral Nutrition: Characteristics  
36 401 Recommended for the Identification and Documentation of Adult Malnutrition  
37 402 (Undernutrition). *J Parenter Enteral Nutr*. 2012 May 1;36(3):275–83.  
38  
39  
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41 403  
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**Highlights**

ESPEN consensus and guidelines were applied in a longitudinal follow-up after being discharged from a postacute geriatric care unit

ESPEN consensus could not identify older patients at risk of readmissions and mortality in older patients discharged from a postacute care unit

Further research with larger samples, multicenter cohorts, and more extended follow-up is required to clarify the clinical value of the ESPEN consensus to predict long-term adverse clinical outcomes.

Further research is needed on the potential prognostic value of the ESPEN consensus guidelines



**Table 1.** Clinical and functional characteristics of the study participants according to malnutrition as defined by the ESPEN consensus (n= 95).

	Total sample (n= 95)	Malnutrition (n= 19)	No malnutrition (n= 76)	P
<b>Intrahospital variables</b>				
Age (years)	84.5 (6.5)	84.3 (5.3)	84.6 (6.8)	0.479
Sex:				
• Male	35 (36.8%)	6 (31.6%)	29 (38.2%)	0.595
• Female	60 (63.2%)	13 (68.4%)	47 (61.8%)	
Body mass index (BMI, Kg/m <sup>2</sup> )	25.5 (4.3)	21.7 (4.3)	26.3 (3.9)	<b>0.005</b>
Fat-free mass index (FFMI, Kg/m <sup>2</sup> )	14.9 (2.9)	12.7 (1.7)	15.4 (2.9)	<b>0.007</b>
Fat-free mass (Kg)	38.4 (10.3)	32.4 (6.6)	39.7 (10.5)	<b>0.069</b>
Unintentional weight loss	<b>31 (32.6%)</b>	<b>14 (73.7%)</b>	<b>17 (22.4%)</b>	<b>&lt;0.001</b>
Charlson comorbidity index	2.4 (1.8)	2.5 (2.2)	2.3 (1.7)	0.466
Short Portable Mental Status Questionnaire	4.2 (3.1)	5.1 (3.4)	4.0 (3.0)	0.265
Instrumental activities of daily living	2.6 (2.6)	2.5 (2.9)	2.6 (2.5)	0.577
Barthel index:				
• Prior	71.4 (21.6)	66.4 (25.3)	72.5 (20.8)	0.359
• At admission	27.0 (15.4)	19.1 (14.8)	28.7 (15.1)	0.057
• At discharge	54.3 (26.2)	38.9 (29.1)	57.7 (24.5)	<b>0.007</b>
Length of stay in postacute care unit (days)	14.9 (5.8)	18.3 (8.1)	14.1 (4.9)	<b>0.009</b>
<b>Postdischarge variables at 3-month follow-up</b>				
Barthel index	48.3 (30.6)	36.5 (27.7)	51.4 (30.7)	<b>0.055</b>
Institutionalization	<b>15 (15.8%)</b>	<b>6 (47.4%)</b>	<b>9 (11.8%)</b>	<b>0.035</b>
Readmissions	<b>19 (20%)</b>	<b>3 (15.8%)</b>	<b>16 (21.1%)</b>	0.608
Mortality postdischarge	<b>13 (13.7%)</b>	<b>3 (15.8%)</b>	<b>10 (13.2%)</b>	0.765

(\*) Data are expressed as numbers and percentages for categorical variables, and as mean and standard deviation (SD) for continuous variables.

**Table 2.** Post-discharge clinical outcomes according to malnutrition and malnutrition-related syndromes at 3-month follow-up (n= 95).

