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Trabajo Original

Nutrición en el anciano

Disability and its influence in nutritional assessment tools in elderly people living in nursing homes

Discapacidad y su influencia en las herramientas de valoración nutricional en ancianos institucionalizados en residencias geriátricas

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Abstract

Introduction: Poor nutritional status is associated with increased morbidity and mortality, especially in older people.

Objective: The aim of this study was to assess nutritional status in elderly nursing home residents with different nutritional test, and to determine which parameters used for nutritional assessment can be carried out in this population, which usually have a high prevalence of functionally dependent residents.

Methods: A cross-sectional study was performed in 383 elderly. The nutritional assessment tools used were the Mini Nutritional Assessment (MNA), the new ESPEN consensus definition of malnutrition, and the tool for Controlling Nutritional Status (CONUT). Moreover, the ability to perform basic activities of daily living was assessed with the Barthel index (BI).

Results: According to BI, 78.9% had a total dependence and only 20.9% could be weighed and heighed. The prevalence of malnutrition with MNA, ESPEN and CONUT was 21.3%, 17.6% and 20.7%, respectively. The agreement between MNA *vs* ESPEN criteria was moderate (κ = 0.483), but with CONUT was low.

Conclusions: Nursing homes had a high percentage of totally dependent residents. This high degree of functional dependence made difficult to obtain some anthropometric parameters such as weight and height, which are essential to carry out most nutritional tests. MNA, CONUT and the new ESPEN criteria of malnutrition showed a high prevalence of malnutrition and risk of malnutrition in subjects in which they could be performed.

Key words:

Elderly. Nursing homes. Nutritional assessment. Disability.

Resumen

Introducción: un estado nutricional deficiente está asociado con un incremento de la morbilidad y la mortalidad, especialmente en personas ancianas.

Objetivo: el objetivo de este estudio fue evaluar el estado nutricional en ancianos institucionalizados en residencias geriátricas mediante diferentes test nutricionales, y determinar qué parámetros utilizados en la valoración nutricional pueden ser realizados en esta población.

Métodos: se llevó a cabo un estudio transversal en 383 ancianos. Las herramientas de valoración nutricional empleadas fueron el Mini Nutritional Assessment (MNA), el nuevo consenso de definición de malnutrición, y el CONUT. Además, la capacidad de realizar las actividades básicas de la vida diaria fue evaluada con el índice de Barthel.

Resultados: según el índice de Barthel, hasta un 78,9% de los residentes tenía una dependencia total, y en solo el 20,9% se pudo determinar el peso y la talla. La prevalencia de malnutrición con MNA, el consenso de ESPEN y CONUT fueron 21,3%, 17,2% y 20,7%, respectivamente. La concordancia (kappa) entre el MNA y el ESPEN fue moderada (κ = 0,483), pero con CONUT fue baja.

Conclusiones: en las residencias geriátricas públicas existe un elevado porcentaje de ancianos totalmente dependientes. Este alto grado de dependencia funcional dificulta la obtención de algunos parámetros antropométricos como el peso y la talla, que son esenciales para llevar a cabo la mayoría de los test de valoración nutricional. El MNA, el CONUT y los nuevos criterios de desnutrición de la ESPEN mostraron una elevada prevalencia de desnutrición y de riesgo de desnutrición en esta población de ancianos institucionalizados, en aquellos en los que fue posible realizarlos.

Palabras clave:

Ancianos. Residencias geriátricas. Valoración nutricional. Discapacidad.

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INTRODUCTION

The increase in age of the elderly population in developed countries has resulted in a higher number of older people who need help and social support. In this context, nursing home residents regularly show low functionality. It is well known that a high risk of malnutrition is associated with worsening functionality and quality of life. This impaired functional ability may be the cause or the consequence of the nutritional status of institutionalised elderly (1). Early identification of nursing home residents at nutritional risk, followed by adequate nutritional intervention, is expected to contribute to maintenance of independency and quality of life.

