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LESS HEALTHY ELDERLY EATING LESS FOOD ARE IDENTIFIED BY A MODIFIED MNA TOOL

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Abstract: *Background:* The MABAT ZAHAV survey is part of several National Health and Nutrition surveys conducted in Israel over the past decade in different population groups. *Objectives:* To ascertain whether a modified form of the Mini Nutritional Assessment (MNA) tool identifies community-dwelling elderly Jews at risk of malnutrition by evaluating their food groups and nutrient intakes. *Design:* A Cross-sectional study. *Participants and setting:* A total of 1,499 free-living Jewish elderly sampled from two major Health Insurance Funds in Israel were interviewed at their homes. This study analyses were restricted to 1,016 and 1,067 elderly with modified full MNA and modified MNA-SF, respectively. *Measurements:* Nutritional status was assessed using a modified full MNA and a modified short form MNA (MNA-SF). To evaluate food intake, a 24-hour dietary recall was carried out. *Results:* Based on the modified full MNA score, about 64% of the elderly had normal nutritional status, 34% were at risk of malnutrition and 2% were malnourished. The corresponding proportions based on the modified MNA-SF score were 66%, 28% and 6%, respectively. According to the modified full MNA, elderly 'at risk of malnutrition' compared to those with 'normal nutritional status', consumed significantly less portions of some food groups. Their energy, macronutrient and selected micronutrient intakes were also significantly lower. According to the MNA-SF, the only significant differences were found for energy, macronutrients and selected micronutrients, with a lower consumption in the elderly at risk of malnutrition. With the modified full MNA being utilized as a gold-standard, the modified MNA-SF sensitivity (for 'risk of malnutrition' vs. 'normal nutritional status') was 85% and its specificity, 96%. *Conclusions:* The modified full MNA accurately captures elderly at risk of malnutrition, and its scores are highly correlated to those of the modified MNA-SF. Thus MNA-SF can be used by the community health care services to screen for malnutrition risk.

Key words: Mini Nutritional Assessment (MNA), 24-h dietary recall, elderly, MABAT ZAHAV survey.

Introduction

Elderly people face many biological, psychological and social problems (1, 2), which affect nutritional status and vice versa. Malnutrition is a highly relevant pathologic condition in the elderly (3) that causes loss of autonomy, lower quality of life, higher frequency of hospital admissions, and untimely death (4). Prevention of malnutrition in community-dwelling older people is of greater importance than its treatment; thus, suitable nutritional assessment tools should be used to detect people 'at risk of malnutrition' (1). Although Mini Nutritional Assessment (MNA) is not considered as the gold standard for the diagnosis of malnutrition, it is recognized as the most established nutrition assessment tool in the elderly, as it was specifically developed and validated in this population (4, 5, 6). The full MNA is composed of 18 items, of which six questions, showing the strongest correlations with the results of the full MNA, are used to constitute the MNA-Short Form (MNA-SF). The MNA maximum score is 30 points and the score is divided into three categories (7). MNA-SF was designed to create an assessment tool that preserves diagnostic accuracy while minimizing the time and training needed for its administration and thus can be used for widespread screening. The original MNA-SF identifies elderly individuals as 'well nourished' or 'at risk of malnutrition' (8), so that the full MNA is needed only if a person is classified as 'at risk of malnutrition'.

A revision of the MNA-SF was necessary in light of changing demographics among elderly populations. The new MNA-SF features the same three categories as the full MNA and the score is divided, as follows: (i) 12-14 – Normal nutritional status; (ii) 8-11 – At risk of malnutrition; (iii) 0-7 – Malnutrition (9). The revised MNA-SF retains the validity and accuracy of the original

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MNA in identifying older adults who are malnourished or at risk of malnutrition (10).

The major objective of this study was to investigate whether the diet of community-dwelling elderly persons, found to be at risk of malnutrition by the modified full MNA, is more deficient in food groups and nutrients compared to the diet of the elderly with normal nutritional status. We also tested if our modified MNA-SF tool correctly identified the elderly at risk of malnutrition.

