TITLE: FOOD CONSUMPTION ANALYSIS IN SPANISH ELDERLY BASED UPON THE MINI NUTRITIONAL ASSESSMENT TEST

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ABSTRACT

Background/Aims: Aged people are an increasing population group worldwide, and nutritional impairments may contribute to additional health problems. The characterization of food consumption of elderly people is a good approach to implementing adequate nutritional policies in order to improve their nutritional status. The aim of this study was to describe and analyze specific aspects of food intake based upon the Mini Nutritional Assessment (MNA) test in a representative country sample.

Methods: The survey consisted of a cross-sectional study assessing the nutritional status of 22,007 Spanish people aged 65 years or older using the MNA test. These data, including dietary information, were obtained by health professionals specifically trained to carry out the questionnaire. A multiple regression analysis was used to evaluate the contributing impact of the diet-related MNA questions on the total MNA score.

Results: Differences in the food choices between men and women were found, but not in the mode of feeding. Obese and non-obese individuals, categorized by a body mass index (BMI) more or less than 30, showed similar intake patterns of protein-rich foods, but differences in fruits, vegetables and fluids. On the other hand, undernourished and non-undernourished subjects, according to the MNA criteria, revealed different food consumption. Loss of appetite and mode of feeding were the items with the highest influence the MNA total score.

Conclusions: While age, gender and BMI considered together are responsible for 11.3% of the total MNA score, dietary-related items can predict the 62.4% of the total MNA classification in the overall elderly Spanish population.

INTRODUCTION

More than 7 million Spanish citizens are 65 or older [1] and it is estimated that the proportion of aged individuals in the European Union will reach around 30% by 2050, almost twice the current data [2].

In this context, the elderly are a population group at the greatest risk of undernutrition which is often related to disability and impaired health [3]. Thus, malnutrition in this stage of the life cycle is associated with an increased prevalence of morbidity and mortality [4]. Also, undernutrition predisposes the individual to longer hospitals stays [5, 6].

The main eating problems that typically occur in the elderly population are loss of appetite, chewing or swallowing problems, feeding dependency, and poor dietary intake [3, 7]. Aging is often accompanied by harmful anorectic effects as well as by psychological, social, and physical disturbances [8]. In addition, it has been demonstrated that variety in the diet affects not only energy intake, but also the quality of meals and nutritional status, which may be jeopardized in elderly populations [9, 10].

Furthermore, smell and taste decline with increasing age, which results in the consumption of a lower variety of foods and a more monotonous diet, which could lead to a higher prevalence of micronutrient deficiencies affecting nutritional status [11].Finally, an impaired oral intake may also influence food choice and limit the type and quantity of food eaten by older people [12].

Whatever the causes, it is important to identify dietary factors closely associated with elderly people's health status and the measures to be taken for comprehensive health maintenance, for maintaining autonomy in the community, and for the prevention of bed confinement and dependence on long-term care.

In general, public health services have limited resources to carry out a nutritional evaluation of all patients. Hence, different nutritional screening tools have been developed for the early detection of undernutrition, although they differ in their criteria, cut-off points, ease of use or acceptability [13]. Among all these methods, the Mini Nutritional Assessment (MNA) has been found to be very useful to detecting undernourished elderly and those at risk for undernutrition in a wide range of settings [14, 15]. It has also been used to study the relationship between unhealthy situations (such as a poor immune function) and undernutrition status [16]. This test was developed and first published in 1994, and is structured in four parts: anthropometric, general, dietary and self-assessment [17]. In 2001 a short form of the MNA was presented based on a survey in which almost half of the population studied was from Spain (Catalonia) [18].

The aim of this study was to analyze specific aspects of food intake in an elderly Spanish population, taking into account gender and body weight, and to analyze the impact of dietary-related factors included in the MNA test on undernutrition screening

SUBJECTS AND METHODS

The study population comprised community-dwelling elderLY (n=22,007) throughout Spain. A cross-sectional survey was conducted during the last 2 months of 2005. Volunteer participants were recruited by community pharmacists who had direct contact with community-dwelling elderLY. All participants were specifically asked if they would be willing to take part in the study. Only those subjects who accepted were enrolled. Recruitment was performed in the pharmacy by asking every other elderly person who entered the premises if they would agree to take part in the study during the foreseen period until the number of subjects needed had been achieved.