The European Society for Clinical Nutrition and Metabolism (ESPEN) has recommended three different screening tools for nutritional assessment in different settings (2), of which the Mini Nutritional Assessment (MNA) test seems to be suited for nursing homes residents (3). In fact, this is the most widely used test in studies of prevalence of malnutrition in nursing homes (Table I), being able to detect risk of malnutrition at an early stage. Guigoz found 5% to 71% of malnutrition among 6,821 elderly persons after a review of 32 studies using MNA, and reported that malnutrition risk was high in nursing homes (4).

In countries like Spain, due to the Mediterranean lifestyle, relatives usually attend older people until the degree of disability is so severe that professional care is required. In addition to that, the nursing homes in which we have carried out the present study are from public grants, in which only patients with more severe functional impairment are admitted; private nursing homes are reserved for those elderly people with less dependence and greater purchasing power (5).

On the other hand, weight and height are basic anthropometric parameters included in the majority of nutritional assessment tests, such as the MNA (6), Malnutrition Universal Screening Tool (MUST), Nutritional Risk Screening 2002 (NRS), Short Nutritional Assessment Questionnaire, Nutritional Form for the Elderly, and Malnutrition Advisory Group. However, in elderly with total or severe disability, weight and height can be difficult to measure because they are unable to stand, therefore it is necessary to use specific formulas to calculate their weight and height, even though those formulas are not validated in all populations.

The aim of this study was to assess the nutritional status in elderly nursing home residents with different nutritional tests and to determine which parameters used for nutritional assessment can be carried out in this population with a high prevalence of totally dependent residents.

METHODS

SUBJECT RECRUITMENT

A cross-sectional study with 383 individuals of both sexes was carried out in three public nursing homes in May 2015 in the urban area of Zaragoza (Spain).

The inclusion criteria comprised people older than 60 years old living in a nursing home at least for six months and who had signed a written informed consent about participating in the study (by participants or their legally authorised representatives). Exclusion criteria were age under 60 years (n = 2), acute infection (n = 9), terminal illness (n = 6), active malignancy (n = 4), hospitalisation in the previous three months (n = 5), or lack of signed informed consent (n = 3). Demographic characteristics included gender, birth date, length of stay in the nursing home and type of diet.

A complete nutritional assessment was undertaken, including anthropometric measurements, bioelectrical impedance analysis, biological markers (levels of albumin, cholesterol and lymphocytes), nutritional screening tools and the ability to perform basic activities of daily living.

ANTHROPOMETRIC MEASURES

Weight was measured in light clothes, with a floor scale. Standing height, waist circumference standing and in prone position and calf circumference were measured with a plastic tape measure. Mid-arm circumference was measured at the midpoint of the relaxed, non-dominant arm between the tip of the acromion and the olecranon process. Triceps skinfold was measured using skinfold callipers (Holtain®) at half way between the olecranon process of the ulna and the acromion process of the scapula. Body mass index (BMI) was calculated as weight (kg)/height^2 (m). Arm muscle circumference (AMC) was calculated with this formula: AMC (cm) = mid arm circumference (cm) - 31,416 × triceps skinfold (mm) (29).

BODY COMPOSITION

Bioelectrical resistance (ohms) was obtained using a Bio-Resistance Body Composition Analyzer (Akern® BIA Device 101, Florence, Italy) with an operating frequency of 50 kHz at 800 μA. The subjects were in supine position with their arms abducted away from the trunk and the legs slightly separated for five minutes. Four electrodes were attached to the right hand and ankle. According to the strong relationship between measured resistance, fat-free mass (FFM), and total body water, prediction equations were developed to estimate percentage of body fat and FFM, which could be directly displayed after BIA measurement. The FFM index (FFMI) was calculated as FFM divided by body height squared (kg/m^2) (30,31).

NUTRITIONAL STATUS

For the assessment of nutritional status in this elderly population, we were using three nutritional tools: MNA, the new ESPEN consensus definition of malnutrition, and Controlling Nutritional Status (CONUT).

