

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

Y. GUIGOZ

Nestlé Product & Technology Centre, Nestlé-Strasse 3, CH-3510 Konolfingen, Switzerland. Address: Applied Science & Quality Assurance, Nestlé Product Technology Centre, Nestlé Strasse 3, 3510 Konolfingen, Switzerland, Tel.: +41 31 790 1509, Fax: +41 31 790 1552, E-mail: yves.guigoz@rdko.nestle.com

Abstract: To review the literature on the MNA® to Spring 2006, we searched MEDLINE, Web of Science & Scopus, and did a manual search in J Nutr Health Aging, Clin Nutr, Eur J Clin Nutr and free online available publications. *Validation and validity:* The MNA® was validated against two principal criteria, clinical status and comprehensive nutrition assessment using principal component and discriminant analysis. The MNA® short-form (MNA®-SF) was developed and validated to allow a 2-step screening process. The MNA® and MNA®-SF are sensitive, specific, and accurate in identifying nutrition risk. *Nutritional Screening:* The prevalence of malnutrition in community-dwelling elderly (21 studies, n = 14149 elderly) is $2 \pm 0.1\%$ (mean \pm SE, range 0-8%) and risk of malnutrition is $24 \pm 0.4\%$ (range 8-76%). A similar pattern is seen in out-patient and home care elderly (25 studies, n = 3119 elderly) with prevalence of undernutrition $9 \pm 0.5\%$ (mean \pm SE, range 0-30%) and risk of malnutrition $45 \pm 0.9\%$ (range 8-65%). A high prevalence of undernutrition has been reported in hospitalized and institutionalized elderly patients: prevalence of malnutrition is $23 \pm 0.5\%$ (mean \pm SE, range 1-74%) in hospitals (35 studies, n = 8596) and $21 \pm 0.5\%$ (mean \pm SE, range 5-71%) in institutions (32 studies, n = 6821 elderly). An even higher prevalence of risk of malnutrition was observed in the same populations, with $46 \pm 0.5\%$ (range 8-63%) and $51 \pm 0.6\%$ (range 27-70%), respectively. In cognitively impaired elderly subjects (10 studies, n = 2051 elderly subjects), detection using the MNA®, prevalence of malnutrition was $15 \pm 0.8\%$ (mean \pm SE, range 0-62%), and $44 \pm 1.1\%$ (range 19-87%) of risk of malnutrition. *Characteristics:* The large variability is due to differences in level of dependence and health status among the elderly. In hospital settings, a low MNA® score is associated with an increase in mortality, prolonged length of stay and greater likelihood of discharge to nursing homes. Malnutrition is associated with functional and cognitive impairment and difficulties eating. The MNA® detects risk of malnutrition before severe change in weight or serum proteins occurs. *Nutritional Intervention:* Intervention studies demonstrate that timely intervention can stop weight loss in elderly at risk of malnutrition or undernourished and is associated with improvements in MNA® scores. The MNA® can also be used as a follow up assessment tool. *Conclusion:* The MNA® is a screening and assessment tool with a reliable scale and clearly defined thresholds, usable by health care professionals. It should be included in the geriatric assessment and is proposed in the minimum data set for nutritional interventions.

Key words: Elderly, nutritional screening, nutritional assessment, Mini Nutritional Assessment.

Abbreviations used in this paper: MNA®, Mini Nutritional Assessment; MNA®-SF, MNA® screening form; BMI, Body Mass Index.

Introduction

Multidimensional geriatric assessment targeting the elderly who need care is effective when used with follow up visits (1, 2). Geriatric assessment uses well-validated instruments that encompass the major assessment domains: Activities of Daily Living (3), Instrumental Activities of Daily Living (4), Mini-Mental State Examination (5), Geriatric Depression Scale (6), and Tinetti balance/gait evaluation (7). Too little attention, however, has been given to identifying those elderly who would benefit from early detection of malnutrition. The prevalence of malnutrition is relatively low in free-living elderly (2-10%), but rises considerably (30-60%) in the hospitalized or institutionalized elderly (8). Nutritional assessment becomes crucial because progressive undernutrition often goes undiagnosed (9). Therefore, as a first-line strategy, we developed the Mini Nutritional Assessment (Figure 1) to

identify the elderly at risk of malnutrition and guide optimal nutritional intervention (8, 10, 11). The MNA® instrument was validated in a series of studies to assess which geriatric patients are at risk for malnutrition (11). It can be easily administered by health professionals in geriatric clinics or on admission to hospitals and nursing homes to detect patients who could be helped by early nutrition intervention. The MNA® should be integrated in the comprehensive geriatric assessment (12, 13).

Literature search

To review the literature through Spring 2006, we searched MEDLINE (PubMed), Web of Science, & Scopus using the keywords Nutritional Status, Screening, Sensitivity and Specificity, Frail Elderly, Aged, Aged 80 and over, and Mini Nutritional Assessment. In addition, we searched MEDLINE (PubMed) & Scopus further for related articles and completed a

manual search of J Nutr Health Aging, Clin Nutr, Eur J Clin Nutr and free online available publications (including Spanish and French publications). A partial literature review was published in 2002 (10). Finally abstracts from ESPEN and IANA were screened for the word MNA. We found 122 studies that reported the percentage of elderly at risk and malnourished (see tables); only 2 studies found weaknesses in the discrimination potential of the full MNA® (14, 15) and 2 studies of the MNA®-SF (16, 17). Next, 62 reviews of care for the elderly (nutrition or global assessment) including 7 reviews about the MNA® (in 4 languages) were found (see Table 8) with only 4 recommending further evaluation of the test. Finally, 52 abstracts using the MNA® were found at ESPEN and IANA meetings (2002-2005); however, these are not included here.

In summary we found studies performed in over 30,000 elderly subjects in different settings (community, general practitioner, home care, outpatient, hospital, and institution) from different countries and suggest that it is widely used for nutritional screening.

Development and validation of the MNA®

The MNA®, a single and rapid nutrition assessment, was developed to assess nutrition status as part of the standard evaluation of elderly patients in clinics, nursing homes, hospitals, or among those who are otherwise frail. A joint effort of the Centre for Internal Medicine and Clinical Gerontology of Toulouse (France), the Clinical Nutrition Program at the University of New Mexico (USA), and the Nestlé Research Centre in Lausanne (Switzerland), it was validated in 3 studies on more than 600 elderly subjects (8, 11). It was designed to meet the following specifications: 1) reliable scale; 2) clearly defined thresholds; 3) compatibility with the skills of a generalist assessor; 4) minimal opportunity for bias introduced by the data collector; 5) acceptability by patients; and 6) low cost (11, 17).

The MNA® was validated using two principal criteria: 1) Clinical Status, which consisted of a nutrition assessment conducted independently by two physicians trained in nutrition on the basis of the subject's clinical record (including the comprehensive nutritional assessment) without knowledge of the MNA® results; and 2) Comprehensive nutrition assessment, which included a complete assessment of anthropometrics (weight, height, knee height, mid-arm and calf circumferences, triceps and subscapular skinfolds); biochemical markers (albumin, prealbumin, creatinine, transferrin, ceruloplasmin, C-reactive protein, alpha-1-acid glycoprotein, cholesterol, triglycerides, vitamins A, D, E, B1, B2, B6, and B12, folate, copper, zinc, haemoglobin, blood cell count and differential); and dietary intake (3-day food records combined with a food-frequency questionnaire) according to the SENECA study (18). Subjects were classified using principal component and discriminant analysis. Principal component analysis indicated

that the MNA® can be used without clinical biochemistry; this was confirmed by discriminant analysis. Threshold value ranges for risk of malnutrition and malnutrition were 22-24 points and 16-18 points, respectively, on a maximum of 30 points. Exact threshold values were set by cross-tabulation of cut-off values for serum albumin without the presence of inflammation (11).

The full MNA® includes 18 items grouped in 4 rubrics: anthropometric assessment (BMI calculated from weight and height, weight loss, and arm and calf circumferences; items B, F, Q and R); general assessment (lifestyle, medication, mobility and presence of signs of depression or dementia; items C, D, E, G, H and I); short dietary assessment (number of meals, food and fluid intake, and autonomy of feeding; items A, J, K, L, M and N); and subjective assessment (self perception of health and nutrition; items O and P). The full MNA® can be completed in less than 15 minutes. Each answer has a numerical value and contributes to the final score, which has a maximum of 30 (Figure 1). With threshold values of ≥ 24 for well-nourished, 17-23.5 for at risk of malnutrition, and <17 for malnourished, the sensitivity, specificity and positive predictive values according to the clinical status were 96%, 98% and 97% (19).

The MNA® short-form (MNA®-SF) was developed and validated to allow a 2-step screening process in low-risk populations that retains the validity and accuracy of the full MNA® (20). Reanalysis of the MNA® data collected on 881 very frail to healthy, independent elderly subjects in France, New Mexico, and Spain (21) identified six items by a gradual process of simplification using correlations between each item and the MNA® total score, internal consistency (coefficient alpha) and sensitivity and specificity (20). These items were used to redesign the MNA® (see figure 1) as a validated questionnaire for healthy elderly which contains 18 items but is administered in two steps. In Step 1, screening uses the six strongly correlated items that make up the MNA®-SF and takes less than 5 minutes; then, if indicated, Step 2 is an assessment for those at risk of malnutrition and takes approximately 10 minutes (10, 20). The MNA®-SF screening maximum score is 14. Scores ≥ 12 indicate satisfactory nutritional status, with no further requirement. A MNA® screening score ≤ 11 suggests risk for malnutrition and confirmation is done by completing the full MNA® questionnaire (step 2 – assessment). Total scores between 17 and 24 indicate risk of malnutrition, scores <17 indicate undernutrition, and scores >24 indicate satisfactory nutritional status. The MNA®-SF can be used with confidence as an efficient screening tool for community-dwelling elderly subjects undergoing comprehensive geriatric assessment. However, administering the full MNA® might more efficient for nursing home patients (10, 22, 23). A practical guide¹ has been developed that describes in detail the procedure for administering the MNA®.

1. A guide to completing the Mini Nutritional Assessment is available from http://www.mna-elderly.com/practice/user_guide/mna_guide.pdf, accessed February 20, 2006.

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

Figure 1
Mini Nutritional Assessment Form (http://www.mna-elderly.com/practice/forms/MNA_english.pdf)



Mini Nutritional Assessment

MNA®

Last name:

First name:

Sex:

Date:

Age:

Weight, kg:

Height, cm:

I.D. Number:

Complete the screen by filling in the boxes with the appropriate numbers.
Add the numbers for the screen. If score is 11 or less, continue with the assessment to gain a Malnutrition Indicator Score.