Health professionals (3,251 community pharmacists) were recruited by the Spanish Pharmacists Council to collect the MNA survey data. Due to the large number of examiners, a possible inter-observer variation was assumed, as has occurred in another study carried out by pharmacists using this kind of questionnaire in Spanish elderly [19]. However, effort was made to minimize such a limitation. Thus, all of the pharmacists received training on how to administer the survey to elderly participants, and were given a detailed document with information about the survey, the correct way to formulate every question, and a decision tree to interpret the result of the survey in each case [20]. This kind of training sessions for health professionals usually has a positive impact on the results of the MNA test [21]. Furthermore, a joint videoconference explaining the study was simultaneously broadcast to every provincial pharmacy college, and a website (http://www.redfarma.es/) was available for all pharmacists involved in the study to support consistency among interviewers.

Data collection

Data were collected by filling out the MNA test, encoded for further processing with a specific programme (JBLEE) using an optical model reading. Approximately 50,000 encoded questionnaires were printed with a magnetic band and sent to each provincial pharmacy college, depending on the number of local community pharmacists. In addition to specific MNA questions, other information was requested, such as the postal code (to identify the region), age, gender, weight, height and place where the interview took place. A total of 26,484 completed questionnaires were received and after careful review, the final complete sample reached 22,007.

Mini Nutritional Assessment

The MNA test is designed to provide a rapid assessment of nutritional risk in elderly people and it is structured in four parts: anthropometric assessment (weight loss, body

mass index (BMI) and body circumferences), general assessment (lifestyle, medication and mobility), dietary assessment (number of meals, food and fluid intake, autonomy of eating), and self assessment (selfperception of health and nutrition) [22]. Dietary assessment questions may contribute a maximum score of 9 points from the MNA total score (30 points). The MNA total score distinguishes between elderly with no risk of undernutrition (score ≥ 24), those at risk of undernutrition (score 17 ≥ to > 24) and those with undernutrition (score < 17) [23] as described in figure 1.

In order to classify participants according to obesity status, the BMI was calculated as weight (kg) divided by height squared (m^2). The weight was measured by the pharmacists to the nearest kilogram and the height to the nearest centimeter. As recommended by the World Health Organization [24] for individuals aged 18 or older, obesity was defined as a BMI of ≥ 30.

For every dietary question, the meaning and the servings of each group of foods were previously defined according to the guidelines for completing the MNA [25]. A full meal is defined as an eating occasion when the subject consumed at least two or more dishes, or at least one dish and one dessert. A serving of dairy products corresponded to a glass of milk, the cheese in a sandwich or a pot of yogurt. A serving of legumes was counted as a cup of cooked beans and a serving of eggs as one unit. Servings of meat, fish or poultry were defined as a small- to medium-sized steak. Regarding vegetables and fruits, one serving was equivalent to a medium dish and a medium piece, respectively. Finally, one serving of fluids was defined as a cup with a volume around 200 ml of water or other liquids as infusions, coffee, milk, juices and other liquid foods, as previously published [20, 25].

Statistical analysis

Statistical analyses were performed with the Statistical Package for Social Sciences (SPSS Inc. Chicago, Ill., USA; version 13.0) for Windows XP according to the criteria described elsewhere [26]. Means and standard deviations were used as descriptive statistics. Analysis of variance (ANOVA) and a *post hoc* Bonferroni test were performed to compare the score distribution of general and specific MNA components among different groups. Mann-Whitney U tests were used to compare MNA total score between both genders. X^2 tests were performed to compare frequency distributions for gender, obesity criteria and MNA score.

Finally, a multiple regression was prepared to analyze the association between food choices and nutritional status based on MNA test. Because some questions had more than two options to answer, dummy variables were prepared. Previously, a univariate analysis of every question was done to confirm that the model was adjusted for all variables proposed, which were predictors without co-linearity.