Table I. Nutritional status according to MNA in nursing homes residents

Author	Year	Country	n	Mean age	% females	% malnutrition	% risk of malnutrition	Degree of dependence (%)
Ruiz-López (7)	2003	Spain	89	85 (6)	100%	7.9%	61.8%	Not referred
Rodríguez (8)	2005	Venezuela	126	77.2 (9)	55.6%	5.6%	46%	Not referred
Suominem (9)	2005	Finland	2114	82 (8.5)	80.7%	29%	60%	Yes (not specified)
Wojszel (10)	2006	Poland	100	79.1 (7.7)	71%	12%	61%	Yes (44%)
González-Hernández (11)	2007	Cuba	106	Not defined	21.7%	50%	45.3%	Not referred
Kulnik (12)	2008	Austria	245	86 (7)	Not defined	37.4%	48.3%	Yes (64.1%)
Santomauro (13)	2011	Italy	463	83.8 (8)	77%	22.5%	58-3%	Yes (not specified)
Vikstedt (14)	2011	Finland	375	83	82%	21%	65%	Yes (86%)
Volkert (15)	2011	Germany	350	84.8 (8)	80.8%	26.7%	52.9%	Yes (58.2%)
De Luis (16)	2011	Spain	493	83.3 (8.5)	65.3%	22.5%	49.6%	Not referred
Camina Martín (17)	2012	Spain	83	81.2 (8.9)	65.1%	41%	56.6%	Not referred
Serrano-Urrea (18)	2013	Spain	895	82.3 (7.1)	58.4%	2.8%	37.3%	Not referred
Diekmann (3)	2013	Germany	200	85.5 (7.8)	73.5%	15.4%	57.4%	Not referred
Rabousková (19)	2013	Czech Republic	815	83.8 (7.1)	80.9%	10.2%	39.4%	Not referred
Verbrugghe (20)	2013	Belgium	1,188	84.3 (7.7)	75.9%	19.4%	38.7%	Not referred
Donini (21)	2013	Italy	100	80.2 (10)	71%	36%	46%	Yes (77%)
Serrano Urrea (22)	2014	Spain	895	82.3 (7.1)	58.4%	2.8%	37.3%	Yes (57.1%)
Nazemi (23)	2015	Iran	263	75.9 (8.5)	54.8%	10.3%	68.82%	Not referred
Sena Pereira (24)	2015	Brazil	359	74.3 (8.7)	72.7%	66.3% malnourished and at risk		Yes (91.3%)
Díaz Muñoz (25)	2015	Colombia	108	80.4 (7.7)	62%	2.8%	33.3%	Not referred
Borgström Bolmsjö (26)	2015	Sweden	318	85	69.8%	17.7%	40.3%	Not referred
Ongan (27)	2015	Turkey	554	76.1 (7.3)	35.4%	6.7%	49.1%	Not referred
Sahin (28)	2015	Turkey	257	78.5 (7.8)	61.9%	8.2%	35.8%	Not referred

The MNA test includes 18 items in four sections: anthropometric assessment (four questions concerning weight, height and body circumferences), global evaluation (six questions concerning life-style, medication and mobility), dietetic assessment (six questions concerning number of meals, food and fluid intakes and autonomy of feeding) and subjective assessment (two questions concerning self-perceptions of health and nutrition). The score obtained (maximum, 30) classifies the elderly in three categories: malnourished (< 17), at risk of malnutrition (17-23.5), and well nourished (> 24). We evaluated the MNA of all those patients who, with the patient's collaboration, were able to complete the form. The reasons why the MNA could not be performed were the patient's inability to answer the questionnaire questions (for neurocognitive or neuropsychological reasons), or the inability for anthropometric assessment.

On the other hand, ESPEN has recently proposed a new consensus definition of malnutrition, for which diagnosis is considered as a two-step process. Before diagnosis, it is mandatory to fulfil criteria for being "at risk" of malnutrition by any validated risk screening tool. We used MNA-Short Form (32). Those who are identified as being at risk proceed in the diagnostic process that includes two options: the first option requires a BMI < 18.5 kg/m^2, following the recommendation by the World Health Organization (33); and the second option encompasses unintentional weight loss (> 10% independent of time or > 5% in the last three months), always combined with either a low BMI < 20 kg/m^2 if < 70 years old or < 22 kg/m^2 if ≥ 70 years old, or a low FFMI < 15 kg/m^2 for women and < 17 kg/m^2 for men (34).