Screening

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
0 = severe loss of appetite
1 = moderate loss of appetite
2 = no loss of appetite

B Weight loss during the last 3 months
0 = weight loss greater than 3 kg (6.6 lbs)
1 = does not know
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
3 = no weight loss

C Mobility
0 = bed or chair bound
1 = able to get out of bed/chair but does not go out
2 = goes out

D Has suffered psychological stress or acute disease in the past 3 months
0 = yes 2 = no

E Neuropsychological problems
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems

F Body Mass Index (BMI) (weight in kg) / (height in m²)
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater

Screening score (subtotal max. 14 points)
12 points or greater Normal – not at risk – no need to complete assessment
11 points or below Possible malnutrition – continue assessment

Assessment

G Lives independently (not in a nursing home or hospital)
0 = no 1 = yes

H Takes more than 3 prescription drugs per day
0 = yes 1 = no

I Pressure sores or skin ulcers
0 = yes 1 = no

Ref: Velaz B, Vilas H, Abellan G, et al. Overview of the MNA® - Its History and Challenges. J Nut Health Aging 2006;10:456-465.
Rubenstein LZ, Harker JD, Salva A, Guigoz Y, Velaz B. Screening for Undernutrition in Geriatric Practice: Developing the Short-Form Mini Nutritional Assessment (MNA-SF). J Geront 2001;56A:M366-377.
Guigoz Y. The Mini-Nutritional Assessment (MNA®) Review of the Literature - What does it tell us? J Nutr Health Aging 2006;10:466-487.

© Nestlé, 1994, Revision 2006. N67200 12/99 10M
For more information : www.mna-elderly.com

J How many full meals does the patient eat daily?
0 = 1 meal
1 = 2 meals
2 = 3 meals

K Selected consumption markers for protein intake
• At least one serving of dairy products (milk, cheese, yogurt) per day yes no
• Two or more servings of legumes or eggs per week yes no
• Meat, fish or poultry every day yes no
0.0 = if 0 or 1 yes
0.5 = if 2 yes
1.0 = if 3 yes .

L Consumes two or more servings of fruits or vegetables per day?
0 = no 1 = yes

M How much fluid (water, juice, coffee, tea, milk...) is consumed per day?
0.0 = less than 3 cups
0.5 = 3 to 5 cups
1.0 = more than 5 cups .

N Mode of feeding
0 = unable to eat without assistance
1 = self-fed with some difficulty
2 = self-fed without any problem

O Self view of nutritional status
0 = views self as being malnourished
1 = is uncertain of nutritional state
2 = views self as having no nutritional problem

P In comparison with other people of the same age, how does the patient consider his/her health status?
0.0 = not as good
0.5 = does not know
1.0 = as good
2.0 = better .

Q Mid-arm circumference (MAC) in cm
0.0 = MAC less than 21
0.5 = MAC 21 to 22
1.0 = MAC 22 or greater .

R Calf circumference (CC) in cm
0 = CC less than 31 1 = CC 31 or greater

Assessment (max. 16 points) .

Screening score

Total Assessment (max. 30 points) .

Malnutrition Indicator Score

17 to 23.5 points at risk of malnutrition

Less than 17 points malnourished

MNA® reliability and validity

Reliability can be assessed by a measure of agreement, namely the kappa statistic or intraclass correlation (24). Kappa values of 0.51 were reported for hospitalized elderly patients (25) and 0.78 for institutionalized elderly (26), suggesting a moderate and substantial agreement respectively. An intraclass correlation of 0.89 represents excellent reliability (26). Cronbach's alpha coefficient of 0.65 was reported in elderly in early stage of dementia (27). These results suggest the MNA® test has good reliability.

The rate of correct identification of patients with or without malnutrition can be assessed by the tests of sensitivity and specificity. A high sensitivity is required for screening tests and a high specificity is required for the assessment or the confirmation of disease (28). Table 1 gives a summary of the sensitivity and specificity obtained using the MNA®. From the 13 studies (14, 19, 29-39), only 2 studies found a sensitivity below 70% compared to a detailed nutritional assessment (14) or to BMI <19 and <21 (29); but both studies showed high specificity. These results suggest the validity of the full MNA® to screen for malnutrition in the elderly is very good. The assessment validity of the MNA® using specificity suggests a wider variation, ranging from 13 - 98%, due to the lack of a

gold standard for nutritional assessment. The standard used for specificity ranges from simple anthropometry to a comprehensive nutritional assessment. However, the results from 6 studies that obtained a specificity >70% (Table 1) demonstrate a good reliability for the MNA® assessment (19, 29-31, 34, 38). The screening validity of the MNA®-SF is nearly as good as the MNA® full form, with a sensitivity of 86-96% in 6 different studies (Table 2) (20, 23, 30, 34, 40, 41). This confirms the use of the 2-step procedure for the MNA® (20, 42).

The MNA® pattern of sensitivity and specificity was further illustrated by receiver operating characteristic curves (ROC curves) (34, 38, 43). Good tests have lines that rise steeply and pass close to the top left hand corner, where both the sensitivity and specificity are 1 (28). The areas under the ROC curves (see figure 1 in Kuzuya et al. 2005 (34)) represent the overall accuracy of the MNA® total score as a test for malnutrition. Values of:

- 0.912 (95% CI 0.850 - 0.974) for total cholesterol levels lower than 150 mg/dL (p<0.0001),
- 0.916 (95% CI 0.846-0.985) for albumin levels lower than 3.5 g/dL (p<0.0001), and
- 0.855 (95% CI 0.801-0.908) for BMI lower than 18.5 kg/m². (p<0.0001)

Table 1
Sensitivity and Specificity values of the MNA® when compared to other nutritional parameters

MNA®	Sensitivity	Specificity	References
Clinical Status	96	98	Guigoz Y et al. 1995 (19)
Detailed nutritional assessment	54	61	Azad N et al. 1999 (14)
Albumin (<35 g/l)	75	50	Murphy MC et al. 2000 (36)
Energy intake (<1 SD mean)			
720 kcal/day	100	37	
970 kcal/day	72	32	
Mindex (<50%tile 81.7 kg/m)	81	47	
Detailed nutritional assessment (albumin, BMI, diet history, clinical data)	72	88	Hui WH et al. 2001 (38)
BMI 19	41	86	Thomas DR et al. 2002 (29)
BMI 21	59	78	
BMI 22	70	71	
Protein energy malnutrition (weight, triceps skin fold, arm circumference, albumin & transthyretin)	96	26	Christensson L et al. 2002 (39)
Nutritional assessment (anthropometry, serum proteins)	98	13	Donini LM et al. 2002 (37)
Detailed nutritional assessment	90	88	Visvanathan R et al. 2004 (30)
Nutritional diagnosis (BMI & laboratory testing)	100	74	Delacorte R.R. et al. 2004 (31)
Full nutritional assessment	77	36	Thorsdottir I. et al. 2005 (32)
PG SGA baseline	97	54	Read JA et al. 2005 (33)
PG-SGA 4-6 wk	79	69	
PG-SGA 8-12 wk	82	66	
Hypoalbuminemia	86	82	Kuzuya M et al. 2005 (34)
PEM (anthrop., Alb, Prealb)	73	31	Wikby K et al. 2006 (35)

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

Table 2

Sensitivity and Specificity values of the MNA®-SF when compared to MNA® or other nutritional evaluation

MNA®-SF	Sensitivity	Specificity	References
MNA®	96	98	Rubenstein LZ et al. 2001 (20)
MNA®	86	89	Cohendy R et al. 2001 (40)
MNA® Community	74	95	Borowiak E & Kostka T 2003 (23)
Institution	64	100	
Detailed nutritional assessment	93	38	Visvanathan R et al 2004 (30)
Malnutrition by nutritionist	100	38	
BMI<23	86	71	Ranhoff AH et al (41)
MNA®	86	94	Kuzuya M et al. 2005 (34)

show the accuracy of the MNA® test is good in correctly classifying those with and without malnutrition. ROC curves for the MNA®-SF as a predictor of an MNA® score below 24 show the accuracy of the MNA®-SF is excellent: the area under the curve is 0.961 (20, 34).

Thus the MNA® demonstrates good sensitivity compared to a variety of nutritional parameters (biochemical, anthropometry, or dietary intakes). Attempts have been made to improve specificity by modifying specific questions and/or threshold levels or the use of specific parts of the MNA® (33, 34, 36-39, 43-46). We suggest that reanalyzing the raw data of

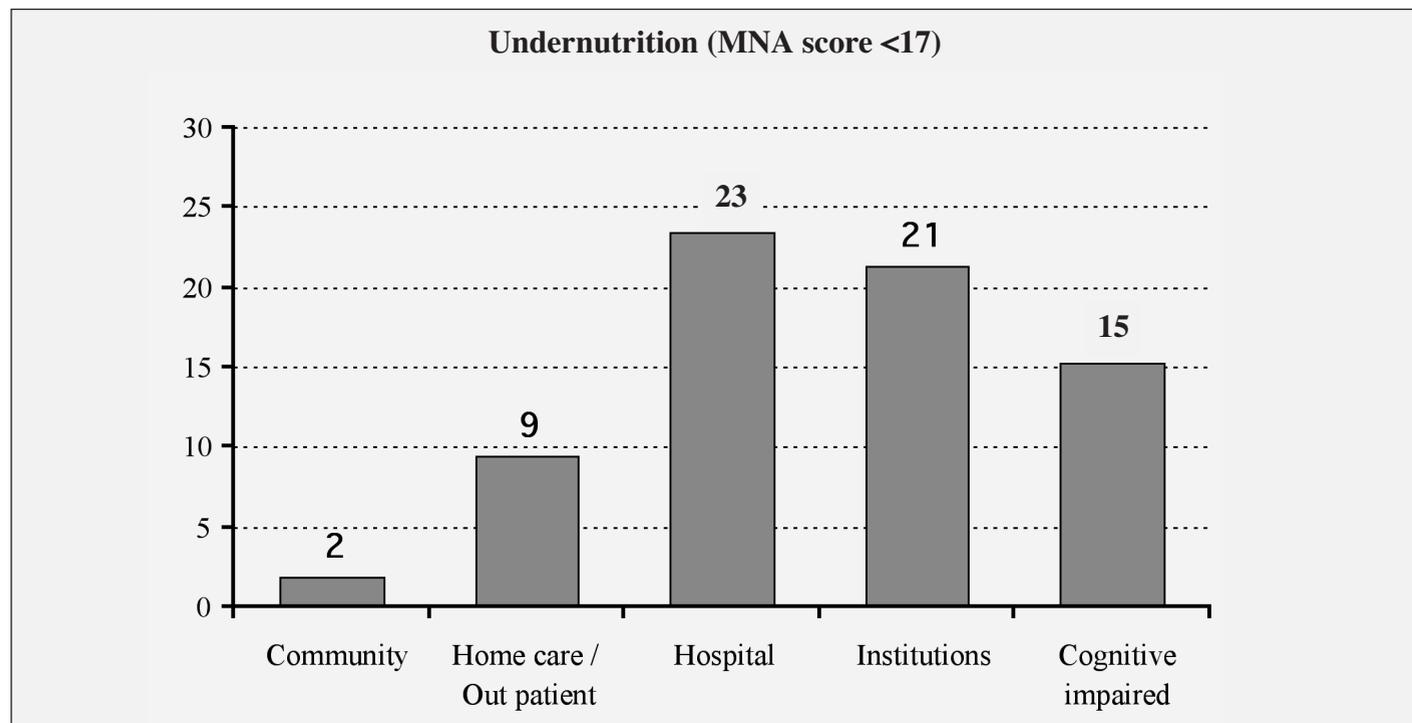
several studies to adjust the threshold values might increase the specificity of the MNA® compared to different nutritional parameters.