RESULTS

The mean age of men (n=8,014) and women (n=13,993) who agreed to be interviewed with the MNA test was 75±7 years for both genders. The mean value of the MNA score was 25.4 ± 3.7 for men and 24.9 ± 3.9 for women ($p<0.001$). According to MNA test, the prevalence of undernutrition (score < 17) was 3.4% in men and 4.8% in women, and the prevalence of risk of undernutrition risk (17 ≥ score > 24) was 20.8% in men and 28.0% in women.

The undernutrition, risk of undernutrition and no undernutrition groups differed significantly from each other in the four MNA subgroups: anthropometrics, dietetics, global and subjective assessments (table 1). As dietary questions are most related to food patterns, the frequency distributions concerning diet-related questions and the

impact of this MNA subgroup on the MNA total score were analyzed. In that context, the answers of the study population to the six MNA questions relating to food habits were specifically studied (table 2) to determine whether a relationship existed with any of the possible nutritional conditions revelaed by the MNA final evaluation.

The percentage of elders who suffered from moderate or severe loss of appetite or whose food intake had declined over the past 3 months was 23.2%. This proportion was higher in women than in men ($p<0.001$), in non-obese than in obese subjects ($p<0.001$), and in individuals at risk of undernutrition, according to MNA test, than in those with not at risk of undernutrition risk ($p<0.001$).

The analysis of the number of full meals taken by the elderly (table 2) revealed that 2.4% of elderly population had one or no full meal daily, 17.0% had 2 full meals every day, and the remaining subjects had 3 or more full meals a day. Statistically significant differences were found by gender ($p<0.05$), with men reporting a higher number of full meals consumed daily than women. There were also differences between obese and non-obese subjects ($p<0.05$), with obese elderly reporting more full meals daily. Furthermore, we found differences between elderly at risk (MNA$\leq$23.5 points) and not at risk of undernutrition (MNA>23.5 points), as those with MNA>23.5 reported more full meals daily ($p<0.001$).

The consumption of at least one daily serving of dairy products was reported by 90.3% of surveyed respondents. With regard to the consumption of legumes or eggs, 16.4% of the sample ate less than 2 servings/week of either of these foods. Finally, 16.2% of the interviewed elderly did not consume at least one daily serving of meat, fish or poultry. For these three protein-rich items, there were significant differences ($p<0.001$) in the distribution frequency of the subjects, taking gender and undernutrition risk into account, but no statistical differences were found between obese and non-obese people.

In this context, women had a higher consumption of dairy products and lower consumption of legumes or eggs, meat, fish or poultry than men ($p<0.001$). Related to the risk of undernutrition, those at risk showed lower consumption ($p<0.001$) of all protein-rich foods.

As table 2 shows, 83.2% of the sample consumed 2 or more servings of fruits or vegetables daily, with higher values in women and obese subjects ($p<0.001$).

The frequency distribution of the fluid intake assessment showed that 18.5% of the sample consumed less than 3 cups and 63.9% up to 5 cups of fluid every day. This fluid consumption was higher in men than in women and in obese than in non-obese elderly ($p<0.001$).

Concerning the mode of feeding, 93.0% of the respondents did not need any kind of help to eat. Statistical differences were found between obese and non-obese subjects ($p<0.001$), with obese people needing less assistance to eat. As expected, subjects with no risk of undernutrition showed less difficulty in eating than those at risk of undernutrition (data not shown). However, the mode of feeding did not statistically differ between men and women.

A multiple regression analysis was used to evaluate the influence of the diet-based MNA questions on total MNA score (Table 3). The univariate examination showed that gender, age, BMI and the six MNA dietary questions were potential predictors for total MNA score ($p<0.001$). These variables showed no co-linearity (tolerance >0.01) and were included in the analysis. Then, in the fitted multiple regression model, all variables accounted for 64.4% of the total MNA score variation ($p<0.001$). However, the multiple regression analysis of age, gender and BMI were responsible for only 11.3% of the score, and the MNA dietary-related items were responsible for 62.4% of the total MNA classification.