Finally, the CONUT is based on three biochemical parameters: albumin, cholesterol and lymphocytes. Every level of its concentration in plasma gives a score with the total up to 12. According to the total score, three groups are distinguished: normal nutritional status (0-1 points), light undernutrition (2-4 points), moderate undernutrition (5-8 points) and severe undernutrition (> 8 points) (35). CONUT could be performed in those patients who had an analysis including levels of albumin, lymphocytes and colesterol, performed in the previous three months and in the context of a routine blood analysis, excluding those carried out in hospitalizations or in patients with an infection or with an acute pathology.

FUNCTIONAL ABILITY

The ability to perform basic activities of daily living was assessed with the Barthel index. It classifies individuals according to different levels of functional dependence and consists of different items, all daily life activities such as the ability to dress, wash, eat, etc., in order to determine the dependence of the subject. According to the final total score, five groups are established: total dependence (< 20 points), severe dependence (20-45), moderate dependence (45-60), mild dependence (> 65) and independence (100) (36).

STATISTICAL ANALYSIS

Data were analysed with the Statistical Package for Social Science (SPSS), version 20.0 (SPSS Inc., Chicago, IL).

The results are expressed as mean ± standard deviation (SD) and as percentages of individuals. The Chi-squared test was used to detect differences between categorical variables, and the normal distribution of continuous variables was tested by the Kolmogorov-Smirnov test. Differences in continuous variables between subgroups were analysed by the Student's t test or analysis of variance if normally distributed. Otherwise, Mann-Whitney U and Kruskal-Wallis tests were used. The value of Pearson's linear correlation coefficient (r) was used to determine the relationship between BMI and some anthropometric parameters. Cohen's kappa (κ) statistic was calculated to determine diagnostic agreement between the assessment tools (MNA, CONUT and ESPEN criteria). κ is a statistical measure of inter-annotator agreement for qualitative variables. In case of complete agreement between the variables, then $\kappa = 1$. If there is no complete agreement, then $\kappa \leq 1$. For all tests, p values below 0.05 were considered as statistically significant.

ETHICAL ASPECTS

For this study, the authorisation of the three nursing homes was previously required through their respective directors and senior administrators, and elderly participation in the study was voluntary, by previous signature of an informed consent. The Ethics Committee for Clinical Research of Aragón (Spain) approved the study protocol (CI. PI15/0237).

RESULTS

A total of 383 subjects (93%) out of the 412 total older people living in the three public nursing homes met inclusion criteria and participated in the study. The distribution of elderly people in each nursing home (NH) was NH1: 149 (38.9%), NH2: 132 residents (34.5%) and NH3: 102 residents (26.6%).

Subjects had a mean age of 84.9 (SD 7.6) years old, being 70.2% (n = 269) females and 29.8% (n = 114) males. They had been living in institutions for 44.7 months. A total of 20.4% of the participants had diabetes mellitus, and dementia was documented in 57.4% of the population studied.

DIFFERENCES BETWEEN GENDERS

The mean age among the female participants was 86.1 (SD 7.2) years old, higher than in males, which was 82.4 ($p < 0.01$). There were statistically significant differences between genders in the variables age, BMI and triceps skinfold (higher in women), while weight, height, AMC, waist circumference and calf circumference were higher in men.

Mean BMI was 26.8 kg/m^2 (overweight according to the classification of the World Health Organization). Only 6.25% had BMI < 18.5 kg/m^2. Due to the high degree of dependence of most residents, all the anthropometric parameters could not be obtained in the whole of the population studied. Only 20.9% (n = 80) of the elderly could be weighed and sized because the rest of residents were unable to stand (Table II).