Nutritional screening

The MNA® is widely used. Published studies report screenings of ~35,000 elderly subjects in different settings (community, general practitioner, home care, outpatient, hospital, and institution) from different countries (see Figure 2 and Tables 3 - 7).

Figure 2

MNA® and screening for undernutrition. The MNA® is widely used, studies performed in ~ 35,000 elderly subjects in different settings: Community-dwelling Elderly (n = 14149; 21 studies), Home care & Outpatients (n = 3119; 25 studies), Hospital Settings (n = 8596; 35 studies), Institutions (n = 6821; 32 studies), and Elderly subjects with cognitive impairment (n = 2051; 10 studies).
Percentage of undernourished elderly (i.e. MNA® score below 17)



Community

In 23 studies using the MNA® in community-dwelling elderly (n = 14149 elderly), the prevalence of malnutrition was $2 \pm 0.1\%$ (mean \pm SE, range 0-8%) and risk of malnutrition was $24 \pm 0.4\%$ (range 8-76%). $74 \pm 0.4\%$ (range 16-100%) of subjects were well-nourished (Table 3). A recent study in Taiwan in a representative cohort of elderly >53 years of age (n = 4440) showed the proportion of free-living elderly who were malnourished increased from 1% to 8% with advancing age from >60 to >80 years old, while those at risk for malnutrition increased from 10% to 30% (44, 47, 48). The low prevalence of malnutrition, $2 \pm 0.1\%$, indicates that the MNA® is sensitive and specific. However, early detection of the risk of malnutrition is important since it has been associated with diminished cognitive function, diminished self-care ability (49-52), bad teeth, poor eyesight, and problems using a fork and knife (53). Simple corrective measures can be taken, such as providing a nutrition program, helping with shopping and cooking, providing meals-on-wheels, or more simply providing adaptive cooking tools (10, 54, 55).

Frail Elderly

Twenty-five studies have been published using the MNA® as a screening tool in more frail elderly subjects, i.e. those who visited their general practitioner, or were clinic outpatients or received home care (n = 3119 elderly). They report a prevalence of undernutrition of $9 \pm 0.5\%$ (mean \pm SE, range 0-30%), risk of malnutrition of $45 \pm 0.9\%$ (range 8-65%), and well-nourished subjects of $50 \pm 0.9\%$ (range 11-91%) (Table 4). Elderly at risk of undernutrition who contacted their general practitioner had higher prevalences of low BMI, insufficient energy intake, need of meals-on-wheels and help with shopping, and hospitalization. In home-care elderly, more patients in the risk group ate alone, had difficulty buying their own food, and had fewer prepared complete meals. BMI alone does not detect many of the patients at risk of malnutrition. That, and the observation that over half of malnourished and at risk patients had no meal support, shows the importance and utility of screening. Identifying the major contributing causes of malnutrition and critically reviewing the diet should allow for targeted corrective measures.

Hospitalized elderly

In 36 studies of hospitalized elderly patients (n = 8596), the prevalence of malnutrition is $23 \pm 0.5\%$ (mean \pm SE, range 1-74%), risk of malnutrition is $46 \pm 0.5\%$ (range 8-63%) and well-nourished subjects is $31.5 \pm 0.5\%$ (range 6-68%) (Table 5). Except for preoperative elective surgical patients who were not institutionalized, the MNA® classified 50-80% of the geriatric patients as being at risk of malnutrition or undernourished. Over 90% of subjects admitted to sub-acute care were either at risk of malnutrition or malnourished on admission (29). Geriatric Depression Scores were higher in malnourished subjects than in those who were at risk (29). Low

MNA® scores are predictive of adverse outcomes including longer lengths of stay, more frequent discharges to a nursing home, and a nearly threefold increase in mortality (25, 29, 43, 56-61). Outcomes after liver transplantation were, however, not influenced by nutritional parameters (SGA and MNA® scores, albumin and prealbumin) (62). Lung functional indexes were not related to nutritional status, cognitive performance or disabilities in elderly free from cardiac and respiratory diseases (63). On follow up, decreased mean MNA® scores were seen in patients with lower BMI and albumin (64), patients with open ulcers (65) and patients receiving chemotherapy (66). Identifying malnourished or at risk patients early should facilitate timely initiation of nutrition support while further investigation of the type and cause of malnutrition continues. MNA®-SF can be used as a first step for screening pre-operative patients (40).

Institutionalized elderly

In 32 studies of institutionalized elderly subjects (n = 6821 elderly) using the MNA®, the prevalence of malnutrition was $21 \pm 0.5\%$ (mean \pm SE, range 5-71%) and risk for malnutrition was $51 \pm 0.6\%$ (range 27-70%). The prevalence of well-nourished subjects was $29 \pm 0.5\%$ (range 4 -61%) (Table 6). The wide range in prevalence of malnutrition in retirement homes (5%) vs. nursing homes (20%) vs. long term care (70%) is mainly due to the level of dependence and health status of the elderly in the different settings. Divided according to accommodation, malnutrition was 21% in service flats, 33% in old people homes, 39% in group living for demented, and 71% in nursing homes (10). The effect of age is not always observed in malnourished subjects and those at risk of malnutrition (47), yet there is a worsening of nutritional status with age (67). Nevertheless, nutritional intervention (supplements or buffet dining) can be effective (68, 69). While nursing homes are becoming the place for terminal care, the trend is to keep the frail and dependent elderly in the community (70).

Cognitively impaired elderly

In cognitively impaired elderly subjects (11 studies, n = 2051 elderly subjects) who were screened using the MNA®, the prevalence of malnutrition was $15 \pm 0.8\%$ (mean \pm SE, range 0-62%), risk of malnutrition was $44 \pm 1.1\%$ (range 19-87%), and well-nourished was $41 \pm 1.1\%$ (range 0 -80%) (Table 7). The different levels of cognitive impairments and settings (living at home or institutionalized) account for the wide ranges. Impaired cognitive function induces dependence in the activities of everyday life, particularly related to eating (27, 71-77). Weight loss and malnutrition is a complication of Alzheimer's disease (78); however, regular follow up of subjects at risk of malnutrition and efficient care can delay weight loss (79, 80). One year follow-up of elderly subjects with Alzheimer's disease living at home showed that lower nutritional status, measured by the MNA®, is related to risk of

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

Table 3

Nutritional screening in free-living elderly: In community-dwelling elderly (23 studies, n = 14149 elderly) using the MNA®, a prevalence of 2 ± 0.1% (mean ± SE, range 0-8%) of malnutrition, 24 ± 0.4% (range 8-76%) of risk of malnutrition and 74 ± 0.4% (range 16-100%) of well-nourished were detected

Setting/Conditions	#Subjects	Age [year]	Nutritional status evaluation		Pub Year	Country	References
			Under-nourished <17	At risk of malnutrition 17-23.5			
1. New Mexico Aging Process Study	330	77 + 6	1	18	1994	USA	Guigoz Y et al (1994) (11) Vellas et al (1999) (88)
2. Community elderly City of Mataro	199	72 ± 5	1	10	1996	Spain	Scheirlinckx K et al (1999) (135) Salva A et al (1996 & 1999) (21) (174)
3. Non-Hispanic white elderly	420	>75	0	15	1997	USA	Guigoz Y et al (1997) (175)
4. SENECA study	783	>70	1	44	1998	Europe	De Groot LC et al (1998) (176)
5. SENECA study	171	>70	0	22	1999	Denmark	Beck AM et al (1997 & 1999) (141;177)
6. Hispanic elderly	356	>65	1	27	1999	USA	Pareo-Tubbeh SL et al (1999) (178)
7. Inner city African Americans	134	> 70	2	39	1999	USA	Miller DK et al (1999) Morley JE et al (1999) (179;180)
8. Random selection of elderly aged 75 years living at home in Warsaw	102	75	1	16	1999	Poland	Chartewska J et al (1999) (181)
9. Elderly persons in the community, Jerusalem	463	>70	1	8	2000	Israel	Maaravi Y et al (2000) (124)
10. Free-living elders	97	76 (70-90)	0	33	2001	Chili	Urteaga C et al. (2001) (15)
11. Elderly in rural and semi-rural regions of central Greece	502	74 ± 7	3	28	2002	Greece	Spatharakis GC et al. (2002) (182)
12. Elderly selected among 7 Spanish regions (Andalucia, Catalunya, Galicia, Madrid, Murcia, Navarra & Valencia)	3459	73 ± 2	4	34	2001	Spain	Spanish Geriatric Oral Health Research Group. (2001) (129)
13. Older Hispanics living independently	51	70 (52 - 92)	2	33	2002	USA	Ramon JM et al. (2001) (47) Kicklighter JR & Duchon D. (2002) (183)
14. Home living retired elderly, Tallinn	51	51- 97	0	26	2002	Estonia	Saava M & Kisper-Hint I (2002) (117)
15. Free-living elderly participating in congregate meal-site programs	69	50-90	3	32	2004	USA	Davidson J & al. (2004) (184)
16. Older persons living in the community	42	71 + 7	0	31	2004	Brazil	Delacorte RR et al (2004) (31)
17. Retiree residents from a community, Shanghai	115	68 ± 9	2	19	2004	China	Fei XF et al. (2004) (118)
18. Representative randomly selected elderly >53 yrs	910	>53	1	8	2004	Taiwan	Tsai AC et al. (2004) (44)
	1180	50-60	2	12			
	1820	60 - 70	4	15			
	530	70 - 80	5	24			
	1564	>80	8	76			
19. Elderly volunteers living in Ankara individuals aged 70-75	128	70-75	0	17	2005	Turkey	Kucukerdomez O et al. (2005) (142)
20. "Middle class" non-institutionalized elderly >53 yrs	240	82 + 9	5	39	2005	USA	Eriksson BG et al. (2005) (49)
21. Community-dwelling elders	82	≥ 65	0	0	2005	France	Chen CC et al. (2005)(130) Rolland Y et al. (2005) (185)
22. Active healthy elderly women	351	73 + 2	0	7	2006	Sweden	Salminen H et al. (2006) (136)
23. Elderly free-living women							

institutionalization (72), and patients with Alzheimer's disease admitted to the hospital as an emergency had low MNA® scores (81). A nutrition education program intended for caregivers of AD patients can have a positive effect on weight and cognitive function (82). Within the REAL.FR research program on Alzheimer's disease, about three-fourths of the subjects had difficulties preparing meals and 40% had lower MNA® scores on initial evaluation (74). Intervention in patients with Alzheimer's disease can reduce morbidity and mortality (83, 84).

Characteristics of the MNA®

The MNA® is easy to administer, patient-friendly, and inexpensive requiring no laboratory investigations. It is very sensitive & specific (19, 30, 31, 34), and reproducible (25, 26). The 6-item MNA®-SF is effective for nutrition screening (34, 36, 40, 85, 86) and should be followed by full MNA® assessment for subjects at risk of malnutrition.

Nutritional status evaluated by the MNA® correlated with energy and nutrient intakes (for carbohydrates, fiber, calcium, vitamin D, iron, vitamin B6, and vitamin C) (87, 88). Diets low in energy were inadequate in micronutrients (76, 89, 90). Energy intake was below estimated requirements in subjects classified as malnourished or subjects at risk for malnutrition (91). Low MNA® scores were related to reduced appetite, as well as to difficulties in chewing and swallowing, bad teeth, poor eyesight, and problems using a fork and knife (10, 27, 91-94).