DISCUSSION

The full MNA includes 18 items grouped in four sections: anthropometrics, dietary, global and subjective assessments [27]. The score analysis of the four question groups revealed statistically significant differences between the three MNA categories (under-nutrition, undernutrition risk and no undernutrition), in comparison to other authors who found no statistical differences between MNA categories in subjective assessment [28]. The difference in these results could be explained by the different setting of the studies: home care versus community.

The current study was designed to assess not only the association between each diet-related MNA question and total MNA score in a sample of Spanish community-dwelling elderly, using a regression analysis to identify the strength of each option, but also to characterize the role of variables such as gender, age, body weight status and the MNA score on food choices of Spanish elderly. Thus, females were a higher risk of suffering from undernutrition compared to males, as was found by other authors in smaller groups of community-dwelling Spanish elderly [29, 30]. Age showed a negative association with MNA score. Thus, the MNA total score decreased by 0.03 points per year of age in those older than 65, adjusted by gender, BMI and dietary MNA questions, comparable to the outcome obtained from other surveys [31]. As expected [31], there was a positive association between BMI and total MNA score. The MNA total score increased by 0.1 points for each kilogram per square meter, after adjusting for gender, age and dietetic MNA questions.

After adjusting for gender, age and BMI, appetite status was found to be the strongest diet-related predictor of the total MNA score followed by the mode of feeding. In earlier studies these questions were also the dietary items most strongly correlated with the

total MNA score [18]. Thus, 64.4% of the interviewed subjects could have been adequately classified concerning with regard to undernutrition using only these six MNA questions, after adjusting by gender, age and BMI.

The loss of appetite, a frequent condition among older adults, may contribute to many negative consequences in the elderly, such as loss of skeletal muscle mass, micronutrient deficiencies, fragility, increased hospital admissions, increased falls and injuries, delayed recovery and accelerated mortality [32]. The present study showed that 3.6% of Spanish community-dwelling elderly were affected by a severe loss of appetite and 19.6% by a moderate loss of appetite. Values were higher in women (4.0% severe and 22.0% moderate) than in men (2.9% severe and 15.5% moderate). Indeed, the same trend was found in the elderly from Iceland [33]. The data analysis also revealed differences in recent loss of appetite between obese and non-obese elders ($p<0.001$). However, the greatest difference in appetite status was found between subjects in a situation of undernutrition risk and those not at risk.

Almost 10% of the sample had less than three full meals daily, which may be interpreted as a poor food intake. It can be related to an altered regulation of food intake in elderly people [34] due to a impaired satiety control because of a delay in gastric emptying [7]. The reported eating behaviour was different between genders ($p<0.05$), with women eating fewer full meals daily than men, which is potentially associated with the report that women are more likely to diet or restrict their food intake [35].

Three questions evaluated the protein intake of the elderly population: those dealing with dairy products, legumes or eggs, and meat, fish or poultry. A higher dairy product consumption among women than in men was detected, as was also found by other researchers in nine European countries based on the EPIC-Elderly study [36]. These findings support nutritional education efforts to increase the intake of calcium to reduce

the risk of osteoporosis and fractures, especially in women after menopause. The consumption of grain legumes in Spain is higher than in other regions of Europe [37]. According to the EPIC-Elderly study that analyzed the dietary patterns of almost 100,000 participants older than 60 years living in nine European countries, the consumption of legumes in Spain is three- to fivefold the European average, with a higher consumption in men than in women [36]. The same EPIC-Elderly cohort also showed a higher consumption of eggs than the European mean with similar gender tendency [36]. Our survey found that only 83.6% of the sample had at least two servings of legumes or eggs per week. These results seem to confirm the data obtained in the former papers. On the other hand, meat consumption in Spain is similar to the European average, but fish consumption is almost double than the European mean, with a higher consumption in men than in women [36]. Grouping both types of foods in the same question, the analysis revealed that 16.2% of Spanish elderly do not have at least one serving of meat, poultry or fish daily, with a lower consumption in women than in men.

Data from some epidemiological studies suggest a positive correlation between protein intake from meat, poultry and fish, and higher BMI [38]. However, the evaluation of protein intake in obese and non-obese elderly in this study did not show any statistically significant differences in any of the three protein-rich food classes.