A good correlation was observed according to Pearson's correlation coefficient between BMI and waist circumference in prone position ($r = 0.814$, $p < 0.0001$), and between BMI and calf circumference ($r = 0.702$, $p < 0.0001$), while between BMI and arm circumference the correlation was moderate ($r = 0.687$, $p < 0.0001$).

FUNCTIONAL ABILITY

The Barthel index classified subjects as follows: 78.9% were totally dependent (no one severely dependent), 6.3% were moderately dependent, 2.6% presented mild dependence and only 12.4% were completely independent subjects (Table III). There were not significant differences between sexes ($p > 0.05$).

Table III shows that the percentage of residents with total dependence is quite similar in the three nursing homes, but in the third we have 20% of independent elderly. In this third nursing home there is a lower rate of malnutrition with the three nutritional assessment tools (MNA, CONUT and ESPEN) ($p < 0.05$). Moreover,

Table II. Anthropometric and demographic characteristics of this population

	Total	Males	Females	p	n
Age (years)	84.9 (7.6)	82.4 (7.8)	86.1 (7.2)	0.0001	383
Weight (kg)	62.1 (12.6)	67.8 (12.1)	59.7 (13.2)	0.0001	80
Height (m)	154.1 (7.5)	162.6 (6.5)	148.3 (4,9)	< 0.001	80
BMI (kg/m^2)	26.8 (4.6)	25.8 (3.4)	27.3 (5.2)	0.031	80
Time living in the nursing home (months)	44.7 (15.2)	42.5 (14.6)	46.1 (15.7)	0.241	383
Mid arm circumference (cm)	25.2 (3.8)	25.5 (3.4)	25.1 (4)	0.381	383
Arm muscle circumference (cm)	21.3 (3.5)	22.6 (3.3)	20.1 (3.6)	0.011	383
Triceps skinfold (mm)	15.8 (3.1)	12.1 (4.1)	16.3 (6.3)	0.0001	383
Waist circumference standing (cm)	95.1 (13.6)	98 (11.3)	93.5 (14.5)	0.001	80
Waist circumference in prone position (cm)	91.7 (4.6)	94.3 (12,5)	91.1 (16.5)	0.041	383
Calf circumference (cm)	30.1 (4.7)	31.3 (4.2)	29.2 (4.4)	0.001	383

The results are expressed as mean (standard deviation, SD). kg: Kilograms; m: Metres; cm: Centimetres; mm: Millimetres.

Table III. Ability to perform basic activities of daily living assessed with the Barthel index, applicability of each nutritional assessment tool in the three nursing homes and distribution into result categories

Barthel	Nursing home 1	Nursing home 2	Nursing home 3
Total dependence	80.5%	80%	75.5%
Severe dependence	0%	0%	0%
Moderate dependence	5.8%	8.1%	4.1%
Mild dependence	5.2%	1.5%	0%
Independence	8.5%	10.4%	20.4%
% residents without weight and height	82.6%	78.8%	72.6%
% malnutrition according to MNA	17.2%	16.7%	9.5%
% of participants that filled out MNA test	38.2%	27.3%	41.2%
% moderate-severe malnutrition according to CONUT	21.4%	17.9%	11.1%
% of participants with CONUT	47%	29.5%	35.2%
% malnutrition according to ESPEN	20.7%	19.4%	11.9%
% of participants with ESPEN criteria	38.2%	27.3%	41.2%

MNA and ESPEN criteria could be carried out in a higher percentage of participants of this nursing home.

NUTRITIONAL ASSESSMENT

Regarding nutritional status according to MNA (n = 136), 21.3% of the elderly who could be interviewed were malnourished (MNA < 17 points), and 55.9% were at risk of malnutrition. The prevalence of malnutrition and risk of malnutrition were significantly more prevalent in women (23.9% and 59.7%, respectively) than in men (15.9% and 47.7%, respectively) ($p < 0.05$).

The CONUT was carried out in 145 of the subjects (37.9%). A total of 67.6% (n = 98) had a normal nutritional status, 11.7% (n = 17) had mild malnutrition and 20.7% (n = 30) had moderate malnutrition. There were no cases of severe malnutrition, and no statistically significant differences between females and males were found ($p = 0.9$).