Nutritional status evaluated by the MNA® also correlated with anthropometric and biological nutritional parameters (for albumin, prealbumin, transferrin, cholesterol, retinol, alpha-tocopherol, 25-OH cholecalciferol, and zinc) and hematological measures (hematocrit and hemoglobin), supporting the sensitivity and specificity of the MNA® (67, 87, 88, 95). A correlation between MNA® and albumin was observed in several studies (34, 36, 59, 75, 96-98), but not in all, which was probably related to the presence of inflammation. Furthermore, the MNA® detects risk of malnutrition before changes in serum proteins occur in relatively healthy elderly (31, 99). In the presence of inflammation, no correlation is observed between the MNA® and prealbumin (100), and measuring inflammatory markers along with prealbumin is recommended to further investigate the presence of an active inflammatory response before planning treatment (101-103). A relationship between oxidative stress and risk of malnutrition was observed in elderly subjects (104); however, there was no relation observed between serum zinc values, suggesting other confounding effects (105). Malnutrition was also associated with low leptin levels and insulin resistance (106). While the MNA® score does not correlate with total lymphocyte counts, immune function is impaired with an MNA® score indicative of malnutrition (98, 107-109).

A significant correlation was observed between nutritional

status assessed by MNA® and fat free mass and/or grip strength (85, 100, 110-113). Weight loss is also a significant parameter in the MNA® assessment (36, 91, 114, 115), and anthropometric parameters correlate with MNA® scores in most studies. When the weight loss question is removed, the MNA® loses its sensitivity (116). Risk of malnutrition is also found in the elderly with overweight (94, 117-119).

MNA® scores also reflect the degree of autonomy enjoyed by the elderly (23, 25, 46, 49, 50, 53, 60, 61, 91, 96, 99, 120-123). Malnutrition is associated with functional impairment, cognitive impairment, and difficulties in chewing and swallowing. A decline in food intake, leaving snacks uneaten, and oral health problems were also linked with malnutrition (27, 53, 92-94, 115, 124-132). Furthermore, in nursing homes and hospitals, the number of drugs taken correlated with the MNA® (25, 114, 127, 133). Depression scores were higher in malnourished subjects (29, 61, 130, 134). These results underline the strength of the MNA®, which comprises elements relating to life style of the elderly as well as objective clinical parameters. Risk of malnutrition results in lower dietary intakes (36, 89), and, for some patients, insufficient intakes to cover energy needs (91). Nutritional status assessed by the MNA® upon admission reflects the patient's nutritional condition, degree of autonomy, and current treatment, with low scores being associated with poorer outcomes (10, 29, 30, 85).

A MNA® threshold score of ≥ 27 seems to be related to successful aging, the lowest risk of death within 3 years and a diminished risk for osteoporosis (50, 53, 135, 136). Food pattern questions correlate with better food habits (137).

All parts of the MNA®, including anthropometric, global, dietetic and subjective items, are significant in screening for malnutrition, and the predictive power for each MNA® item depends on the setting (26, 35, 36, 38, 39, 43, 89, 92, 97, 100, 115, 138). The key benefit of the MNA® is that it detects the risk of malnutrition early before severe changes in weight or albumin levels occur (88, 89, 99).

Compared with other screening tools, the MNA® was shown to be better or as effective as the Subjective Global Assessment (SGA). It is better than the SGA for early screening (39, 45, 59, 85, 139, 140) and more specific than Nutrition Screening Initiative checklist (141, 142). It has also been used to validate other nutritional screening tests (16, 32, 111, 143, 144, 145), as recommended by Omran and Morley (146, 147).

Nutritional intervention

Intervention studies, with increased food choices in meals-on-wheel services (55) or with nutritional supplements (83, 101, 102, 148-155), demonstrate that timely intervention can stop weight loss in elderly who are at risk of malnutrition or undernourished. Intervention is also cost effective (153, 156). In intervention studies, elderly subjects improved or maintained their MNA® scores after nutritional intervention, suggesting that the MNA® can also be used as a follow-up nutritional

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

Table 4
Nutritional screening in frail elderly. In more frail elderly subjects (patients visiting their general practitioner, clinic outpatients or elderly with home-care: 25 studies, n = 3119 elderly) using the MNA®, prevalence of undernutrition was 9 ± 0.5% (mean ± SE, range 0-30%), 45 ± 0.9% (range 8-65%) for risk of malnutrition and 50 ± 0.9% (range 11-91 %) for well-nourished

Setting/Conditions	#Subjects	Age	Nutritional status evaluation % of subjects	Pub Year	Country	References
			Under-nourished <17 At risk of malnutrition 17-23.5 Well-nourished ≥24			
1. Home care Elderly patients with leg and foot ulcers living in their own homes	70	79	3	1999	Sweden	Wissing U et al (1999) (186)
2. Follow-up of elders with leg-ulcers	43	83	13	2001	Sweden	Wissing U et al (2001) (65)
3. Home care	529	78 ± 9	6	1999	Belgium	Ridder D et al (1999) (187)
4. Outpatient Elderly patients visiting the university teaching hospital outpatient clinic	53	80 ± 7	2	1999	Switzerland	Decrey H et al (1999) (188)
5. Home care Elderly receiving home nursing care	80	84 ± 6	3	2000	Sweden	Saletti A et al (2000) (70)
6. Community geriatric outpatient clinic	463	70	1	2000	Israel	Maaravi Y et al (2000) (124)
7. General practitioner: Patients over 65 year not acutely ill and who contacted their general practitioner	61	75 (72-79)	0	2001	Denmark	Beck AM et al (2001) (51)
8. Outpatient Elderly patients referred to a geriatric outpatient clinic	56		11	2001	UK	Cottee M et al (2001) (189)
9. Patient over 65 y in general practice, with no acute illness.	61	75 (71-80)	0	2001	Denmark	Beck AM et al (2001) (51)
10. Outpatient Elderly lived at home in Tallinn	150	58-86	1	2002	Estonia	Saava M et al (2002) (117)
11. Elderly admitted to municipal care	261	84 + 7	23	2002	Sweden	Christensson et al (2002) (39)
12. Domiciliary care clients (190)	173	67 - 99	5	2003	Australia	Visvanathan R et al (2003)
13. Frail elderly receiving support services	51	84 ± 4	1	2003	Finland	Soini H et al (2003) (125)
14. Elderly living at home, receiving Meals-on-Wheels (MOW)	324	60-90	24	2003	USA	Kretzer AJ et al (2003) (55)
15. Municipal home-care services in rural Finland.	178	>75 (75-94)	3	2004	Finland	Soini H et al (2004) (115)
16. Home living elderly Swedish women	351	~73	0	2004	Sweden	Salminen H et al (2004)(191)
17. Outpatients	215	>60	4	2004	Turkey	Sakarya M et al (2004) (192)
18. Home-care Patients	104	>65	20	2004	Spain	Ricart Casas J (2004) (122)
19. Elderly in various settings	226	78.6 + 0.5	20	2005	Japan	Kuzuya M et al (2005) (34)
20. Elderly living at home in 5 Swedish municipalities	353	82 ± 7	8	2005	Sweden	Saletti A et al (2005) (70)
21. Patients living at home and receiving home health care services	51	76-93	0	2005	Finland	Soini H et al (2005) (132)
22. Community-dwelling and frail elderly	187	>60	5	2005	South Africa	Charlton KE et al (2005) (145)
23. Apartment residents (123)	67	70 ± 2.5	0	2005	Canada	Lawrence HP et al (2005)
24. Elderly service flat residents (91)	80	85.5 (79-90)	30	2005	Sweden	Ödlund Olin A et al (2005)
25. Residential homes	127	>65	20	2006	Sweden	Wikby K et al (2006) (35)

Table 5
Nutritional screening in hospitalized elderly. In hospitalized elderly (36 studies, n = 8596) using the MNA®, prevalence of malnutrition was $23 \pm 0.5\%$ (mean \pm SE, range 1-74%), risk of malnutrition was $46 \pm 0.5\%$ (range 8-63%) and well-nourished subjects $31.5 \pm 0.5\%$ (range 6-68%)

Setting/Conditions	#Subjects	Age	Nutritional status evaluation % of subjects		Pub Year	Country	References
			Under-nourished <17	At risk of malnutrition 17-23.5			
1. Acute care Elderly patients admitted for acute medical pathology in geriatric units of hospital	39	79 \pm 9	17	58	24	Belgium	Gazzotti C et al (1997) (193)
2. Geriatric medicine Assessment on admission to hospital	166	>70	15	33	52	Switzerland	Quadri P et al (1999) (57)
3. Acute care elderly patients	151	84 (70-99)	26	52	22	Belgium	Joosten E et al (1999)(194)
4. Acute care general surgery and neurosciences	152	>65	15	44	41	Canada	Azad N et al (1999) (14)
5. Acute care. Elderly patients, not institutionalized, scheduled for elective surgery	419	72 (60 - 98)	7	25	68	France	Cohendy R et al (1999) (195)
6. Acute care	299	83 \pm 8	24	45	31	France	Compan B et al (1999) (157)
Sub-acute care	196		32	55	13		
Long-term care	423		25	50	25		
7. Geriatric Medicine elderly patients admitted to the regional university hospital	175	80 \pm 8	22	49	30	Belgium	Gazzotti C et al (2000) (25)
8. Internal Medicine	101	80 \pm 6	8	46	47	France	Clement A et al (2000) (111)
9. Acute care Orthopedic ward patients admitted for emergency surgery	49	60 -103	16	47	37	UK	Murphy MC et al (2000) (36)
10. Geriatric medicine Assessment on admission to hospital	1145	84	19	60	21	Switzerland	van Nes MC et al (2001) (56)
11. Hospital, General Medicine	408	63 (>60)	19	43	38	France	Gin H. et al (2001) (196)
Hospital, Surgery	113		21	44	35		
Hospital, Geriatry	75		53	41	6		
12. Geriatric ward of a general hospital	126	83 \pm 7	31	51	18	Belgium	Peppersack T et al (2002) (101)
13. Acute geriatric inpatient ward.	83	76 \pm 13	26	56	18	Sweden	Persson M et al (2002) (85)
14. Sub-acute care	837	81 \pm 8	29	63	9	USA	Thomas DR et al (2002) (29)
15. Geriatric hospital admissions	486	81 \pm 8	74	23	3	Italy	Donini LM et al (2002) (37)
16. Geriatric hospital	167	82 \pm 8	2	30	68	Italy	Donini LM et al (2003) (58)
17. Inpatient geriatric service of an university hospital and a geriatric ward of a non-academic teaching hospital	298	> 60	61	93	2003	The Netherlands	Rypkema et al (2003) (153)
18. Demented patients admitted to an Alzheimer section	174	80 \pm 8	36	48	17	Italy	Magri F et al (2003) (75)
19. Patients over 60-year admitted in hematology department	123	74 (60-97)	13	36	51	France	Bauduer F et al . (2003) (114)
20. Patients admitted to 5 regional hospitals	43	79 (68-94)	21	29	50	Australia	Barone L et al (2003) (45)
21. Geriatric convalescence unit (intermediate care facility)	118		46	47	8	Spain	Arellano Perez M et al (2004) (64)
22. Patients with various forms of advanced cancer about to start palliative chemotherapy	71	> 65	13	63	24	Australia	Slaviero KA et al (2003) (103)