Methods

Survey population

The first National Health and Nutrition Survey in the elderly (MABAT ZAHAV) was conducted between July 2005 and December 2006 with the collaboration of the Israeli Hypertension Society, the Geriatric and the Dental Health Divisions of the Israeli Ministry of Health, the two major Health Insurance Funds (Maccabi and Clalit Health Services) and the Joint Distribution Committee (JDC-Eshel).

The survey sample was based on the elderly insured by the two major Health Insurance Funds, who care for 86.3% of the elderly citizens living in Israel. The survey included free- living elderly residing in urban settings of at least 20,000 residents. Elderly persons with significant cognitive impairment, based on the score of the Mini Mental State Examination – MMSE (11) adjusted for age and education (12), were excluded from the analyses. The sampling frames from the two Health Insurance Funds were combined and divided into Jewish and Arab sectors. In total, 1,799 individuals (1,499 Jews and 300 Arabs) were included in the survey, with the compliance for Jews being 29%.

The survey was approved by the Chaim Sheba Medical Center and the Ministry of Health Ethics Committees. Each interviewee signed an informed consent form.

This study comprises only the Jewish population and analyses were restricted to 1,016 and 1,067 elderly persons with modified full MNA and modified MNA-SF, respectively.

Survey tools and procedure

Face-to-face interviews were conducted in the interviewees' homes, using a structured questionnaire, in Hebrew, Russian, Arabic or English. The questionnaire included questions on demographics, health status, chronic morbidity, oral and dental health, functional, cognitive and emotional states, use of medications, eating and dieting patterns and food security.

The interview also included a 24-hour dietary recall, reporting on foods and drinks consumed from 4:00 a.m. the day before the interview day through 4:00 a.m. in the morning of the interview.

Measurements included standing height and weight, knee height and ulna length for the calculation of height by accepted equations (13, 14), as well as mid-arm and calf circumferences, and were performed according to a written protocol. The measurements were taken twice and an average was calculated.

BMI values of the participants were calculated based on the equation of kg/m^2, using the average of the three values of height – the measured standing height, height estimated by knee height and height estimated by ulna length.

Mid-arm circumference (MAC) was measured on the left arm. Calf circumference (CC) was measured on the left leg at its widest point, the interviewee sitting with the knee bent to 90 degrees.

Physical function evaluation was based on the Katz et al. scale of Activities of Daily Living – ADL (15). Accordingly, a score of 5 or less indicated 'no functional limitations', a score of 6-10 indicated some functional limitations, and a score of 11 to 15 indicated several functional limitations.

Cognitive function was evaluated using the Folstein et al. MMSE (11) adjusted for age and education (12). The maximum score is 30.

Well-being health status was carried out using the 12-item General Health Questionnaire (GHQ) (16), which measures anxiety and depression. The maximum score is 12. A total score of less than 4 indicates no anxiety and depression disturbance; 4-8 indicates mild disturbance and a score greater than 8 indicates significant disturbance (17).

Nutritional assessment and nutritional screening were performed using a modified MNA, full form and a modified MNA-SF (with its three new categories), respectively. In the current study, some of the original questions included in the modified full and short forms of the MNA were substituted by proxy questions, as was done in the SENECA study (18). The questions that were replaced are detailed in Table 1.

The values of BMI, MAC & CC measures (included in the MNA tool), which denote undernutrition, were adjusted to the 5th percentile of the Israeli Jewish elderly population 65 years and older, as was done in the Taiwanese study (19). As in the Taiwanese study, the scores of the other groups of anthropometric measures were determined by the percentile distribution curves of each measure (Table 2). The cut-off points of the three anthropometric measures were determined using measurements of 1,499 elderly Jews. As the percentile values of the anthropometric measures were quite similar for males and females, the analyses were combined for both genders.