In the nutritional assessment according to the new ESPEN definition of malnutrition (n = 80), of the 72.5% of people with risk of malnutrition identified with the MNA-Short Form, 17.5% were malnourished.

Of this population, only 6.25% had a BMI < 18.5 as a criterion of malnutrition, and the unintentional weight loss was the most frequent criterion (Table IV).

The agreement between MNA and ESPEN criteria was moderate ($\kappa = 0.483$, confidence interval 95%: 0.205-0.657, $p = 0.003$). Only 60 of the 145 participants that had blood tests had also other nutritional assessment tools (MNA and ESPEN). The agreement between CONUT *vs* MNA criteria and CONUT *vs* ESPEN criteria was low ($\kappa = 0.19$, confidence interval 95%: 0.026-0.38, $p = 0.046$; and κ: 0.23, confidence interval 95%: 0.096-0.42, $p = 0.037$, respectively).

Figure 1 shows a summary of the applicability of the different nutritional assessment tools in this population.

Table IV. Prevalence rates of malnutrition according to the new ESPEN consensus definition and to its individual diagnostic criteria (n = 80)

Screened at risk of malnutrition according to MNA-SF test	72.5%
Malnourished according to ESPEN definition (%)	17.5%
BMI < 18.5 kg/m^2	6.25%
Unintentional weight loss (WL) > 10% indefinite of time or 5% over the last 3 months	18.75%
BMI < 20 kg/m^2 if < 70 years of age, or < 22 kg/m^2 if > 70 years of age	11.25%
FFMI < 15 and 17 kg/m^2 in females and males, respectively	15%
– Unintentional WL + low BMI according to ESPEN definition	7.5%
– Unintentional WL + low FFMI according to ESPEN definition	5%

Data are presented as %. MNA: Mini Nutritional Assessment; BMI: Body mass index; FFMI: Fat free mass index; WL: Weight loss.

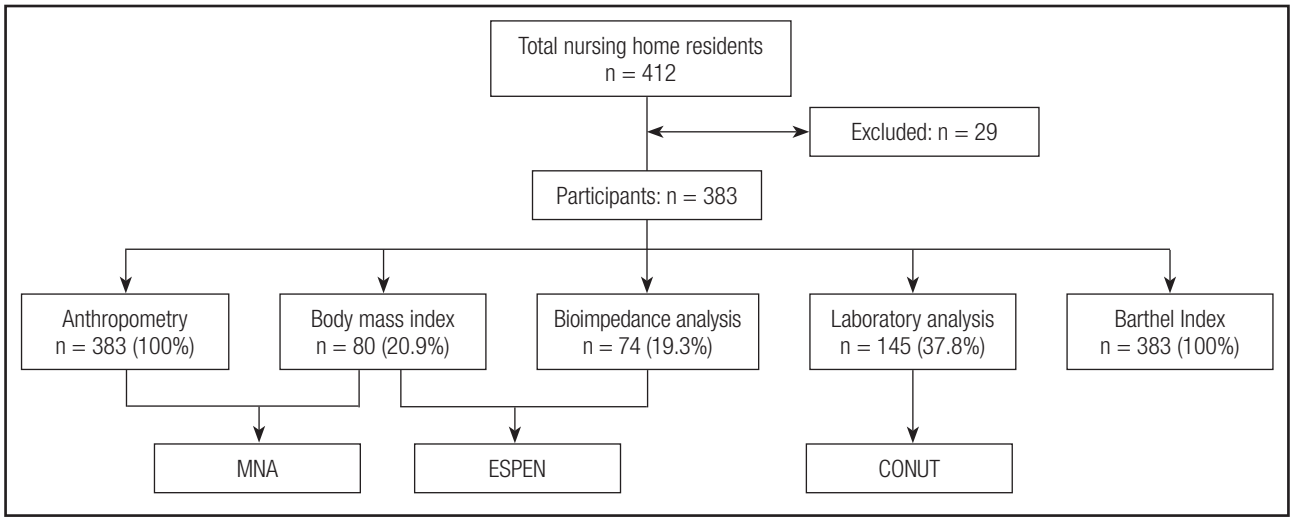

Figure 1.