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

Table 5 (continued)

Nutritional screening in hospitalized elderly. In hospitalized elderly (36 studies, n = 8596) using the MNA®, prevalence of malnutrition was 23 ± 0.5% (mean ± SE, range 1-74%), risk of malnutrition was 46 ± 0.5% (range 8-63%) and well-nourished subjects 31.5 ± 0.5% (range 6-68%)

Setting/Conditions	#Subjects	Age	Nutritional status evaluation		Pub Year	Country	References
			Under-nourished <17	At risk of malnutrition 17-23.5			
23. Older men with prostate cancer	Total = 80	> 65 (65-94)			2004	Lithuania	Toliusiene J et al (2002,2004) (197, 198)
GROUP A: Advanced	40		10	50			
GROUP B: Benign	40		0	8			
24. First visit to a geriatric clinic for surgery	204	77.5 ± 6	8	37	2004	Spain	Esteban M et al (2004) (99)
25. Patients on discharge from surrounding acute hospitals. Hampstead Rehabilitation Centre in Adelaide, a sub-acute care facility	65	>65	29	46	2004	Australia	Visvanathan R et al (2004) (30)
26. Rehabilitation unit at the Repatriation General Hospital	133	81 ± 6	6	47	2005	Australia	Neumann SA et al (2005) (60)
27. Patients attending medical oncology day centers	157	65 (32-81)	9	57	2005	Australia	Read JA et al (2005) (33)
28. Acute care geriatric wards	80	80 ± 8	33	38	2005	Germany	Bauer JM et al (2005) (59)
29. Patients admitted to hospital	200	81 ± 7	50	38	2005	Spain	Gomez Ramos et al (2005) (95;199)
30. Patients admitted to hospital	145		68	30	2005	Spain	Izaola O et al (2005) (97)
31. Patients from a geriatric hospital	414	≥75	49	33	2005	Israel	Kagansky N et al (2005) (43)
32. Elderly institutionalized in geriatric units	126	60 - 96	6	48	2005	Venezuela	Rodriguez N et al (2005) (200)
33. Patients referred to hospital	120	80 ± 7	17	44	2005	China(Hong-Kong)	Shum NC et al (2005) (46)
34. Acute care	204	74 ± 6	1	39	2006	Israel	Castel H et al (2006) (61)
35. Patients who underwent major elective surgery	202	55 ± 15	17	73	2006	Turkey	Kuzu MA et al (2006) (139)
36. Elderly non-diabetic patients on admission to hospital	29	86 ± 6	21	59	2006	Switzerland	Bonin-Guillaume S et al (2006) (106)

Table 6

Nutritional screening in institutionalized elderly. In institutionalized elderly subjects (32 studies, n = 6821 elderly), using the MNA®, prevalence of malnutrition was 21 ± 0.5% (mean ± SE, range 5-71%), risk of malnutrition was 51 ± 0.6% (range 27-70%), and well-nourished was 29 ± 0.5% (range 4 -61%). The large variability results mainly from the differences in level of dependence and health status among the elderly living in retirement homes, nursing homes, or long-term care facilities

Setting/Conditions	#Subjects	Age	Nutritional status evaluation		Pub Year	Country	References
			Under-nourished <17	At risk of malnutrition 17-23.5			
1. Medical nursing facility	77	86 ± 9	32	43	1999	France	Meneceier P et al (1999) (128)
2. Residential home residents	100	>65	5	41	1999	Slovakia	Hrabinska L et al (1999) (201)
3. Retirement homes residents	107	65 - 104	21	62	1999	Poland	Adamska-Skula M & Lutynsky R (1999) (202)

Table 6 (continued)
Nutritional screening in institutionalized elderly. In institutionalized elderly subjects (32 studies, n = 6821 elderly), using the MNA®, prevalence of malnutrition was 21 ± 0.5% (mean ± SE, range 5-71%), risk of malnutrition was 51 ± 0.6% (range 27-70%), and well-nourished was 29 ± 0.5% (range 4-61%). The large variability results mainly from the differences in level of dependence and health status among the elderly living in retirement homes, nursing homes, or long-term care facilities

Setting/Conditions	#Subjects	Age	Nutritional status evaluation % of subjects		Pub Year	Country	References
			Under-nourished <17	At risk of malnutrition 17-23.5			
4. Nursing home	100	85 ± 9	21	60	19	Italy	Molaschi M et al (1999) (203)
5. Nursing home elderly with dementia	51	86 ± 8	41	45	14	France	Lauque S et al (1999) (71)
6. Nursing home-elderly without dementia	24	90 ± 4	21	42	38	France	Lauque S et al (1999) (71)
7. Community setting	261	84 ± 7	23	56	21	Sweden	Christensson L et al (1999) (204)
Elderly admitted from home							
8. Nursing home	87	82 ± 8	6	47	47	Spain	Salvà A et al (1999) (174)
9. Retirement homes	81	83 ± 7	2	37	61	Belgium	Griep MI et al (2000) (127)
10. Long term care	431	>60	71	26	4	Italy	Donini LM et al (2000) (205)
11. Long term care	77	86 ± 9	32	43	25	France	Menecier-Ossia L et al (2000) (68)
12. Institution (all)	872	84.5 ± 8	36	48	16	Sweden	Saletti A et al (2000) (70)
13. Rehabilitation unit	73	80 ± 8	23	67	10	Switzerland	Liver C et al (2000) (110)
14. Long term care settings	107	82 ± 8	21	52	26	Hong-Kong	Hui WH et al (2001) (38)
15. Institutionalized elderly Chinese	120	>60	21	52	26	China	Hui WH et al (2001) (38)
16. Spanish institution		>65				Spain	Ramon JM et al (2001) (47)
Women	134		5	38	58		
Men	255		9	46	45		
17. Nursing home	150	58 - 96	1	27	73	Estonia	Saava M & Kisper-Hint IR (2002) (117)
18. Nursing home	66	>65	32	55	9	Denmark	Beck AM et al (2002) (152)
19. Municipal care	261	65 -107	23	56	21	Sweden	Christensson et al (2002)(39)
20. Long term geriatric unit Mataró	67	83 ± 8	24	37	39	Spain	Bleda MN et al (2002) (26)
21. Nursing homes	205	>65	35	51	24	Spain	Ribeiro Casado JM (2002) (165)
	94	79	5	45	50		
22. Institutionalized patients with a diagnosis of AD according to NINCDS/ADRDA criteria from 8 nursing homes	99	86.5 ± 6	17	68	14	Spain	Gregorio PG et al (2003) (83)
23. Institutionalized older women	89	85 ± 6	8	82	30	Spain	Ruiz-López MD et al (2003) (89)
24. Nursing homes residents	90	86 ± 6	13	63	23	Switzerland	Gerber V et al (2003) (96)
25. Nursing Home elders with pressure ulcers	24	>65	54	29	17	USA	Hudgens JH et al (2004) (108)
26. Elderly from a geriatric home	63	>60	14	70	16	Venezuela	Peña E et al (2004) (119)
27. Nursing home residents	50	81	16	54	30	Spain	Villaverde Gutierrez C et al (2004) (138)
28. Two municipal service flat complexes	80	79-90	30	59	11	Sweden	Odlund Olin A et al (2005) (91)
29. All nursing homes in Helsinki community						Finland	Suominen M et al (2004) (76)
Women	1696	84 ± 8.5	30	60	9		
Men	409	79.5 ± 8.5	23	61	17		
30. Subjects from residential homes	237	83 ± 9	5	60	35	Italy	Cairrella G et al (2005) (94)
31. Elderly institutionalized patients	153	77 ± 10	19	46	36	Brazil	Alves de Rezende CH et al (2005) (67)
32. Nursing home & chronic care	31	65 ± 3	7	48	45	Canada	Lawrence HP et al (2005) (123)25

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

Table 7

Nutritional screening in cognitively impaired elderly. In cognitively impaired elderly subjects (11 studies, n = 2051 elderly subjects), detection using the MNA®, prevalence of malnutrition is 15 ± 0.8% (mean ± SE, range 0–62%), 44 ± 1.1% (range 19–87%) of risk of malnutrition and 41 ± 1.1% (range 0–80%) well-nourished. The large variability results mainly from the differences in level of dependence and health status among the elderly living in retirement homes, nursing homes, or long-term care facilities

Setting/Conditions	#Subjects	Age	Nutritional status evaluation % of subjects			Pub Year	Country	References
			Under-nourished <17	At risk of malnutrition 17-23.5	Well-nourished ≥24			
1. Elderly subjects with dementia in a nursing home	51	86 ± 7.5	41	45	14	1999	France	Lauque S et al (1999) (71)
2. Psychogeriatric hospital Day patients	133	75 ± 7	14	54	32	1999	Switzerland	De Mendonca Lima CA et al (1999) (206)
3. Home living Alzheimer's disease elderly patients	100	76 ± 12	6	36	58	2001	France	Rivière S et al (2001) (82)
4. Home living Alzheimer's disease patients (ELSA study)	318	75 (45-89)	1	19	80	2001	France	Andrieu S et al (2001) (72)
5. Memory Clinic Community dwelling subjects referred to a memory clinic	123	75 ± 7	2	33	64	2001	Ireland	Fallon C et al (2001) (207)
6. Demented patients admitted to an Alzheimer's section	174	80 ± 8	36	48	17	2003	Italy	Magri F et al (2003) (75)
7. REAL.FR, Alzheimer's disease	479	77 ± 7	5	35	61	2003	France	Brocker P et al (2003) & Gillette-Guyonnet S et al (2003) (73) (74)
8. Elderly with perceived impaired memory	59	74 (52-86)	14	63	24	2003	Sweden	Holm B & Söderholm O (2003) (27)
9. Cognitive impaired patients, geriatric convalescence unit	63	80 ± 8	62	37	2	2004	Spain	Arellano M et al (2004) (208)
10. Elderly residents with dementia in a nursing home	23	69 - 89	13	87	0	2004	Finland	Suominen M et al (2004) (76)
11. AD patients living at home	528	76 ± 6	0	26	74	2005	France	Nourhashemi F et al (2005) (77)

Table 8

Reviews citing MNA® as screening tool

Title	Country	Year	Reference
- Anorexia of aging: physiologic and pathologic	USA	1997	Morley JE (147)
- Study design for nutritional assessments in the elderly	Canada	1999	Payette H et al (209)
- Nutritional evaluation tools in the elderly	France	1999	Lauque S et al (210)
- Assessment of nutritional status in elderly: methodology and problems	Sweden	1999	Cederholm T (211)
- Practical and validated use of the Mini Nutritional Assessment in geriatric evaluation	USA	1999	Garry PJ and Vellas BJ (88)
- Use of nutritional scores to predict clinical outcomes in chronic diseases	France	2000	Schneider SM & Hebuterne X (212)
- Management of Cancer in the Older Person: A Practical Approach	USA	2000	Balducci L & Extermann M (160)
- Position of the American Dietetic Association: Nutrition, aging, and the continuum of care	USA	2000	American Dietetic Association (213)
- Management of malnutrition in the elderly and the appropriate use of commercially manufactured oral nutritional supplements	USA	2000	Johnsen C et al (161)
- Assessment of protein energy malnutrition in older persons, part I: history, examination, body composition, and screening tools	USA	2000	Omran ML & Morley JE (146)

