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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>Introduction: 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>Methods: A cohort of 102 consecutive deconditioned patients was assessed at three months postdischarge from postacute care. Inclusion criteria were age ≥ 70 years, scores of Mini-Mental Status Examination $\geq 21/30$, 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>Results: Of 95 included patients (84.5\pm6.5 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, $p=0.008$). Institutionalization was related to unintentional weight loss in univariate analysis (OR= 3.9; 95%CI 1.3 to 12.4, $p=0.018$). Meeting the basic ESPEN definition of malnutrition was related to institutionalization in univariate (OR=3.4; 95% CI 1.0 to 11.3, $p=0.042$) but not multivariate analysis, and was not significantly associated with readmissions or mortality at 3-month follow-up.</p> <p>Conclusions: 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
4
5 24 nutrition-related conditions diagnosed during hospitalization using the ESPEN
6
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 ≥ 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 ≤ 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/m² (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/m² in <70 years, or
8
9 52 <22 kg/m² in ≥70 years) or fat-free mass index (<17 kg/m² in men and 15 kg/m² 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/m²): 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/m² 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
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
6
7 74 World Health Organization recommendations: BMI 25-30 kg/m² and ≥ 30 kg/m²,
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,
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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**

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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
47
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**

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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
28
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
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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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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
20
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,
27
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
28
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,
34
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
29
30 232 ASPEN/AND criteria; however, this is a complex tool using subjective assessment
31
32 233 skills rather than objective body composition measures (45). Conversely, the ESPEN
33
34 234 consensus definition is based on objective anthropometric measurements (BMI and
35
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
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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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13 253 **Conflict of interest**
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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
4
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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3 28 **METHODS**
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6 29 **Design**
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8 Cohort study of postacute inpatients who participated in a larger prospective study on
9
10 malnutrition and sarcopenia (14). The Strengthening the Reporting of Observational
11
12 Studies in Epidemiology (STROBE) Statement (18) was followed (Additional file 1).
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15 33 **Setting**
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17 The study was conducted in a postacute geriatric rehabilitation care unit in a university
18
19 hospital. The unit focuses specifically on a 2-week period of rehabilitation and
20
21 functional recovery, after which patients are expected to be discharged home.
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25 37 **Participants**
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27 Consecutive patients aged ≥ 70 years hospitalized in the postacute geriatric rehabilitation
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29 care unit due to functional loss resulting from a non-disabling medical disease were
30
31 included from January to August 2011. Patients with general and/or cognitive conditions
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33 (Mini-Mental State Examination score $< 21/30$) that prevented completion of the
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35 diagnostic tests or absence of information regarding weight loss in the previous year
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37 were excluded.
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41 44 **Procedure**
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43 All inpatients were screened for risk of malnutrition at admission by the Mini-
44
45 Nutritional Assessment Short-Form (MNA-SF) (19)(20). The diagnosis of malnutrition
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47 as defined by the ESPEN consensus was then retrospectively applied in all patients
48
49 identified as at risk of malnutrition (MNA-SF scores ≤ 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/m² (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/m² in <70 years, or
8
9 52 <22 kg/m² in ≥70 years) or fat-free mass index (<17 kg/m² in men and 15 kg/m² 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/m²): 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
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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-**
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27 61 **free mass index** (FFMI), expressed in kg/m² 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
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
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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
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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/m² and ≥ 30 kg/m²,
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
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
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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
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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,
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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**

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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
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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
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18 101 participants and the study was approved by the local Clinical Ethics Committee.
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21 102 **Statistical analysis**

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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
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31 107 ESPEN consensus. Qualitative variables were compared by Chi-square or Fisher exact
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33 108 test, as appropriate and quantitative variables by Student *t* test. As histograms and Q-Q
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35 109 plot showed that Barthel Index at 3 months was not normally distributed, median
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37 110 regression was applied to check median differences (MD) with 95% confidence interval
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39 111 (CI). The analysis of factors associated with institutionalization was performed using
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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
13
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
19
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
23
24 131 nutrition-related conditions are described in **Table 2**.

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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-
33
34 135 month follow-up, both in univariate analysis (median difference [MD]= -25; 95% CI: -
35
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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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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20
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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20
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
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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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For Peer Review

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15
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29 259 **REFERENCES**
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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
Intrahospital variables				
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 ²)	25.5 (4.3)	21.7 (4.3)	26.3 (3.9)	0.005
Fat-free mass index (FFMI, Kg/m ²)	14.9 (2.9)	12.7 (1.7)	15.4 (2.9)	0.007
Fat-free mass (Kg)	38.4 (10.3)	32.4 (6.6)	39.7 (10.5)	0.069
Unintentional weight loss	31 (32.6%)	14 (73.7%)	17 (22.4%)	<0.001
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)	0.007
Length of stay in postacute care unit (days)	14.9 (5.8)	18.3 (8.1)	14.1 (4.9)	0.009
Postdischarge variables at 3-month follow-up				
Barthel index	48.3 (30.6)	36.5 (27.7)	51.4 (30.7)	0.055
Institutionalization	15 (15.8%)	6 (47.4%)	9 (11.8%)	0.035
Readmissions	19 (20%)	3 (15.8%)	16 (21.1%)	0.608
Mortality postdischarge	13 (13.7%)	3 (15.8%)	10 (13.2%)	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).