Applicability of the different nutritional assessment tools in this population. Of the total 412 residents, 383 were included in the study. In the figure, the total number and the percentage of residents who could be assessed with the different nutritional assessment test are expressed.

NUTRITIONAL TREATMENT

In relation to the type of diet, 38.9% (n = 149) of the participants took an oral diet with normal texture, 56.9% (n = 218) took blended food and only 4.2% (n = 16) took oral nutritional supplementation.

In two of the nursing homes (NH1 and NH2), more residents took blended food, whereas in NH3, with a higher percentage of independent people, 68.6% took a normal diet and more people took oral supplementation (9.8%).

NH1: normal texture 32.2% (n = 48), blended food 65.7% (n = 98), oral supplementation 2.1% (n = 3).

NH2: normal texture 23.5% (n = 31), blended food 74.2% (n = 98), oral supplementation 2.3% (n = 3).

NH3: normal texture 68.6% (n = 70), blended food 21.6% (n = 22), oral supplementation 9.8% (n = 10).

Table V expresses the percentages of people with malnutrition and with total dependency according to the type of diet they were taking.

DISCUSSION

In this cross-sectional study, most of the participants were females (70.2%) and they were older than the males, which is similar to most studies carried out in elderly nursing home residents (13-26). Weight was higher in males but BMI was higher in females, in part due to their lower height (which could be influenced by the higher age and the higher prevalence of osteoporosis in females). In both obese and non-obese subjects, regional differences exist with regard to adipose tissue distribution in both genders. Abdominal circumference (which is a marker of visceral fat) was higher in males, whereas triceps skinfold (reflecting the peripheral body fat) was higher in females.

According to the Barthel index, 78.9% of participants were totally dependent. Due to this high degree of dependence, a high percentage of people had difficulty standing. Height and weight, which are important anthropometric parameters in assessing nutritional status, only could be obtained in 20.9% of the participants. There are some equations to estimate these parameters (for instance, Chumlea's equations), but they usually underestimate the real values.

This low percentage of people in which height and weight can be obtained makes looking for other options necessary, such as the measurement of waist circumference in prone position or the calf circumference, which show a good correlation with BMI values and are easily obtainable in the nutritional assessment of this population. The relationship between waist circumference, fat mass and BMI has been previously described (37).

Moreover, most participants could not be surveyed with the MNA test due to their baseline cognitive impairment. A possible alternative to detect risk of malnutrition could be using blood tests in order to calculate CONUT, or other different anthropometric parameters that could be measured instead of BMI. In our study, only a low percentage of participants (37.8%) had a recent blood test. This is probably due to the tendency to avoid "invasive measures" such as obtaining a blood sample in people with a high degree of dependence, although, in fact, this could be a simple alternative to assess nutritional status in people unable to stand.

The study of nutritional status in this sample of nursing home residents confirmed that malnutrition remains a common problem among elderly people living in nursing homes. The prevalence of malnutrition and risk of malnutrition is different depending on the nutritional assessment tool used to diagnose malnutrition (MNA, CONUT or ESPEN criteria), being lower with ESPEN criteria (17.5%). According to MNA, 55.9% of the elderly people were in risk of malnutrition and 21.3% were malnourished. With CONUT, 20.7% had moderate-severe malnutrition. This high prevalence of risk of malnutrition and established malnutrition is probably in relation to the high degree of total dependence of this population; in fact, the prevalence of malnutrition was higher in the nursing home with a higher percentage of totally dependent residents.

A close relationship between malnutrition and functional dependence has been obtained in different studies (38,39). Our results show that functional impairment was significantly more prevalent in residents with malnutrition.