Table 8 (continued)
Reviews citing MNA® as screening tool

Title	Country	Year	Reference
- Nutrition assessment in the elderly	France	2001	Vellas B et al (214)
- Surgery in the elderly: the role of nutritional support	Italy	2001	Bozzetti F (215)
- Nutrition and Ageing. Screening for malnutrition in dwelling elderly	Spain	2001	Salvà A & Pera G (216)
- Role of Nutrition in Maintaining health in the nation's elderly: Evaluating Coverage of Nutrition Services for Medicare Population	USA	2001	Committee on Nutrition Services for Medicare Beneficiaries, Food and Nutrition Board, Institute of Medicine (213a)
- Bonnes pratiques diététiques en cancérologie: dénutrition et évaluation nutritionnelle	France	2002	Fédération Nationale des centres de lutte contre le cancer Duguet A et al (217)
- L'évaluation gérontologique: un outil de prévention des situations à risque chez les personnes âgées	France	2002	Rainfray M et al (218)
- La perte de poids dans la maladie d'Alzheimer [Weight loss in Alzheimer's disease]	France	2002	Romatet S & Belmin J (79)
- Estado nutricional de la población anciana de Cataluña [Nutritional status of the elderly population of Catalonia, Spain]	Spain	2002	Garcia-Lorda P et al (219)
- Nutritional problems in nursing homes with special reference to Spain	Spain	2002	Ribera Casado JM (165)
- Identifying the elderly at risk for malnutrition - The Mini Nutritional Assessment	Switzerland	2002	Guigoz Y et al (10)
- Methodology of nutritional screening and assessment tools	UK	2002	Jones JM (220)
- Evaluating and treating unintentional weight loss in the elderly	USA	2002	Huffman GB (164)
- Nutritional requirements with aging - Prevention of disease	USA	2002	Meyyazhagan S & Palmer RM (221)
- Nutrition as a mediator in the relation between oral and systemic disease: associations between specific measures of adult oral health and nutrition outcomes	USA	2002	Ritchie CS (222)
- Under-Nutrition in Older People: A Serious and Growing Global Problem!	Australia	2003	Visvanathan R (223)
- Nutritional assessment in the hospitalized patient	Brazil	2003	Waitzberg DL & Correia ITD (224)
- ESPEN guidelines for nutrition screening	Europe	2003	Kondrup J et al (159)
- État des lieux de la prise en charge de l'alimentation et de la nutrition dans 11 hôpitaux de médecine gériatrique de l'assistance publique-hôpitaux de Paris [Situation of dietary and nutrition practice in 11 geriatric hospital of assistance publique-hôpitaux de Paris]	France	2003	De Chambine S et al (225)
- Outils et procédures de dépistage de la dénutrition et de son risque en milieu hospitalier [Tools and procedures for screening for malnutrition and its associated risks in hospital]	France	2003	Hasselmann M & Alix E (42)
- Évaluation Diagnostique de la dénutrition protéino-énergétique des adultes hospitalisés [Diagnostic assessment of protein-energy malnutrition in hospitalized adults]	France	2003	Service des recommandations professionnelles (226)
- Grundsatzstellungnahme	Germany	2003	Brüggeman J et al (227)
- Ernährung und Flüssigkeitsversorgung älterer Menschen			
- Assessment tools for nutritional status in the elderly	Israel	2003	Berner YN (228)
- ¿Se nutren bien las personas mayores? [Are old people well nourished?]	Spain	2003	Ruipérez Cantera I (229)
- Implementing change – the mini nutritional assessment tool to enhance leg ulcer healing	UK	2003	Gerry S & Edwards L (162)
- New paradigms for treating elderly patients with cancer: the comprehensive geriatric assessment and guidelines for supportive care	USA	2003	Balducci L (166)
- Early Nutritional Screening of Older Adults: Review of Nutritional Support	USA	2003	Stechmiller JK (167)
- Évaluation de la fragilité de la personne âgée	Belgium	2004	Cornette P et al (230)
- Human ageing: Demographic trends and medical implications	France	2004	Muller F et al (231)
- Minimum data set for nutritional intervention studies in the elderly	IAG/IANA	2004	Salvà et al (232)
- Acute nutritional problems in the oncology patient	Spain	2004	Oria E et al (233)
- Old age, malnutrition, and pressure sores: an ill-fated alliance (234)	The Netherlands	2004	Mathus-Vliegen EMH
- Nutritional status of older people in long term care settings: Current status and future directions	UK	2004	Cowan DT et al (235)
- Feeding and hydration issues for older adults with dementia	USA	2004	Amella EJ (236)
- Undernutrition in older adults across the continuum of care:	USA	2004	Furman EF (237)
- Nutritional assessment, barriers, and interventions			

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

Table 8 (continued)
Reviews citing MNA® as screening tool

Title	Country	Year	Reference
- The Mini Nutritional Assessment as an assessment tool in elders in long-term care	USA	2004	Hudgens J & Langkamp-Henken B (238)
- Assessing nutrition in older adults	USA	2004	Lawrence JF & Amella EJ (239)
- A Brief History of Geriatrics	USA	2004	Morley JE (13)
- Nutritional deficiencies in long-term care. Part I - Detection and diagnosis	USA	2004	Morley JE et al (240)
- Caring for the elderly: A case-based approach	USA	2004	Pilot F et al (241)
- Geriatric failure to thrive	USA	2004	Robertson RG & Montagnini M (242)
- An approach to the management of unintentional weight loss in the elderly	Canada	2005	Alibhai SMH et al (243)
- Complémentation orale: spécificités gériatriques [Nutritional supplementation in elderly people]	France	2005	Raynaud-Simon A (244)
- Ernährung im Alter [Nutrition for the elderly]	Germany	2005	Nikolaus T (245)
- Erfassung der Ernährungssituation älterer Menschen - Das Mini Nutritional Assessment (MNA®) [Nutritional assessment in the elderly - The Mini Nutritional Assessment (MNA®)]	Germany	2005	Volkert D (172)
- Valoración geriátrica en el hospital: Unidades de postagudos [Comprehensive geriatric assessment in a hospital: Postacute care units]	Spain	2005	Miralles R et al(246)
- Hospital length of stay and nutritional status	Switzerland	2005	Kyle UG et al (247)
- Malnutrition screening in the elderly population	UK	2005	Harris D & Haboubi N (248)
- Nutrition in older Adults	USA	2005	DiMaria-Ghalili RA & Amella E (168)
- Importance of nutritional screening in treatment of cancer-related weight loss	USA	2005	Huhmann MB & Cunningham RS (171)
- ESPEN Guidelines on Enteral Nutrition: Geriatrics	Europe	2006	Volkert D et al (249)
- Diagnostik der Mangelernährung des älteren Menschen [Diagnosing malnutrition in the elderly]	Germany	2006	Bauer JM et al (163)
- Standards for specialized nutrition support for adult residents of long-term care facilities	USA	2006	Durfee SM et al (173)

evaluation tool. Improvement in MNA® scores on follow up correlated with duration of hospitalization (157). Implementation of a dietary program consisting of increased protein and energy density of meals, adapting meals to oral health, additional help during meals, and dietary supplements between meals resulted in improved or stabilized nutritional status and weight gain (68). The importance of oral supplementation in improving MNA® scores during convalescence after hospitalization was observed (149). Adjunctive peripheral parenteral nutrition when necessary has also been shown to be feasible and safe in postacute care (158).

Conclusion

Studies in over 30,000 elderly subjects screened by the MNA® show the mean prevalence of malnutrition is 1% in community healthy elderly, 4% in outpatients/home care, 5% in home living Alzheimer's disease patients, 20% in hospitalized patients, and 37% in institutionalized elderly. In community dwelling elderly, the MNA® can detect risk of malnutrition while albumin and BMI are in the normal range and life style characteristics are associated with nutritional risk. In outpatients and hospital patients, the MNA® is predictive of outcome and cost of care. In home care patients and nursing

home residents, the MNA® is related to meal patterns and chronic conditions. It has been successfully used to monitor nutritional interventions. The MNA® and MNA®-SF provide advantages over using visceral proteins in screening and assessing nutritional status of elderly people.

The MNA® is reliable and can be easily administered by health professionals using its two-step procedure for screening (MNA®-SF) followed by assessment (full MNA®). It can be done in general practice or on admission to the hospital or nursing home to detect risks of malnutrition early. The MNA® was specifically developed to evaluate the nutritional status of the elderly and makes it possible to follow the effectiveness of intervention. Once elderly subjects have been identified as being at risk for malnutrition, the MNA® should be used to guide nutritional interventions. The MNA® is widely recommended and should be integrated into the comprehensive geriatric assessment and completed at regular intervals in all settings. (8, 13, 42, 79, 146, 159-173).

References

1. Stuck AE, Egger M, Hammer A, Minder CE, Beck JC. Home visits to prevent nursing home admission and functional decline in elderly people: Systematic review and meta-regression analysis. *JAMA* 2002; 287:1022-1028.
2. Rubenstein LZ, Joseph T. Freeman Award Lecture: Comprehensive geriatric