Table 1
Questions of the original version of the full MNA form vs. their modifications

Question No.	Original	Modified
A	Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?	1. Do you have problems with chewing? 2. Do you have difficulty with swallowing solids 3. Do you have difficulty with swallowing liquids
	0 = severe loss of appetite	0 = 'Often' to all of the above questions
	1 = moderate loss of appetite	1 = 'Often' to one or two of the above questions
	2 = no loss of appetite	2 = 'Occasionally' or 'No' to the above questions
C	Mobility	Get in and out of bed? or Go to the restroom/WC?
	0 = bed or chair bound	0 = When the answer is 'Can't'
	1 = able to get out of bed/chair but does not go out	1 = When the answer is 'Can but it's difficult'
	2 = goes out	2 = When the answer is 'Can with no difficulty'
D	Has suffered psychological stress or acute disease in the past 3 months	Do you feel stressed all the time?
	0 = yes	0 = A bit more than usual or Much more than usual
	2 = no	2 = Not at all or Not more than usual
E	Neuropsychological problems	
	0 = severe dementia or depression	0 = GHQ > 8
	1 = mild dementia	1 = MMSE: 17 – 23.9
	2 = no psychological problems	2 = MMSE: ≥ 24 or GHQ ≤ 8
O	Self view of nutritional status	In the last 12 months, were you ever hungry but didn't eat because you didn't have enough money to buy food?
	0 = View self as being malnourished	0 = Yes
	1 = Is uncertain of nutritional state	1 = Does not know
	2 = Views self as having no nutritional problem	2 = No
P	In comparison with other people of the same age, how do they consider their health status?	How is your health today as compared to your health a year ago?
	0 = Not as good	0 = Not as good
	0.5 = Does not know	
	1 = As good	1 = The same
	2 = Better	2 = Better

Table 2
The scores of the three anthropometric measures (BMI, MAC and CC), by the Israeli Jewish elderly population percentiles

Score	Anthropometric measures	Percentiles
	BMI	
0	< 22	5th
1	22-22.99	6th - 10th
2	23-24.99	11th- 25th
3	25 or greater	>25th
	MAC	
0	< 24	5th
0.5	24-25	6th - 10th
1	> 25	>10th
	CC	
0	< 31	5th
1	31 or greater	>5th

Food data analysis

Nutrient intake was analyzed by 'Zameret' software program, developed by the Food and Nutrition Administration, Israel Ministry of Health. Foods were arranged in 12 food groups: 1. Milk and dairy products; 2. Meat, fish, poultry; 3. Eggs; 4. Legumes; 5. Cereals, including grains, bread, crackers, salty snacks; 6. Baked goods and cakes; 7. Potatoes; 8. Fruit; 9. Vegetables; 10. Nuts and seeds; 11. Fats and oils; 12. Sweets and sweet beverages.

The food groups were further clustered into five major groups: 1. High protein – meat, poultry, fish, eggs, milk and dairy, legumes; 2. High complex carbohydrates – cereals, baked goods (including breads and cakes), potatoes; 3. High fat – oils, nuts, seeds; 4. Fruit; 5. Vegetables. Serving portions were determined according to accepted daily mean quantity intakes among the Jewish elderly (e.g. bread – 30 g; dry cereal grains – 80 g; baked goods, including cakes, biscuits etc. – 30-50g; meats – 75 g; milk – 240 cc; fluid dairy products – 200 cc; soft cheese – 100 g; fresh vegetables – 100 g; fresh fruit – 150; vegetable and fruit juice – 200 cc; cooked legumes – 180 g; fats and oils –15 g; soft drinks – 200 cc; nuts and seeds – 30 g).

Statistical analysis

Statistical analysis was carried out using the SAS software program (version 9.1.3) at an adopted significance level of 0.05. Participants at risk of malnutrition according to the modified full MNA were compared to participants with normal nutritional status with respect to their personal and medical characteristics and their main dietary intake. The Student's t-test was used for continuous variables and the Chi-square test, for categorical variables.

Table 3

Population Characteristics by two full MNA category scores (normal nutritional status vs. at risk of malnutrition)