	Malnutrition (ESPEN) (n= 19)	Sarcopenia (EWGSOP) (n= 44)	Frailty (Fried) (n= 94)	Cachexia (Evans) (n= 20)	Total sample (n= 95)
Barthel index	36.5 (27.7)	38.8 (28.2)	48 (30.6)	42.4 (29.0)	48.3 (30.6)
Institutionalization	6 (31.6%)	7 (15.9%)	15 (16.0%)	4 (20%)	15 (15.8%)
Readmissions	3 (15.8%)	8 (18.2%)	19 (20.2%)	3 (15%)	19 (20%)
Mortality	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**.

Barthel index at 3-month follow-up				
	Univariate analysis		Multivariate analysis	
	Median difference (95% CI)	p	Median difference (95% CI)	p
Clinical characteristics				
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	18.05 (-0.41 to 36.51)	0.055
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
Malnutrition and nutrition-related conditions				
Malnutrition	-20 (-46.65 to 6.65)	0.139	-14.10 (-46.06 to 17.87)	0.383
Sarcopenia	-25 (-43.22 to -6.78)	0.008	-25.49 (-46.66 to -4.32)	0.019
Overweight-obesity	15 (-8.86 to 38.86)	0.215	0.24 (-20.58 to 21.07)	0.981
Nutrient deficiency	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
Clinical characteristics				
Age	1.08 (0.99 to 1.19)	0.083	1.14 (1.01 to 1.28)	0.033
Sex	0.32 (0.10 to 1.0)	0.005	0.18 (0.04 to 0.72)	0.016
Comorbidity (Charlson>2)	0.88 (0.63 to 1.22)	0.443	0.85 (0.58 to 1.25)	0.420
Unintentional weight loss	3.95 (1.26 to 12.41)	0.018	5.46 (0.94 to 31.62)	0.058
Malnutrition and nutrition-related conditions				
Malnutrition	3.44 (1.04 to 11.31)	0.042	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
Nutrient deficiency	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

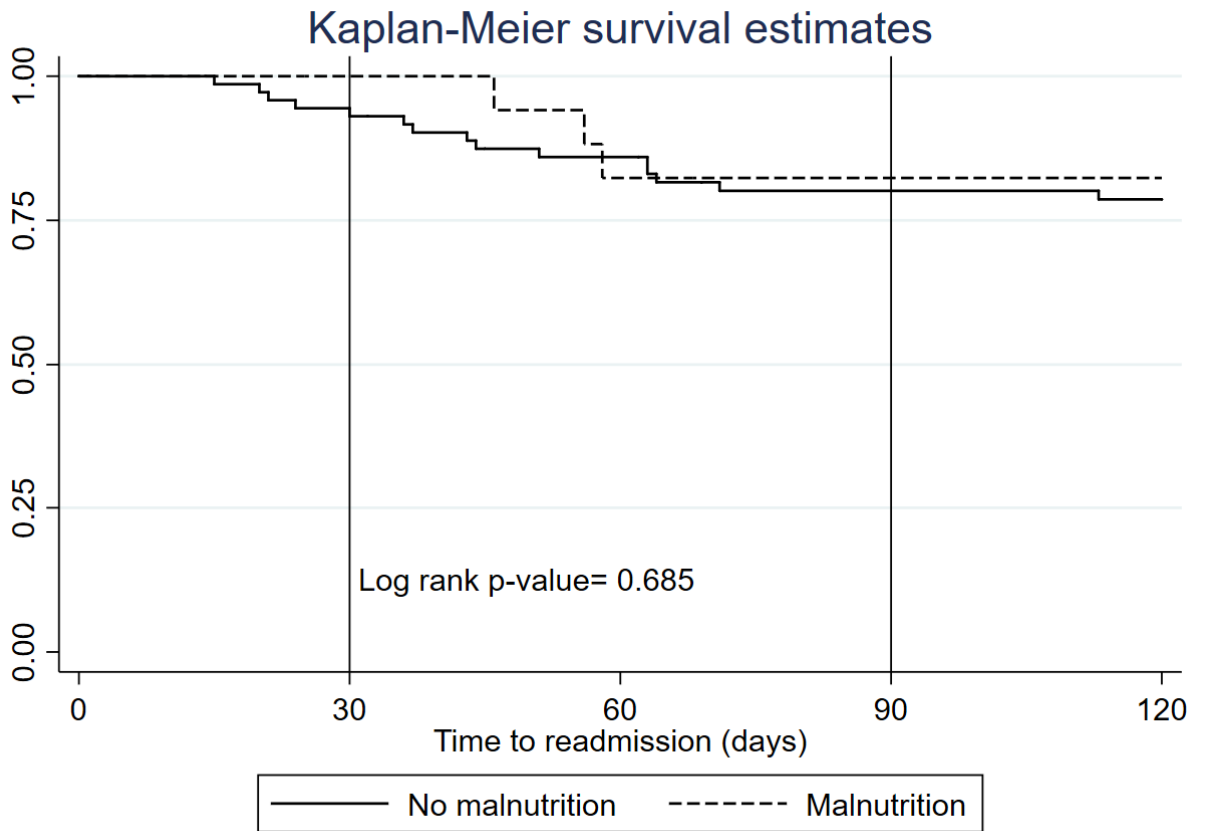
Table 5. Factors affecting readmissions at 3-month follow-up, according to clinical characteristics, components of malnutrition as defined by ESPEN consensus and nutrition-related conditions.