	<b>Malnutrition (ESPEN) (n= 19)</b>	<b>Sarcopenia (EWGSOP) (n= 44)</b>	<b>Frailty (Fried) (n= 94)</b>	<b>Cachexia (Evans) (n= 20)</b>	<b>Total sample (n= 95)</b>
<b>Barthel index</b>	36.5 (27.7)	38.8 (28.2)	48 (30.6)	42.4 (29.0)	48.3 (30.6)
<b>Institutionalization</b>	6 (31.6%)	7 (15.9%)	15 (16.0%)	4 (20%)	15 (15.8%)
<b>Readmissions</b>	3 (15.8%)	8 (18.2%)	19 (20.2%)	3 (15%)	19 (20%)
<b>Mortality</b>	3 (15.8%)	5 (11.4%)	12 (12.8%)	2 (10%)	12 (12.6%)

(\*) Data are expressed as numbers and percentages for categorical variables, and as mean and standard deviation (SD) for continuous variables. **List of abbreviations.** **ESPEN:** European Society of Clinical Nutrition and Metabolism; **EWGSOP:** European Working Group on Sarcopenia in Older People; **BMI:** Body mass index; **SD:** Standard deviation.

**Table 3.** Factors affecting **Barthel index at 3-month follow-up**, according to clinical characteristics, components of **malnutrition as defined by the ESPEN consensus and nutrition-related conditions**.

<b>Barthel index at 3-month follow-up</b>				
	<b>Univariate analysis</b>		<b>Multivariate analysis</b>	
	<b>Median difference (95% CI)</b>	<b>p</b>	<b>Median difference (95% CI)</b>	<b>p</b>
<b>Clinical characteristics</b>				
Age	-2 (-3.50 to -0.50)	0.009	-2.19 (-7.28 to 2.89)	0.393
Sex	15 (-8.47 to 38.47)	0.208	<b>18.05 (-0.41 to 36.51)</b>	<b>0.055</b>
Comorbidity (Charlson >2)	0 (-6.21 to 6.21)	1.00	-2.19 (-7.28 to 2.89)	0.393
Unintentional weight loss	-12 (-34.91 to -10.91)	0.301	-5.29 (-29.28 to 18.69)	0.662
<b>Malnutrition and nutrition-related conditions</b>				
Malnutrition	-20 (-46.65 to 6.65)	0.139	-14.10 (-46.06 to 17.87)	0.383
Sarcopenia	<b>-25 (-43.22 to -6.78)</b>	<b>0.008</b>	<b>-25.49 (-46.66 to -4.32)</b>	<b>0.019</b>
Overweight-obesity	15 (-8.86 to 38.86)	0.215	0.24 (-20.58 to 21.07)	0.981
<b>Nutrient deficiency</b>	0 (-22.18 to 22.18)	1.000	12.93 (-5.31 to 31.17)	0.162
Cachexia	-15 (-41.65 to 11.65)	0.266	11.83 (-18.60 to 42.25)	0.441

**Table 4.** Factors affecting institutionalization at 3-month follow-up, according to clinical characteristics, components of malnutrition as defined by the ESPEN consensus and nutrition-related conditions.

Institutionalization at 3-month follow-up				
	Univariate analysis		Multivariate analysis	
	Odds ratio (95% CI)	p	Odds ratio (95% CI)	p
<b>Clinical characteristics</b>				
Age	1.08 (0.99 to 1.19)	0.083	<b>1.14 (1.01 to 1.28)</b>	<b>0.033</b>
Sex	<b>0.32 (0.10 to 1.0)</b>	<b>0.005</b>	<b>0.18 (0.04 to 0.72)</b>	<b>0.016</b>
Comorbidity (Charlson>2)	0.88 (0.63 to 1.22)	0.443	0.85 (0.58 to 1.25)	0.420
Unintentional weight loss	<b>3.95 (1.26 to 12.41)</b>	<b>0.018</b>	<b>5.46 (0.94 to 31.62)</b>	<b>0.058</b>
<b>Malnutrition and nutrition-related conditions</b>				
Malnutrition	<b>3.44 (1.04 to 11.31)</b>	<b>0.042</b>	3.69 (0.34 to 40.27)	0.285
Sarcopenia	1.02 (0.34 to 3.07)	0.976	1.51 (0.28 to 8.17)	0.629
Overweight-obesity	1.33 (0.42 to 4.27)	0.628	2.53 (0.49 to 13.15)	0.268
<b>Nutrient deficiency</b>	0.9 (0.29 to 2.78)	0.855	0.63 (0.16 to 2.50)	0.511
Cachexia	1.45 (0.41 to 5.17)	0.563	0.58 (0.05 to 6.30)	0.657