Characteristics of the Survey Population	All N = 1016	MNA ≥ 24 n = 646	17 ≤ MNA < 24 n = 346	P value
Age, mean ± SD	74.7 (6.25)	74.3 (6.1)	75.8 (6.4)	N.S
	n (%)			
Gender				
Male,	465 (46.9)	331 (51.2)	134 (38.7)	< 0.001
Female	527 (53.1)	315 (48.8)	212 (61.3)	< 0.001
Education, y ≤ 8	220 (22.2)	110 (17.1)	110 (31.9)	< 0.0001
Widowed	261 (26.3)	153 (23.7)	108 (31.2)	< 0.05
Living alone	252 (25.5)	151 (23.5)	101 (29.2)	< 0.05
Immigration in 1990 through Dec 2003	136 (13.7)	81 (12.5)	55 (15.9)	N.S
Economic status, Below Poverty Line*	138 (13.9)	75 (11.6)	63 (18.2)	< 0.05
Food insecurity (eating less due to money shortage)	43 (4.4)	9 (1.4)	34(10)	< 0.0001
CC < 31	34 (4)	14 (1.4)	20 (2)	<0.005
MAC < 24 cm	30 (3.0)	12 (1.9)	18 (5.2)	<0.01
BMI < 22	46 (4.6)	4 (0.6)	42 (12.1)	< 0.0001
BMI ≥ 30	359 (36.2)	242 (37.5)	117 (33.8)	N.S
Waist circumference†	547(56.4)	364 (57.4)	183 (54.5)	N.S
Co-morbidities				
0	31 (3.1)	17 (2.6)	14 (4.1)	0.054
1-2	392 (39.5)	269(41.6)	123 (35.6)	
3-4	500 (50.4)	323 (50)	177 (51.2)	
5-7	69 (7)	37(5.7)	32 (9.3)	
Medications > 3	671 (67.6)	393(60.8)	278 (80.3)	< 0.0001
Functional Disorders				
Some or several limitations, ADL > 5	157 (15.1)	36 (5.6)	113 (32.7)	< 0.0001
Mild cognitive decline, 17 ≤ MMSE< 24	20 (2.0)	7 (1.1)	13 (3.8)	< 0.005
Mild or severe disturbance, GHQ ≥ 4	813 (82)	500 (77.4)	313 (90.5)	< 0.0001
Chewing problems	169 (17.0)	55 (8.5)	114 (33)	< 0.0001
Swallowing difficulties (solids), often	21 (2.1)	1 (0.2)	20 (5.8)	< 0.0001
Constipation, often	178 (18.3)	83(13.0)	95 (28.2)	< 0.0001
Subjective Health Perception, Fair or Poor	411 (41.4)	179 (27.7)	232 (67.1)	< 0.0001
Dental Health Status − subjective self-assessment (Fair or Poor)	523 (57.8)	301(46.6)	222 (64.4)	< 0.0001

*Poverty line was determined by a combination of two parameters, a monthly household income and the number of persons living in the house, as follows: income up to 1744 ILS (Israeli shekel) and ≥ 1 persons living in the house; income between 1744 and 3484 ILS (Israeli shekel) and ≥ 2 persons living in the house; income between 3485 and 5254 ILS (Israeli shekel) and ≥ 4 persons living in the house; income between 5255 and 6974 ILS (Israeli shekel) and ≥ 5 persons living in the house; income between 6975 and 8719 ILS (Israeli shekel) and ≥ 7 persons living in the house. †Male, ≥ 102 cm; Female ≥ 88 cm

Table 4

Population Characteristics by three full MNA categories (N = 1016)

Characteristics of the Survey Population	MNA ≥ 24 n = 646	17 ≤ MNA < 24 n = 346	MNA < 17 n = 24
Age, mean ± SD	74.3 (6.1)	75.8 (6.4)	76.2 (7.3)
	n (%)		
Living alone	151 (23.4)	101 (29.2)	8 (33.3)
Economic status,			
Below Poverty Line*	75 (11.6)	63 (18.2)	9 (37.5)
Food insecurity (eating less due to money shortage)	9 (1.4)	34 (10)	7 (29.2)
CC < 31	14 (2.2)	20 (5.8)	9 (37.5)
MAC < 24 cm	12 (1.9)	18 (5.2)	7 (29.2)
BMI < 22	4 (0.6)	42 (12.1)	11 (45.8)
Heart Disease†	198 (30.7)	160 (46.2)	9 (37.5)
Medications > 3	393 (60.8)	278 (80.3)	17 (70.8)
Functional Disorders			
Some or several limitations, ADL > 5	36 (5.6)	113 (32.7)	19 (79.2)
Mild cognitive decline, 17 ≤ MMSE < 24	7 (1.1)	13 (3.8)	2 (8.3)
Mild or severe disturbance, GHQ ≥ 4	500 (77.4)	313 (90.5)	24 (100)
Chewing problems	55(8.5)	114 (33)	19 (79.2)
Swallowing difficulties (solids), often	1 (0.2)	20 (5.8)	8 (33.3)
Subjective health perception, Fair or Poor	179 (27.7)	232 (67.1)	24 (100)
Dental health status − subjective self-assessment, Fair or Poor	301 (46.6)	222 (64.4)	22 (91.7)