The MNA test is a simple, low cost, non-invasive and well-validated instrument that can be used at bedside, regarded as the gold standard for nutritional assessment for elderly living in long-term care facilities. This prevalence of malnutrition varies greatly among different studies using the MNA test (2.8-41% in the Spanish population) (7,28), which may be due to the different degree of dependence of elderly residents, but most studies do not take it into account neither assess the ability to perform basic activities of daily living of the institutionalised elderly.

According to the new ESPEN definition of malnutrition, in this study 17.5% of the elderly people were malnourished. In the study by Rojer

Table V. Malnutrition and functional ability according to the type of diet

Diet	Malnutrition MNA	Malnutrition CONUT	Malnutrition ESPEN	Totally dependent (BI)
Normal (38.9%)	15.1%	12.5%	13.2%	64.4%
Blended (56.9%)	25.9%	26.8%	20.8%	91.7%
Supplementation (4.2%)	3.4%	3.3%	4.2%	62.5%

et al. (40), which was the first to provide insight into the applicability of the new ESPEN consensus definition of malnutrition, the highest prevalence of malnutrition was in acute-ill patients (15%), being lower in geriatric outpatients and healthy old individuals; however, they did not study nursing home residents. With regard to the different diagnostic criteria of this consensus, only 6.25% had BMI < 18.5 kg/m^2; in fact, most men and women were overweight according to the BMI. Usually, the geriatric population has a high BMI but a low FFMI. BMI can be misleading in persons with high BMI who are losing weight or in persons that had low BMI values at a younger age. This may suggest that BMI is not one of the best parameters to diagnose malnutrition alone, and that it is advisable to assess FFMI in addition to BMI to diagnose a proportionally high loss of FFM to define malnutrition. Unintentional weight loss, which reflects the dynamic part of becoming malnourished, was the most frequent criterion. Although the CONUT test is usually carried out in hospitalised population, it could be an alternative screening nutritional assessment tool in people unable to stand and living in nursing homes. In our study, only 44.1% of people with MNA and 75% with ESPEN had a blood test to calculate CONUT, and agreement was low; further studies would be needed in nursing home residents. Agreement between MNA and ESPEN is very acceptable in routine clinical examination, but both have the disadvantages that have been previously discussed. With CONUT, it is important to take into account that some diseases can affect the biochemical parameters used.

In the study by Diekmann et al. (3), a comparative analysis of MNA, NRS and MUST among nursing home residents was carried out. The highest agreement of screening results was detected between MUST *vs* NRS ($\kappa = 0.40$), and the agreement between MNA *vs* MUST and MNA *vs* NRS was low ($\kappa = 0.16$ and 0.13, respectively). We have not found a comparison of MNA, CONUT and ESPEN new criteria in nursing home residents to which to compare our results.

On the other hand, the prevalence of malnutrition was clearly higher in people with a blended diet compared to people with a normal diet, probably because these people usually have problems such as dysphagia, dental problems, anorexia or cognitive impairment, and the blended food administered could not have enough nutrients to maintain an adequate nutritional status.

Among the limitations of this study we find those related to its cross-sectional design, as no causal relationships can be identified. There is also lack of applicability in community-dwelling elderly and hospitalized patients, because we have only analyzed data of people living in nursing homes.

On the other hand, our study has several strengths: it is a multicenter study of older nursing home residents and a standardized methodology to assess nutritional status was used. Moreover, it is not usual for studies to evaluate the applicability of the different nutritional assessment tools in institutionalized populations.

CONCLUSION

In this study, we have found that nursing homes had a high percentage of totally dependent residents. This high degree of functional dependence made it difficult to obtain some anthropometric parameters such as weight and height, which are essential to carry out most nutritional tests. MNA, CONUT and the new ESPEN criteria of malnutrition showed a high prevalence of malnutrition and risk of malnutrition in those residents in which performing the nutritional test was possible. The relationship between nutritional risk and functional impairment highlights the need to sensitise nursing personnel to nutritional problems, especially in functionally impaired residents, in order to initiate early intervention and avoid further nutritional and functional deterioration. Further studies in nursing home residents would be required to evaluate if CONUT and other anthropometric parameters such as waist circumference in prone position could be used instead of BMI to assess nutritional status in this population.

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