Readmissions at 3-month follow-up				
	Univariate analysis		Multivariate analysis	
	Odds ratio (95%CI)	p	Odds ratio (95%CI)	p
Clinical characteristics				
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
Malnutrition and nutrition-related conditions				
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**.

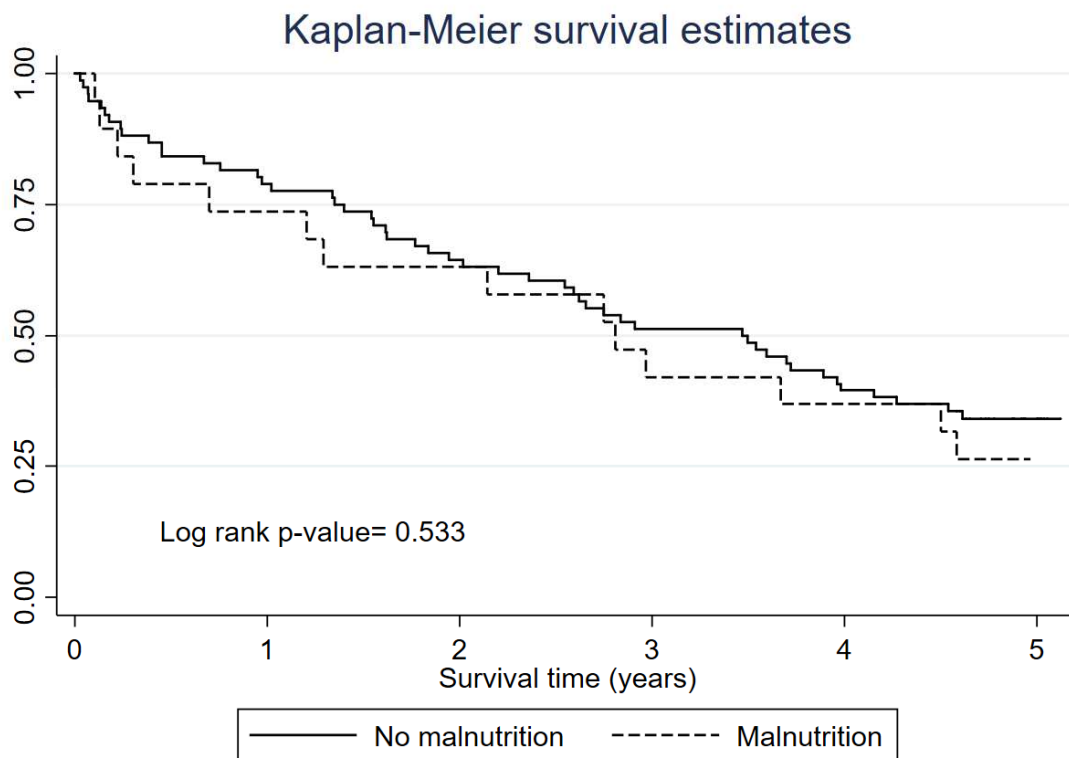
Postdischarge mortality				
	Univariate analysis		Multivariate analysis	
	Odds ratio (95% CI)	p	Odds ratio (95% CI)	p
Clinical characteristics				
Age	1.05 (1.01 to 1.09)	0.005	1.08 (1.03 to 1.13)	0.001
Sex	1.01 (0.61 to 1.69)	0.964	1.10 (0.65 to 1.87)	0.718
Comorbidity (Charlson>2)	1.11 (0.98 to 1.27)	0.105	1.15 (1.0 to 1.33)	0.053
Unintentional weight loss	1.10 (0.616 to 1.85)	0.711	1.20 (0.56 to 2.55)	0.641
Malnutrition and nutrition-related conditions				
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
Nutrient deficiency	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
Title and abstract	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
Introduction		
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
Methods		
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	Bias	9	Describe any efforts to address potential sources of bias Page 12, efforts to minimize errors and bias
13 14 15	Study size	10	Explain how the study size was arrived at Prospective cohort study of all inpatients admitted in postacute care during study period
16 17 18 19 20 21	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
22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	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
40	Results		
41 42 43 44 45 46 47 48 49 50 51 52 53	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
54 55 56 57 58 59 60	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 http://mc.manuscriptcentral.com/ncp

		(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
Discussion		
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
Other information		
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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