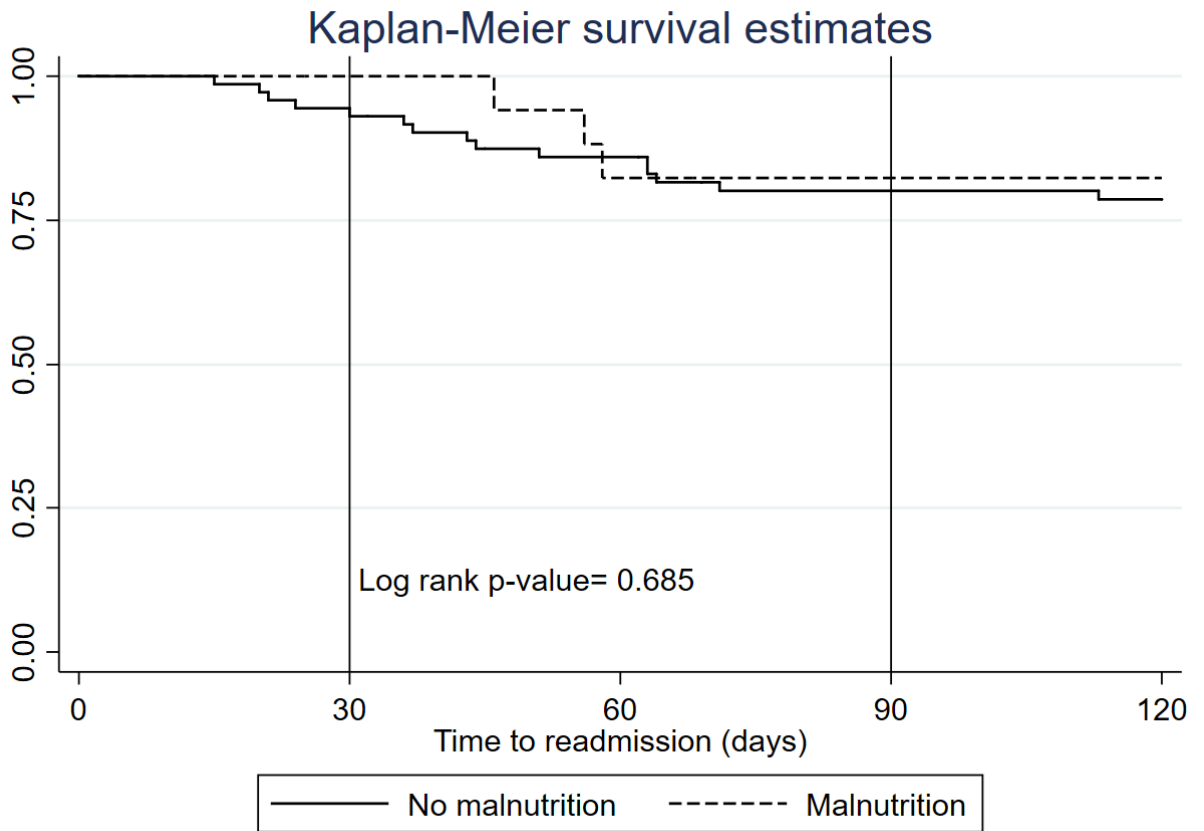
**Table 5.** Factors affecting readmissions at 3-month follow-up, according to clinical characteristics, components of malnutrition as defined by ESPEN consensus and nutrition-related conditions.