*Poverty line was determined by a combination of two parameters, a monthly household income and the number of persons living in the house, as follows: income up to 1744 ILS (Israeli shekel) and ≥ 1 persons living in the house; income between 1744 and 3484 ILS (Israeli shekel) and ≥ 2 persons living in the house; income between 3485 and 5254 ILS (Israeli shekel) and ≥ 4 persons living in the house; income between 5255 and 6974 ILS (Israeli shekel) and ≥ 5 persons living in the house; income between 6975 and 8719 ILS (Israeli shekel) and ≥ 7 persons living in the house. †Heart disease (Heart Dis.) − self-report (myocardial infarction and or other heart disease and or heart failure) and or bypass surgery (CABG) and or catheterization (angiogram) with balloon and or catheterization (angiogram) with stent.

Table 5

Portions of food groups, food group categories and selected mean nutrient intakes per day by modified full MNA category scores (at risk of malnutrition vs. normal nutritional status)

	All	MNA ≥ 24	17 ≤ MNA < 24	P value
	Mean (SD)			
Food Groups, Portions				
Milk and Dairy Products	1.4 (1.1)	1.5 (1.0)	1.2 (1.1)	<0.0005
Meat, Fish, Poultry	1.7 (1.6)	1.8 (1.6)	1.6 (1.5)	<0.05
Eggs	0.4 (0.6)	0.4 (0.6)	0.4 (0.6)	N.S
Legumes	0.1 (0.4)	0.1 (0. 4)	0.1 (0.3)	N.S
Cereals	3.9 (2.2)	4.0 (2.2)	3.9 (2.3)	N.S
Cakes and Baked Goods	0.5 (0.8)	0.5 (0.8)	0.4 (0.8)	N.S
Potatoes	0.7 (1.2)	0.6 (1.1)	0.7 (1.2)	N.S
Fruit	1.7 (1.5)	1.75 (1.4)	1.5 (1.6)	<0.05
Vegetables	2.5 (2.0)	2.7 (2)	2.1(2.0)	<0.0001
Nuts and Seeds	0.2 (0.7)	0.3 (0.9)	0.1(0.4)	<0.0001
Fats and Oils	0.9 (1.2)	0.9 (1.1)	0.9(1.5)	N.S
Sweets and Sweet Beverages	2.2 (2.6)	2.2 (2.5)	2.4(2.8)	N.S
Food groups categories				
High protein*	3.6 (1.9)	3.8 (1.9)	3.3 (2.0)	<0.0005
High Complex Carbohydrates†	5.0 (2.5)	5.1 (2.5)	5.0 (2.6)	N.S
High fat‡	1.1 (1.4)	1.2 (1.4)	1.0 (1.5)	<0.01
Nutrients				
Energy, kcal	1511 (600)	1569 (592)	1403 (603)	<0.0001
Energy, kcal/kg body weight	20.9 (9)	21 (8.2)	20.7 (10.5)	N.S
Protein, g	64.7 (29)	67.6 (28)	59.1 (28.6)	<0.0001
Protein % of energy	17.5 (5)	17.7 (5.1)	17.1 (4.9)	N.S
Carbohydrates, g	174 (70.3)	178 (69.8)	167 (71)	<0.05
Carbohydrates % of energy	46.9 (9.7)	46 (9.4)	48.7 (9.9)	<0.0001
Fat, g	58 (33)	61.1 (32.4)	52.3 (33.5)	<0.0001
Fat % of energy	33.4 (8.5)	34 (8.3)	32.2 (8.9)	<0.01
Vitamin C, mg	119 (101)	125 (98)	108 (105)	<0.05
Folate, mcg	283 (153)	296 (161)	258 (135)	<0.001
Vitamin E, mg	6.7 (5.2)	7.2 (5.7)	5.6 (3.7)	<0.0001
Iron, mg	9.4 (5.3)	10 (5.6)	8.3 (4.6)	<0.0001
Zinc, mg	7.8 (4.3)	8.3 (4.6)	6.9 (3.5)	<0.0001
Calcium, mg	594 (312)	625 (290)	535 (343)	<0.0001
Magnesium, mg	314 (158)	332 (160)	282 (148)	<0.0001