Although fruit and vegetable consumption among Spanish elderly is slightly above the European average [36], the present study suggests that almost 1 of 5 Spanish elderly does not consume at least two servings daily, which is below the minimum amount recommended, 5 servings [39]. Statistically significant differences between men and women were found ($p<0.001$), with women consuming fruits or vegetables more frequently. Also an inverse association between fruit and vegetable intake and an excess

weight has been demonstrated [38] that contrasts with the higher number of fruit or vegetable servings consumed by obese subjects in our survey.

With aging the thirst response declines, whereas hydration needs do not, rendering a difficult maintenance of homeostasis in that population group [40]. Only 36% of the sample reached the desirable minimum intake of 5 cups of liquids/day. In this context, the low beverage consumption detected in our survey reveals a potential risk situation in the elderly population. These data are in accordance with earlier findings suggestions that the prevalence of dehydration among community-dwelling older adults could reach as much as 60% [41].

According to the Spanish Statistical Institute, 2.3% of elderly need some help eating and 2.5% are unable to eat without assistance [1]. These percentages are slightly higher than those found in this study, probably because they include institutionalized and non-institutionalized elderly. Furthermore, Spanish data from the Euronut Seneca study [42], which was designed to assess dietary quality of life factors and healthy aging in Europe [43], are generally in good agreement with out data.

Since this MNA questionnaire was previously applied in other Spanish population groups, we assumed that its implementation in a larger population is valid. Nevertheless, the fact that a specific validation was not carried out, should be considered as a limitation. Another drawback that should be considered is the effect size when interpreting results from large samples because, in some cases, they may have a limited practical significance.

Summing up, the present work analyzed the reported food frequency consumption of over 22,000 Spanish elderly men and women and the impact of dietary items on their MNA scores. The food frequency distribution analysis pertaining to gender and BMI groups revealed significant differences, but not for all questions. The public health

implication of this survey is that about two thirds of the total MNA classification in an elderly Spanish population are predicted by diet-related items, which could be used to give appropriate nutritional advise to avoid undernutrition.

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Fig. 1. MNA used in the present study (translated into Spanish). From Guigoz et al. [17]