Readmissions at 3-month follow-up				
	Univariate analysis		Multivariate analysis	
	Odds ratio (95%CI)	p	Odds ratio (95%CI)	p
<b>Clinical characteristics</b>				
Age	0.93 (0.91 to 1.56)	0.074	0.93 (0.85 to 1.01)	0.095
Sex	1 (0.35 to 2.83)	1	1.09 (0.35 to 3.37)	0.879
Comorbidity (Charlson >2)	1.19 (0.91 to 1.56)	0.211	1.18 (0.88 to 1.59)	0.269
Unintentional weight loss	0.94 (0.32 to 2.77)	0.913	0.82 (0.19 to 3.47)	0.784
<b>Malnutrition and nutrition-related conditions</b>				
Malnutrition	0.70 (0.18 to 2.71)	0.609	0.91 (0.13 to 6.44)	0.929
Sarcopenia	0.81 (0.29 to 2.23)	0.681	1.03 (0.27 to 3.88)	0.964
Overweight-obesity	0.85 (0.30 to 2.36)	0.752	0.59 (0.17 to 2.07)	0.408
Nutrient deficiency	1.41 (0.48 to 4.12)	0.527	1.33 (0.42 to 4.17)	0.623
Cachexia	0.66 (0.17 to 2.50)	0.532	0.52 (0.08 to 3.58)	0.506

**Table 6.** Factors affecting **postdischarge mortality**, according to clinical characteristics, components of **malnutrition as defined by the ESPEN consensus and nutrition-related conditions**.

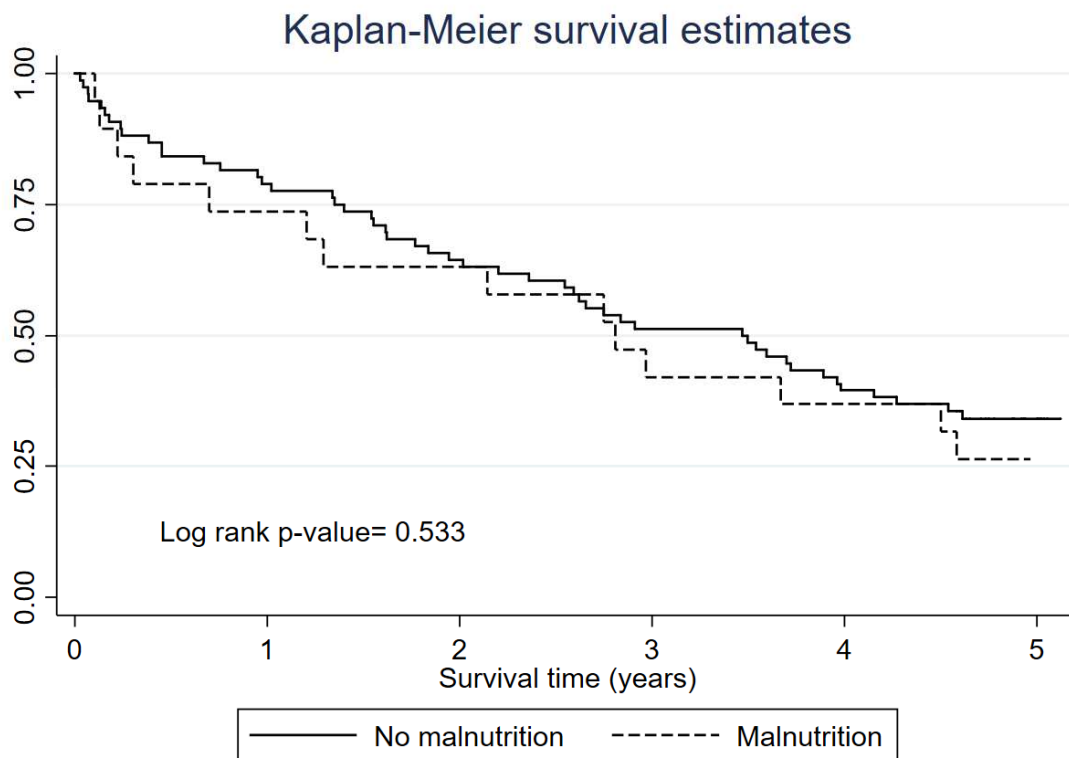
Postdischarge mortality				
	Univariate analysis		Multivariate analysis	
	Odds ratio (95% CI)	p	Odds ratio (95% CI)	p
<b>Clinical characteristics</b>				
Age	<b>1.05 (1.01 to 1.09)</b>	<b>0.005</b>	1.08 (1.03 to 1.13)	<b>0.001</b>
Sex	1.01 (0.61 to 1.69)	0.964	1.10 (0.65 to 1.87)	0.718
Comorbidity (Charlson>2)	1.11 (0.98 to 1.27)	0.105	<b>1.15 (1.0 to 1.33)</b>	<b>0.053</b>
Unintentional weight loss	1.10 (0.616 to 1.85)	0.711	1.20 (0.56 to 2.55)	0.641
<b>Malnutrition and nutrition-related conditions</b>				
Malnutrition	1.21 (0.67 to 2.18)	0.534	1.28 (0.52 to 3.11)	0.589
Sarcopenia	1.03 (0.63 to 1.69)	0.896	0.85 (0.44 to 1.63)	0.625
Overweight-obesity	1.04 (0.62 to 1.72)	0.889	1.09 (0.57 to 2.10)	0.788
<b>Nutrient deficiency</b>	1.07 (0.64 to 1.76)	0.800	1.13 (0.66 to 1.94)	0.654
Cachexia	0.98 (0.53 to 1.80)	0.940	0.88 (0.39 to 2.01)	0.772