- assessment: From miracle to reality. *J Gerontol A: Biol Sci Med Sci* 2004; 59:M473-M477.
3. Katz S, Downs TD, Cash HR, Grotz RC. Progress in the development of the index of ADL. *Gerontology* 1970; 1:20-30.
 4. Lawton MP, Brody EM. Assessment of older people: Self-monitoring and instrumental activities of daily living measure. *Gerontologist* 1969; 9:179-186.
 5. Folstein MF, Folstein S, 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.
 6. Yesavage JA, Brink TL. Development and validation of a geriatric depression scale: a preliminary report. *J Psychiatr Res* 1983; 17:37-49.
 7. Tinetti ME. Performance-oriented assessment of mobility problems in the elderly. *J Am Geriatr Soc* 1986; 34:119-126.
 8. Guigoz Y, Vellas B, Garry PJ. Assessing the nutritional status of the elderly: The Mini Nutritional Assessment as part of the geriatric evaluation. *Nutr Rev* 1996; 54:S59-S65.
 9. Mowe M, Bohmer T. The prevalence of undiagnosed protein-calorie undernutrition in a population of hospitalized elderly patients. *J Am Geriatr Soc* 1991; 39:1089-92.
 10. Guigoz Y, Lauque S, Vellas BJ. Identifying the elderly at risk for malnutrition. The Mini Nutritional Assessment. *Clin Geriatr Med* 2002; 18:737-757.
 11. Guigoz Y, Vellas B, Garry PJ. Mini nutritional assessment : A practical assessment tool for grading the nutritional state of elderly patients. *Facts, Research in Gerontology* 1994;(Suppl 2):15-59.
 12. Vellas B, Guigoz Y. Nutritional Assessment as Part of the Geriatric Evaluation. In: Rubenstein LZ, Bernabei R, Wieland D, editors. *Geriatric Assessment Technology: State of the Art*. Milano, Italy: Kurtz Publishing Company, 1995: 179-194.
 13. Morley JE. A brief history of geriatrics. *J Gerontol A Biol Sci Med Sci* 2004; 59:1132-1152.
 14. Azad N, Murphy J, Amos SS, Toppan J. Nutrition survey in an elderly population following admission to a tertiary care hospital. *CMAJ* 1999; 161:511-515.
 15. Urteaga C, Ramos RI, Atalah E. Validación del criterio de evaluación nutricional global del adulto mayor [Validation of global nutrition assessment in elders]. *Rev Med Chil* 2001; 129:871-876.
 16. Stratton RJ, Hackston A, Longmore D, Dixon R, Price S, Stroud M et al. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the 'malnutrition universal screening tool (MUST)' for adults. *Br J Nutr* 2004; 92:799-808.
 17. Kane RA, Kane RL. *Assessing the elderly. A practical guide to measurement*. 1981. Lexington, Lexington Books.
 18. *Nutrition and the elderly. A European collaborative study in cooperation with World Health Organisation (WHO-SPRA) and the International Union of Nutritional Sciences (IUNS) Committee on Geriatric Nutrition. Manual of operations, Euronut Report 11*. de Groot CPGM, van Staveren WA, editors. 1988. Wageningen, The Netherlands.
 19. Guigoz Y, Vellas B. Test d'évaluation de l'état nutritionnel de la personne âgée : le Mini Nutritional Assessment (MNA) [Test to assess the nutritional status of the elderly: The Mini Nutritional Assessment (MNA)]. *Med Hyg* 1995; 53:1965-1969.
 20. 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.
 21. Salva A, Bolibar I, Munoz M, Sacritan V. Un nuevo instrumento para la valoración nutricional en geriatría: el "Mini Nutritional Assessment" (MNA). *Rev Gerontol* 1996; 6:319-328.
 22. Persson M, Stefanovic-Andersson K, Ulander K. Short-Form MNA® is not reliable in elderly living at sheltered housing. *J Nutr Health Aging* 2004; 8:470.
 23. Borowiak E, Kostka T. Usefulness of short (MNA-SF) and full version of the Mini Nutritional Assessment (MNA) in examining the nutritional state of older persons. *New Medicine* 2003; 6:125-129.
 24. Jones JM. Reliability of nutritional screening and assessment tools. *Nutrition* 2004; 20:307-311.
 25. Gazzotti C, Albert A, Pepinster A, Petermans J. Clinical usefulness of the mini nutritional assessment (MNA) scale in geriatric medicine. *J Nutr Health Aging* 2000; 4:176-181.
 26. Bleda MJ, Bolibar I, Pares R, Salva A. Reliability of the mini nutritional assessment (MNA) in institutionalized elderly people. *J Nutr Health Aging* 2002; 6:134-137.
 27. Holm B, Soderhamn O. Factors associated with nutritional status in a group of people in an early stage of dementia. *Clin Nutr* 2003; 22:385-389.
 28. Deeks JJ. Systematic reviews in health care: Systematic reviews of evaluations of diagnostic and screening tests. *BMJ* 2001; 323:157-162.
 29. Thomas DR, Zdrowski CD, Wilson MM, et al. Malnutrition in subacute care. *Am J Clin Nutr* 2002; 75:308-313.
 30. Visvanathan R, Penhall R, Chapman I. Nutritional screening of older people in a subacute care facility in Australia and its relation to discharge outcomes. *Age Ageing* 2004; 33:260-265.
 31. Delacorte RR, Moriguti JC, Matos FD, Pfrimer K, Marchini JS, Ferrioli E. Mini-nutritional assessment score and the risk for undernutrition in free-living older persons. *J Nutr Health Aging* 2004; 8:531-534.
 32. Thorsdottir I, Jonsson PV, Asgeirsdottir AE, Hjaltadottir I, Bjornsson S, Ramel A. Fast and simple screening for nutritional status in hospitalized, elderly people. *J Hum Nutr Diet* 2005; 18:53-60.
 33. Read JA, Crockett N, Volker DH, et al. Nutritional assessment in cancer: comparing the Mini-Nutritional Assessment (MNA) with the scored Patient-Generated Subjective Global Assessment (PGSGA). *Nutr Cancer* 2005; 53:51-56.
 34. Kuzuya M, Kanda S, Koike T, Suzuki Y, Satake S, Iguchi A. Evaluation of Mini-Nutritional Assessment for Japanese frail elderly. *Nutrition* 2005; 21:498-503.
 35. Wikby K, Ek AC, Christensson L. Nutritional status in elderly people admitted to community residential homes: comparisons between two cohorts. *J Nutr Health Aging* 2006; 10:232-238.
 36. Murphy MC, Brooks CN, New SA, Lumbers ML. The use of the Mini-Nutritional Assessment (MNA) tool in elderly orthopaedic patients. *Eur J Clin Nutr* 2000; 54:555-562.
 37. Donini LM, de Felice MR, Tassi L, et al. A "proportional and objective score" for the mini nutritional assessment in long-term geriatric care. *J Nutr Health Aging* 2002; 6:141-146.
 38. Hui WH, Law CB, So KY, et al. Validating a modified version of the mini-nutritional assessment (MNA) in institutionalized elderly Chinese. *Hong Kong J Gerontol* 2001; 15:35-43.
 39. Christensson L, Unosson M, Ek AC. Evaluation of nutritional assessment techniques in elderly people newly admitted to municipal care. *Eur J Clin Nutr* 2002; 56(9):810-818.
 40. Cohendy R, Rubenstein LZ, Eledjam JJ. The Mini Nutritional Assessment-Short Form for preoperative nutritional evaluation of elderly patients. *Ageing (Milano)* 2001; 13:293-297.
 41. Ranhoff AH, Gjoen AU, Mowe M. Screening for malnutrition in elderly acute medical patients: the usefulness of MNA-SF. *J Nutr Health Aging* 2005; 9:221-225.
 42. Hasselmann M, Alix E. Outils et procédures de dépistage de la dénutrition et de son risque en milieu hospitalier [Tools and procedures for screening for malnutrition and its associated in risks in hospital]. *Nutr Clin Metab* 2003; 17:218-226.
 43. Kagansky N, Berner Y, Koren-Morag N, Perelman L, Knobler H, Levy S. Poor nutritional habits are predictors of poor outcome in very old hospitalized patients. *Am J Clin Nutr* 2005; 82:784-791.
 44. Tsai AC, Chang JM, Lin H, Chuang YL, Lin SH, Lin YH. Assessment of the nutritional risk of >53-year-old men and women in Taiwan. *Public Health Nutr* 2004; 7:69-76.
 45. Barone L, Milosavljevic M, Gazibarich B. Assessing the older person: is the MNA a more appropriate nutritional assessment tool than the SGA? *J Nutr Health Aging* 2003; 7:13-17.
 46. Shum NC, Hui WW, Chu FC, Chai J, Chow TW. Prevalence of malnutrition and risk factors in geriatric patients of a convalescent and rehabilitation hospital. *Hong Kong Med J* 2005; 11:234-242.
 47. Ramon JM, Subira C. Prevalencia de malnutrición en la población anciana española [Prevalence of malnutrition in the elderly Spanish population]. *Med Clin (Barc)* 2001; 117:766-770.
 48. von Heideken WP, Gustavsson JM, Lundin-Olsson L, et al. Health status in the oldest old. Age and sex differences in the Umea 85+ Study. *Ageing Clin Exp Res* 2006; 18:116-126.
 49. Eriksson BG, Dey DK, Hessler RM, Steen G, Steen B. Relationship between MNA and SF-36 in a free-living elderly population aged 70 to 75. *J Nutr Health Aging* 2005; 9:212-220.
 50. Zeyfang A, Rukgauer M, Nikolaus TH. Gesunde senioren zeigen auch bei normalem ernährungszustand im Mini-Nutritional-Assessment (MNA) risikobereiche und eingeschränkte funktionen [Healthy seniors with a normal nutritional level in the Mini-Nutritional Assessment (MNA) identified as at risk for status decline and impaired function]. *Z Gerontol Geriatr* 2005; 38:328-333.
 51. Beck AM, Ovesen L, Schroll M. A six months' prospective follow-up of 65+-y-old patients from general practice classified according to nutritional risk by the Mini Nutritional Assessment. *Eur J Clin Nutr* 2001; 55:1028-1033.
 52. Pearson JM, Schlettwein-Gsell D, Brzozowska A, van Staveren WA, Bjornso K. Life style characteristics associated with nutritional risk in elderly subjects aged 80-85 years. *J Nutr Health Aging* 2001; 5:278-283.
 53. Saletti A, Johansson L, Yifter-Lindgren E, Wissing U, Osterberg K, Cederholm T. Nutritional status and a 3-year follow-up in elderly receiving support at home. *Gerontology* 2005; 51:192-198.
 54. Kelsheimer HL, Hawkins ST. Older adult women find food preparation easier with specialized kitchen tools. *J Am Diet Assoc* 2000; 100:950-952.
 55. Kretser AJ, Voss T, Kerr WW, Cavadini C, Friedmann J. Effects of two models of nutritional intervention on homebound older adults at nutritional risk. *J Am Diet Assoc* 2003; 103:329-336.
 56. Van Nes MC, Herrmann FR, Gold G, Michel JP, Rizzoli R. Does the mini nutritional assessment predict hospitalization outcomes in older people? *Age Ageing* 2001; 30:221-226.
 57. Quadri P, Fragiaco M, Pertoldi W, Guigoz Y, Herrmann F, Rapin CH. MNA and cost of care. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:141-148.
 58. Donini LM, Savina C, Rosano A, et al. MNA predictive value in the follow-up of