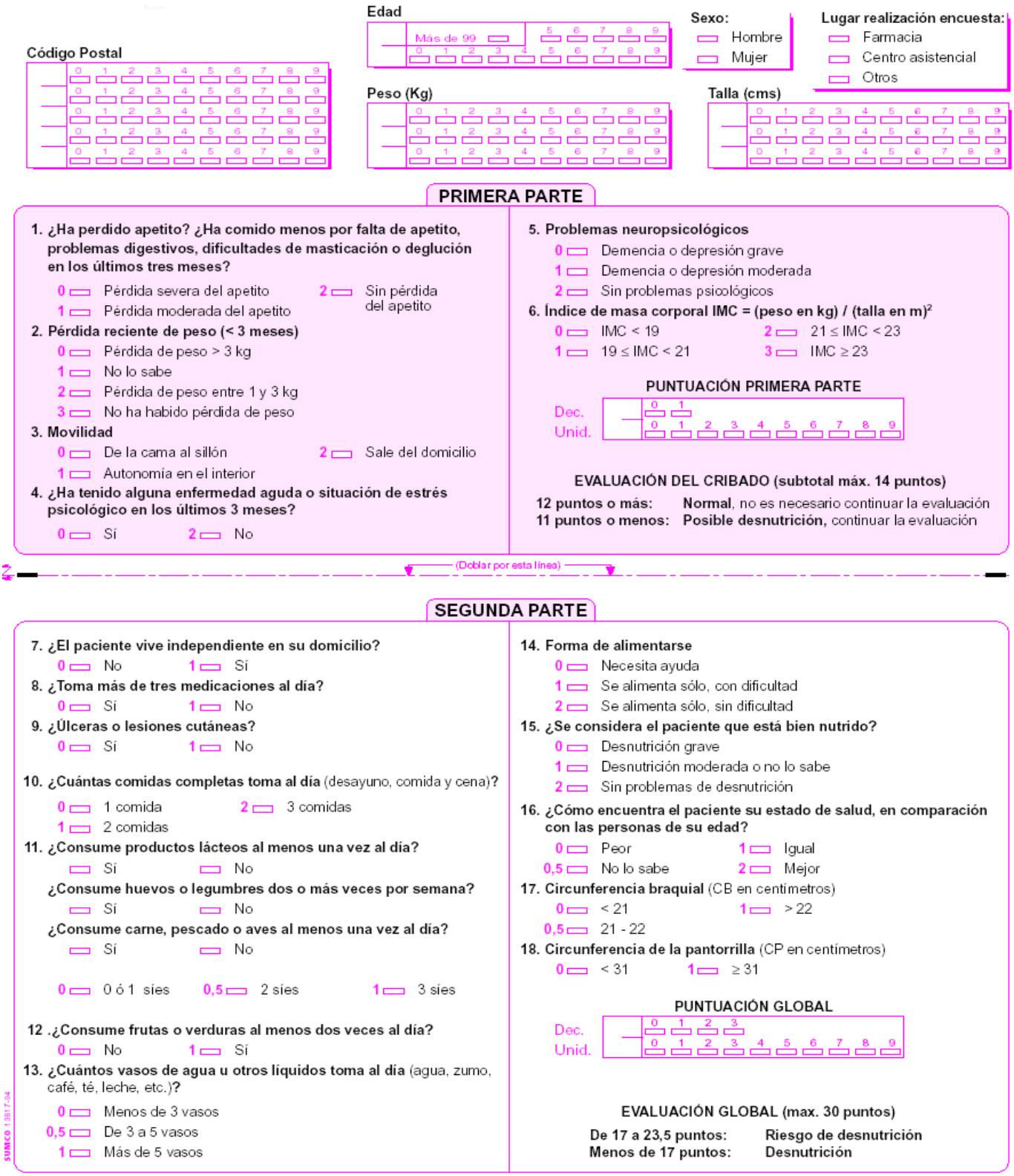

Table 1. Comparison of the four MNA subgroups in the undernutrition, undernutrition risk and no undernutrition groups of 22,007 community-dwelling elderly.

MNA subgroups	Maximum score	Whole group (n=22,007)		Under-nutrition (n=953)		Under-nutrition risk (n=5,579)		No under-nutrition (n=15,475)		ANOVA p
		Mean	Sd	Mean	SD	Mean	Sd	Mean	SD	
Anthropometrics	8	6.9	1.4	3.8 [a]	1.8	5.9 [b]	1.5	7.5 [c]	0.9	<0.001
Dietary assessment	9	7.6	1.3	4.6 [a]	1.5	6.8 [b]	1.2	8.1 [c]	0.8	<0.001
Subjective assessment	4	3.1	0.9	1.4 [a]	0.7	2.5 [b]	0.8	3.4 [c]	0.6	<0.001
Global assessment	9	7.2	1.7	3.9 [a]	1.8	5.9 [b]	1.5	7.9 [c]	1.1	<0.001
Total MNA	30	24.9	3.9	13.7 [a]	2.7	21.2 [b]	1.9	26.9 [c]	1.7	<0.001

[a]: Statistically significant differences ($p<0.05$) between the undernutrition and undernutrition risk groups (Bonferroni)
[b]: Statistically significant differences ($p<0.05$) between undernutrition risk and no undernutrition groups (Bonferroni)
[c]: Statistically significant differences ($p<0.05$) between undernutrition and no undernutrition groups (Bonferroni)

Table 2: Food consumption frequency of subjects taking gender and BMI into account