Figure 1. Readmissions curves by malnutrition as defined by the ESPEN consensus



Review

Figure 2. Survival curves by **malnutrition as defined by the ESPEN consensus**





**STROBE Statement**—Checklist of items that should be included in reports of *cohort studies*: **Prognostic value of the ESPEN consensus and guidelines for malnutrition: Prediction of post-discharge clinical outcomes in older inpatients**

	Item No	Recommendation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (Title page, Abstract)  Abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found  Abstract
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported  Page 1
Objectives	3	State specific objectives, including any prespecified hypotheses  Page 2
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper  Page 3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection  Page 3
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up  Page 3  (b) For matched studies, give matching criteria and number of exposed and unexposed  Not applicable: this was not a matched study
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable  Pages 3-4: procedure and data collection Pages 4-6: variables and diagnostic criteria Page 4-6: outcome variables Exposures, predictors, potential confounders, and effect modifiers are not applicable to our study.

1 2 3 4 5 6 7	Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group  Pages 5-6: calculation and cut-off points of outcomes measures; data source for all variables
8 9 10 11 12 13 14 15	Bias	9	Describe any efforts to address potential sources of bias  Page 12, efforts to minimize errors and bias
16 17 18 19 20 21	Study size	10	Explain how the study size was arrived at  Prospective cohort study of all inpatients admitted in postacute care during study period
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why  Page 4-6: variables, cut-off points of main outcome variables Table 1, 2
40	Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding  Page 8-9, Statistical Methods paragraph  (b) Describe any methods used to examine subgroups and interactions  Pages 6-7  (c) Explain how missing data were addressed  Pages 13 (patients unable to stand)  (d) If applicable, explain how loss to follow-up was addressed  Not applicable  (e) Describe any sensitivity analyses  Not applicable
41	<b>Results</b>		
42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60	Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed  Page 8, Table 1 and 2  (b) Give reasons for non-participation at each stage  Not applicable  (c) Consider use of a flow diagram  Not applicable
	Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders  Page 8 and Tables 1 and 2  <a href="http://mc.manuscriptcentral.com/ncp">http://mc.manuscriptcentral.com/ncp</a>

		(b) Indicate number of participants with missing data for each variable of interest
		Page 8 and Tables 1 and 2
		(c) Summarise follow-up time (eg, average and total amount)
		Page 3
Outcome data	15*	Report numbers of outcome events or summary measures over time
		Page 8 and Tables 1 and 2
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		Page 8 and Tables 1 to 6, includes 95% confidence interval
		(b) Report category boundaries when continuous variables were categorized
		Pages 8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
		Not applicable
Other analyses	17	Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses
		Page 8, Tables 3 to 6
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives
		Pages 10 (discussion of results) and 13 (Conclusion)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
		Page 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
		Pages 12-13.
Generalisability	21	Discuss the generalisability (external validity) of the study results
		Page 12-13
<b>Other information</b>		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
		Page 15: No internal or external funding was received to support this research.

\*Give information separately for exposed and unexposed groups.

1 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and  
2 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely  
3 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at  
4 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is  
5 available at <http://www.strobe-statement.org>.  
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