*High protein – meat, poultry, fish, eggs, milk and dairy, legumes. †High Complex Carbohydrates – cereals, baked goods (including breads), potatoes. ‡High fat – fats and oils, nuts, seeds

The scores calculated according to the modified full MNA and those calculated according to the modified MNA-SF were compared in most participants, and a kappa coefficient was computed. Additionally, the sensitivity and the specificity of the modified MNA-SF as a screening tool for the 'risk of malnutrition' were computed (with the modified MNA-SF score of ≥ 12 to denote normal nutritional status), using the modified full MNA as a gold-standard.

Results

The study population characteristics are described in Table 3. The elderly with normal nutritional status and those at risk of malnutrition were of about the same age. Compared to the elderly with normal nutritional status, a significantly higher percentage of the elderly at risk of malnutrition were widowed (31% vs. 24%, respectively), lived alone (29% vs. 24%, respectively), lived below the poverty line (18% vs. 12%, respectively), had eight or less years of schooling (32% vs. 17%) and a higher percentage of them had anthropometric measures below normal values. Also, the elderly at risk of malnutrition were more functionally, cognitively and mentally disadvantaged, used more medications and more of them perceived their dental and health status as 'fair' or 'poor', compared to those with normal nutritional status.

According to the modified full MNA score 64% of the elderly had normal nutritional status, 34% were at risk of malnutrition and 2% were malnourished (Table 4). The comparable data for the modified MNA-SF were 66 % with normal nutritional status, 28% at risk of malnutrition and 6% malnourished (data not shown).

In comparison with the two other categories of nutritional status ('normal' and 'at risk of malnutrition'), in the category of malnutrition, the highest rate of the elderly were found to be disadvantaged (Table 4).

According to the full MNA, the elderly 'at risk of malnutrition' compared to those with 'normal nutritional status', consumed significantly less portions of the following food groups: milk and dairy products, meat, fish and poultry, fruits, vegetables and nuts and oils (Table 5). Their energy, macronutrient and selected micronutrient intakes were also significantly lower, as was the number of portions of high protein and high fat foods.

In comparison with the two other categories of nutritional status (normal nutritional status and at risk of

malnutrition), the elderly in the category of malnutrition, consumed the lowest number of portions of high protein and high fat foods, fruits and vegetables groups.

According to the modified MNA-SF, there were no differences between the numbers of each food group portions consumed by the elderly 'at risk of malnutrition' compared to those with 'normal nutritional status'. The only significant differences were found for energy and macronutrients (protein, carbohydrates and fat) as well as for selected micronutrients, with a lower consumption in the elderly at risk (data not shown).

When comparing results for 'risk of malnutrition' vs. 'normal nutrition status', obtained by the modified MNA-SF, to those of the modified full MNA form, the kappa coefficient was 0.83. The sensitivity and the specificity of the modified MNA-SF as a screening tool for the 'risk of malnutrition' (computed using the modified full MNA as a gold-standard) were 85%, and 96%, respectively.

The modified full MNA identified 24 (2.2%) elderly as being 'malnourished', of which 22 were also identified as 'malnourished' by the screening tool. That is to say, 92% of the elderly were accurately categorized by the modified MNA-SF and only two elderly persons were misclassified. However, 43 elderly persons, identified as 'malnourished' by the modified MNA-SF, were not categorized as such by the modified full MNA, yielding a positive predictive value of 34%, and a false positive result of 66% (data not shown).