	Total, % (n=22007)	Men, % (n = 8,014)	Women, % (n = 13,993)	X^2 test (p value)	BMI<30, % (n=15,351)	BMI≥30, % (n=6,656)	X^2 test p value
Appetite Status							
Severe loss of appetite	3.6	2.9	4.0		4.2	2.1	
Moderate loss of appetite	19.6	15.5	22.0	<0.001	22.1	13.8	<0.001
No loss of appetite	76.8	81.6	74.0		73.6	84.1	
Number of full meals							
0-1 full meals daily	2.4	2.0	2.7		2.3	2.7	
2 full meals daily	17.0	16.6	17.3	<0.05	17.4	16.1	<0.05
>2 full meals daily	80.5	81.3	80.1		80.3	81.1	
Dairy Products consumption							
Consumes <1 serving of dairy products per day	9.7	13.3	7.6	<0.001	9.8	9.4	n.s.
Consumes ≥1 serving of dairy products per day	90.3	86.7	92.4		90.2	90.6	
Legumes or eggs consumption							
Consumes <2 servings of legumes or eggs per week	16.4	15.0	17.2	<0.001	16.2	16.9	n.s.
Consumes ≥2 servings of legumes or eggs per week	83.6	85.0	82.8		83.8	83.1	
Meat, fish or poultry consumption							
Does not consume meat, fish or poultry every day	16.2	15.3	16.7	<0.05	16.0	16.6	n.s.
Consumes meat, fish or poultry every day	83.8	84.7	83.3		84.0	83.4	
Fruits or vegetables consumption							
Consumes <2 servings of fruits or vegetables daily	16.8	19.5	15.2	<0.001	17.8	14.5	<0.001
Consumes ≥2 servings of fruits or vegetables daily	83.2	80.5	84.8		82.2	85.5	
Fluids consumption							
Consumes <3 cups of fluids per day	18.5	17.0	19.4		19.0	17.4	
Consumes 3-5 cups of fluids per day	45.4	44.2	46.1	<0.001	46.4	43.1	<0.001
Consumes >5 cups of fluids per day	36.0	38.8	34.5		34.6	39.5	
Self-fed autonomy							
Unable to eat without assistance	1.9	1.7	2.1		2.2	1.3	
Self-fed with some difficulty	5.1%	5.2%	5.0%	n.s.	5.8%	3.4%	<0.001
Self-fed without any problem	93.0%	93.1%	92.9%		92.0%	95.3%	

Table 3: Independent predictors of nutritional situation in Spanish elderly (MNA total score as dependent variable) in a multiple linear regression analysis.

	β univariate	β multivariate	I.C. 95%	p
Gender*	-0.79	-0.53	(-0.60)-(-0.47)	<0.001
Age (years)	-0.12	-0.03	(-0.03)-(-0.02)	<0.001
BMI	0.21	0.10	0.09-0.11	<0.001
Adjusted R^2: 0.113				**<0.001**
Loss of appetite				
Severe	0 (ref)	0 (ref)		
Moderate	4.52	3.15	2.97-3.33	<0.001
It does not exist	9.12	6.64	6.47-6.82	<0.001
Number of meals daily				
0-1 meal	0 (ref)	0 (ref)		
2 meals	2.97	1.32	1.11-1.54	<0.001
3 or more meals	5.80	2.55	2.34-2.76	<0.001
Dairy intake				
No	0 (ref)	0 (ref)		
Yes	1.38	0.56	0.45-0.67	<0.001
Eggs or legumes intake				
No	0 (ref)	0 (ref)		
Yes	2.03	0.78	0.69-0.87	<0.001
Meat, fish or poultry intake				
No	0 (ref)	0 (ref)		
Yes	2.60	0.94	0.85-1.02	<0.001
Fruits or vegetables intake				
No	0 (ref)	0 (ref)		
Yes	3.17	1.48	1.39-1.56	<0.001
Fluid consumption				
Less than 3 cups	0 (ref)	0 (ref)		
3 to 5 cups	1.50	0.75	0.67-0.84	<0.001
More than 5 cups	2.97	1.55	1.46-1.64	<0.001
Mode of feeding				
Unable to eat without assistance	0 (ref)	0 (ref)		
Self-fed with some difficulty	2.75	2.81	2.54-3.07	<0.001
Self-fed without any problem	9.27	6.90	6.67-7.13	<0.001
Adjusted R^2: 0.624				**<0.001**

All the variables included in the model appeared as potential predictors in the univariate analysis ($p<0.001$).

*Reference category: male