Discussion

MNA should be as country or culturally and ethnically specific as possible (20). A BMI of < 19 is associated with malnutrition in the original full MNA tool (7). We have adjusted this value to the 5th percentile of the Israeli elderly population 65 years and older and a value of < 22 was set. The 5th percentile of MAC was found to be 24 cm (instead of 21 cm), but the CC was identical to that of the original MNA. According to BMI, CC and MAC, about 12%, 5.8% and 5.2%, respectively, of the MABAT ZAHAV Jewish population, were at risk of malnutrition. In Brazilian patients on admission to hospital the values for those measures were much higher, 36%, 26% and 16%, respectively (5). According to the modified full MNA, the percentage of the elderly at risk of malnutrition was 35%, a proportion corresponding to that found in the Brazilian patients (5) and higher than that found in the Greek population, 23% (1) and in the Japanese population, 13% (21). These results, as well as those of other studies, show that some of the community elderly people possibly need nutritional interventions in order to improve their nutritional status (1, 21).

Elderly people at risk of malnutrition tended to live alone, were less educated, were poorer and with more cognitive, psychological and functional problems, including chewing and swallowing disorders. All these factors are known to cause decreased food intake (22) and are associated with a low diet variety (23). The MABAT ZAHAV elderly 'at risk of malnutrition' compared to those with 'normal nutritional status', indeed consumed significantly less servings of milk and dairy products, meats, fruits, vegetables and nuts and seeds. Consequently, their energy, protein, fat and micronutrient intakes were significantly lower, as also found by Wyka et al (24). Inadequate food intake is the predominant cause of undernutrition in older persons (6, 25, 26).

Comparing the capability of the two modified MNA tools to detect elderly at risk of malnutrition, the sensitivity was 85%, that is, 15% of the elderly were not identified by the MNA-SF as being at risk of malnutrition. Most of them probably were at risk of malnutrition, and not malnourished, because only 24 elderly persons were identified as malnourished by our gold-standard, while 65, by our screening tool. Moreover, the specificity was very high (96%), that is, the modified MNA-SF identified most of the elderly as having normal nutritional status. Practically, those identified either at 'risk of malnutrition' or 'at malnutrition', would be reassessed by professionals and treated appropriately.

Though the specificity of the MNA-SF was high, it traced no differences between the elderly at risk of malnutrition and those with normal nutritional status with respect to the consumption of food group portions. We believe that it is due to the fact that 15% of the misclassified elderly were not identified by the MNA-SF as being at risk of malnutrition. Most of them were probably categorized as malnourished and not included in the comparisons. If they had been classified correctly, we might have seen the same differences relating to food groups consumption as with the modified full MNA.

The study has some limitations as its design is cross-sectional and causality cannot be concluded. The study is also limited by its use of self-reported data. However, prior studies have suggested that self-report provides accurate prevalence estimates for actual diseases, and the concordance between self-report and medical record review is generally good, k = 0.60 (27). Although nutritional evaluation was based on one day 24-h dietary recall, we assume that the self-reported answers for the MNA questions as well as for food consumption were similarly distributed between the elderly.

Conclusions

Since the modified full MNA correctly identifies the elderly at risk of malnutrition and those malnourished, and since it is highly correlated with the scores obtained by the modified MNA-SF, health systems should adopt the MNA-SF as a screening tool and use it within the comprehensive geriatric assessment.

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References

1. Triantafillou G, Vassilakou T. Early identification of free living elderly persons at risk of malnutrition in Athens, Greece. Aging 2011;3:1-13.
2. Odlund AO, Koochek A, Ljungqvist O, Cederholm T. Nutritional status, well-being and functional ability in frail elderly service flat residents. Eur J Clin Nutr 2005;59:261-270.
3. Kaiser MJ, Bauer JM, Christiane Ramsch Ch, Uter W, Guigoz Y, Cederholm T. Frequency of malnutrition in older adults: a multinational perspective using the mini nutritional assessment. J Am Geriatr Soc 2010;58:1734–1738.
4. Bauer JM, Kaiser MJ, Anthony P, Guigoz Y, Sieber CC. The Mini Nutritional Assessment® – Its History, Today's Practice, and Future Perspectives. Nutr Clin Pract 2008 23: 388-396.
5. Leandro-Merhi VA, Braga De Aquino JL, Teixeira De Camargo JG. Agreement between body mass index, calf circumference, arm circumference, habitual energy intake and the MNA in hospitalized elderly. J Nutr Health & Aging 2012;16:128-132.
6. Guigoz Y. Frailty and nutrition: what we have learned from research and clinical practice on the Mini Nutritional Assessment. J Frailty Aging 2012;1:52-55.
7. Guigoz Y, Vellas B and Garry PJ. Mini Nutritional Assessment: A practical assessment tool for grading the nutritional state of elderly patients. Facts Res in Gerontol 1994;Supplement 2:15-59.
8. Rubenstein LZ, Harker JO, Salva A, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). J Gerontol A Biol Sci Med Sci. 2001;56:M366-M372.
9. Kaiser MJ, Bauer JM, Ramsch C, et al. Validation of the mini nutritional assessment short-form (MNA®-SF): a practical tool for identification of nutritional status. J Nutr Health & Aging 2009;13:782-788.
10. Nestle Nutrition Institute. MNA® Mini Nutritional Assessment. http://www.mna-elderly.com.
11. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189-198.
12. Crum RM, Anthony JC, Besset SS, Folstein MF. Population-based norms for the Mini-Mental State Examination by age and educational level. JAMA 1993;269:2386-2391.
13. Malnutrition Advisory Group, a Standing Committee of BAPEN. The 'Must' explanatory booklet: a guide to the 'Malnutrition Universal Screening Tool' ('MUST') for adults. 2003. www.bapen.org.uk.
14. Chumlea WC, Roche AF, Steinbaugh ML. Estimating stature from knee height for persons 60 to 90 years of age. J Am Geriatr Soc 1985; 33:116-122.
15. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The index of ADL: a standardized measure of biological and psychosocial function. JAMA 1963;185:914-919.
16. Mari JJ, Williams P. A comparison of the validity of two psychiatric screening questionnaires (GHQ-12 and SRQ-20) in (ROC) analysis. Psychol Med 1985;15:651-659.
17. Schattner PL, J Coman GJ. The stress of metropolitan general practice. Med J Aust 1998;169:133-137.
18. de Groot LCPGM, Beck AM, Schroll M, van Staveren WA. Evaluating the DETERMINE your nutritional health checklist and the Mini Nutritional Assessment as tools to identify nutritional problems in elderly Europeans. Eur J Clin Nutr 1998;52:877-883.
19. Tsai ACh, Ho Ch, Chang M. Population-specific anthropometric cut-points improve the functionality of the Mini Nutritional Assessment (MNA) in elderly Taiwanese. Asia Pac J Clin Nutr 2007;16:656-662.
20. Chumlea WC. Is the MNA valid in different populations and across practice settings? J Nutr Health Aging 2006;10:524-527.
21. Iizaka Sh, Tadaka E, Sanada H. Comprehensive assessment of nutritional status and associated factors in the healthy, community-dwelling elderly. Geriatr Gerontol Int 2008;8: 24-31.
22. De Castro MJ. Age-related changes in the social, psychological, and temporal influences on food intake in free-living, healthy, adult humans. J Gerontol: Biol Sci Med Sci 2002;57: M368-M377.
23. Marshall TA, Stumbo PJ, Warren JJ, Xie XJ. Inadequate nutrient intakes are common and are associated with low diet variety in rural, community-dwelling elderly. J Nutr 2001;131:2192–2196.
24. Wyka J, Biernat J. Consumption of Alzheimer disease protective nutrients in diets of Polish elderly divided into different nutritional status (MNA). Health 2012;4: 755-761.
25. van Staveren WA, de Groot LCPGM. Evidence-based dietary guidance and the role of dairy products for appropriate nutrition in the elderly. J Am Coll Nutr 2011;30:429S–437S.
26. Tur JA, Colomer M, Monino M, Bonnin T, Llompart I, Pons A. Dietary intake and nutritional risk among free-living elderly people in Palma de Mallorca. J Nutr Health Aging 2005;9:390-396.
27. Tisnado DM, Adams JL, Liu H, et al. What is the concordance between the medical record and patient self-report as data sources for ambulatory care? Med Care 2006;44:132-140.