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

- geriatric patients. *J Nutr Health Aging* 2003; 7:282-293.
59. Bauer JM, Vogl T, Wicklein S, Trogner J, Muhlberg W, Sieber CC. Comparison of the Mini Nutritional Assessment, Subjective Global Assessment, and Nutritional Risk Screening (NRS 2002) for nutritional screening and assessment in geriatric hospital patients. *Z Gerontol Geriatr* 2005; 38:322-327.
60. Neumann SA, Miller MD, Daniels L, Crotty M. Nutritional status and clinical outcomes of older patients in rehabilitation. *J Hum Nutr Diet* 2005; 18:129-136.
61. Castel H, Shahar D, Harman-Boehm I. Gender differences in factors associated with nutritional status of older medical patients. *J Am Coll Nutr* 2006; 25:128-134.
62. de Luis DA, Izaola O, Velicia MC, et al. Impact of dietary intake and nutritional status on outcomes after liver transplantation. *Rev Esp Enferm Dig* 2006; 98:6-13.
63. De Filippi F, Tana F, Vanzati S, Balzarini B, Galetti G. Study of respiratory function in the elderly with different nutritional and cognitive status and functional ability assessed by plethysmographic and spirometric parameters. *Arch Gerontol Geriatr* 2003; 37:33-43.
64. Arellano Perez M, Garcia Caselles M, Marquez MA, Miralles R, Vazquez Ibar O, Cervera AM. Nutritional assessment in a geriatric convalescence unit: Initial assessment and follow-up I [Valoración del estado nutricional en una unidad de convalecencia: Evaluación inicial y seguimiento]. *Rev Mult Gerontol* 2004; 14:258-261.
65. Wissing U, Ek AC, Unosson M. A follow-up study of ulcer healing, nutrition, and life-situation in elderly patients with leg ulcers. *J Nutr Health Aging* 2001; 5:37-42.
66. Chen H, Cantor A, Meyer J, et al. Can older cancer patients tolerate chemotherapy? A prospective pilot study. *Cancer* 2003; 97:1107-1114.
67. Alves de Rezende CH, Marquez CT, Alvarenga JV, Penha-Silva N. Dependence of Mini-Nutritional Assessment scores with age and some hematological variables in elderly institutionalized patients. *Gerontology* 2005; 51:316-321.
68. Menezier-Ossia L, Menezier P, Debatty D, Piroth L, Bonnet N, Lenoir C. Suivi nutritionnel en hébergement médicalisé pour personnes âgées [Nutritional report in nursing homes]. *Revue de Geriatrie* 2000; 25:65-70.
69. Remsburg RE, Luking A, Baran P, et al. Impact of buffet-style dining program on weight and biochemical indicators of nutritional status in nursing home residents: a pilot study. *J Am Diet Assoc* 2001; 101:1460-1463.
70. Saletti A, Lindgren EY, Johansson L, Cederholm T. Nutritional status according to mini nutritional assessment in an institutionalized elderly population in Sweden. *Gerontology* 2000; 46:139-145.
71. Lauque S, Guyonnet S, Nourhashemi F, Guigoz Y, Albaredo JL, Vellas B. Le statut nutritionnel des personnes âgées vivant en maison de retraite: étude comparative en cas de démence ou non [Nutritional status of institutionalized elderly persons with or without dementia]. *Revue de Geriatrie* 1999; 24:115-119.
72. Andrieu S, Reynish W, Nourhashemi F, et al. Nutritional risk factors for institutional placement in Alzheimer's disease after one year follow-up. *J Nutr Health Aging* 2001; 5:113-117.
73. Brocker P, Benhamidat T, Benoit M, et al. Etat nutritionnel et maladie d'Alzheimer: Résultats préliminaires de l'étude REAL.FR [Nutritional status and Alzheimer's disease: preliminary results of the REAL.FR study]. *Rev Med Interne* 2003; 24 Suppl 3:314s-318s.
74. Gillette-Guyonnet S, Nourhashemi F, Andrieu S, et al. The REAL.FR research program on Alzheimer's disease and its management: Methods and preliminary results. *J Nutr Health Aging* 2003; 7:91-96.
75. Magri F, Borza A, del Vecchio S, et al. Nutritional assessment of demented patients: a descriptive study. *Aging Clin Exp Res* 2003; 15:148-153.
76. Suominen M, Laine A, Routasalo P, Pitkala KH, Räsänen L. Nutrient content of served food, nutrient intake and nutritional status of residents with dementia in a Finnish nursing home. *J Nutr Health Aging* 2004; 8:234-238.
77. Nourhashemi F, Amouyal-Barkate K, Gillette-Guyonnet S, Cantet C, Vellas B. Living alone with Alzheimer's disease: cross-sectional and longitudinal analysis in the REAL.FR Study. *J Nutr Health Aging* 2005; 9:117-120.
78. Guerin O, Andrieu S, Schneider SM, et al. Different modes of weight loss in Alzheimer disease: a prospective study of 395 patients. *Am J Clin Nutr* 2005; 82:435-441.
79. Romatet S, Belmin J. La perte de poids dans la maladie d'Alzheimer [Weight loss in Alzheimer's disease]. *Revue de Geriatrie* 2002; 27:587-596.
80. Thomas P, Hazif-Thomas C, Clement JP. Influence of antidepressant therapies on weight and appetite in the elderly. *J Nutr Health Aging* 2003; 7:166-170.
81. Nourhashemi F, Andrieu S, Sastres N, et al. Descriptive analysis of emergency hospital admissions of patients with Alzheimer disease. *Alzheimer Dis Assoc Disord* 2001; 15:21-25.
82. Riviere S, Gillette-Guyonnet S, Voisin T, et al. A nutritional education program could prevent weight loss and slow cognitive decline in Alzheimer's disease. *J Nutr Health Aging* 2001; 5:295-299.
83. Gil GP, Ramirez Diaz SP, Ribera Casado JM. Dementia and nutrition. Intervention study in institutionalized patients with Alzheimer disease. *J Nutr Health Aging* 2003; 7:304-308.
84. Vellas B, Lauque S, Gillette-Guyonnet S, Andrieu S, Cortes F, Nourhashemi F et al. Impact of nutritional status on the evolution of Alzheimer's disease and on response to acetylcholinesterase inhibitor treatment. *J Nutr Health Aging* 2005; 9:75-80.
85. Persson MD, Brismar KE, Katzarski KS, Nordenstrom J, Cederholm TE. Nutritional status using mini nutritional assessment and subjective global assessment predict mortality in geriatric patients. *J Am Geriatr Soc* 2002; 50:1996-2002.
86. Formiga F, Chivite D, Mascaro J, Ramon JM, Pujol R. No correlation between mini-nutritional assessment (short form) scale and clinical outcomes in 73 elderly patients admitted for hip fracture. *Aging Clin Exp Res* 2005; 17:343-346.
87. Vellas B, Guigoz Y, Baumgartner M, Garry PJ, Lauque S, Albaredo JL. Relationships between nutritional markers and the mini-nutritional assessment in 155 older persons. *J Am Geriatr Soc* 2000; 48:1300-1309.
88. Vellas B, Guigoz Y, Garry PJ, et al. The Mini Nutritional Assessment (MNA) and its use in grading the nutritional state of elderly patients. *Nutrition* 1999; 15:116-122.
89. Ruiz-Lopez MD, Artacho R, Oliva P, et al. Nutritional risk in institutionalized older women determined by the Mini Nutritional Assessment test: what are the main factors? *Nutrition* 2003; 19:767-771.
90. Deplas A, Debiais F, Alcalay M, Bontoux D, Thomas P. Bone density, parathyroid hormone, calcium and vitamin D nutritional status of institutionalized elderly subjects. *J Nutr Health Aging* 2004; 8:400-404.
91. Odlund-Olin A, Koochek A, Ljungqvist O, Cederholm T. Nutritional status, well-being and functional ability in frail elderly service flat residents. *Eur J Clin Nutr* 2005; 59:263-270.
92. Suominen M, Muurinen S, Routasalo P, et al. Malnutrition and associated factors among aged residents in all nursing homes in Helsinki. *Eur J Clin Nutr* 2005; 59:578-583.
93. de Oliveira TR, Frigerio ML. Association between nutrition and the prosthetic condition in edentulous elderly. *Gerodontology* 2006; 21:205-208.
94. Cairella G, Baglio G, Censi L, et al. Il Mini Nutritional Assessment (MNA) e la valutazione del rischio nutrizionale in età geriatrica. Proposta di un modello operativo di sorveglianza nutrizionale all'interno del Dipartimento di Prevenzione [Mini Nutritional Assessment (MNA) and nutritional risk in elderly. A proposal of nutritional surveillance system for the Department of Public Health]. *Ann Ig* 2005; 17:35-46.
95. Gomez Ramos MJ, Gonzalez Valverde FM, Sanchez AC. Estudio del estado nutricional en la población anciana hospitalizada [Nutritional status of a hospitalized aged population]. *Nutr Hosp* 2005; 20:286-292.
96. Gerber V, Krieg MA, Cornuz J, Guigoz Y, Burckhardt P. Nutritional status using the Mini Nutritional Assessment questionnaire and its relationship with bone quality in a population of institutionalized elderly women. *J Nutr Health Aging* 2003; 7:140-145.
97. Izaola O, de Luis Roman DA, Cabezas G, et al. Mini Nutritional Assessment (MNA) como método de evaluación nutricional en pacientes hospitalizados [Mini Nutritional Assessment (MNA) test as a tool of nutritional evaluation in hospitalized patients]. *An Med Interna* 2005; 22:313-316.
98. Kuzuya M, Kanda S, Koike T, Suzuki Y, Iguchi A. Lack of correlation between total lymphocyte count and nutritional status in the elderly. *Clin Nutr* 2005; 24:427-432.
99. Esteban M, De Tena-Davila MC, Serrano P, Romero R, Martin-Diez C, Martinez-Simancas A. Valoración del estado nutricional en una consulta de geriatría: Aportaciones preliminares [Nutritional assessment in a geriatric clinic: A preliminary report]. *Rev Esp Geriatr Gerontol* 2004; 39:25-28.
100. Langkamp-Henken B, Hudgens J, Stechmiller JK, Herrlinger-Garcia KA. Mini nutritional assessment and screening scores are associated with nutritional indicators in elderly people with pressure ulcers. *J Am Diet Assoc* 2005; 105:1590-1596.
101. Peppersack T, Corrette M, Beyer I, et al. Examining the effect of intervention to nutritional problems of hospitalised elderly: a pilot project. *J Nutr Health Aging* 2002; 6:306-310.
102. Peppersack T. Outcomes of continuous process improvement of nutritional care program among geriatric units. *J Gerontol A Biol Sci Med Sci* 2005; 60:787-792.
103. Slaviero KA, Read JA, Clarke SJ, Rivory LP. Baseline nutritional assessment in advanced cancer patients receiving palliative chemotherapy. *Nutr Cancer* 2003; 46:148-157.
104. Maugeri D, Santangelo A, Bonanno MR, et al. Oxidative stress and aging: studies on an East-Sicilian, ultraoctogenarian population living in institutes or at home. *Arch Gerontol Geriatr Suppl* 2004;9:271-277.
105. Peppersack T, Rotsaert P, Benoit F, et al. Prevalence of zinc deficiency and its clinical relevance among hospitalised elderly. *Arch Gerontol Geriatr* 2001; 33:243-253.
106. Bonin-Guillaume S, Herrmann FR, Boillat D, et al. Insulinemia and leptinemia in geriatric patients: markers of the metabolic syndrome or of undernutrition? *Diabetes Metab* 2006; 32:236-243.
107. Schiffrin EJ, Guigoz Y, Perruisseau G, Blum S, Delneste Y, Mansourian R et al. MNA and immunity: nutritional status and immunological markers in the elderly. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:22-33, discussion 33-34.
108. Hudgens J, Langkamp-Henken B, Stechmiller JK, Herrlinger-Garcia KA, Nieves C, Jr. Immune function is impaired with a mini nutritional assessment score indicative of malnutrition in nursing home elders with pressure ulcers. *JPEN J Parenter Enteral Nutr* 2004; 28:416-422.
109. Cereda E, Limonta D, Vanotti A. Other haematological changes may occur in the elderly according to nutritional status. *Clin Nutr* 2005; 24:1110.
110. Liver C, Girardet V, Coti P. La malnutrition protéino-énergétique chez des sujets

- agés admis en réadaptation. [Protein energy undernutrition in geriatric rehabilitation patients]. *Age & Nutrition* 2000; 11:67-71.
111. Clement A, Jolly D, Novella JL, et al. Diagnostic de la denutrition chez les personnes âgées par l'absorptiométrie biénergétique [Diagnosis of malnutrition in the elderly by dual energy absorptiometry]. *Presse Med* 2000; 29:1207-1213.
112. Stoppard E, Piquet MA, Niklas V, Alberti M, Laffely S, Von Overbeck J et al. Prevalence of malnutrition in HIV positive outpatients: Evaluation of mini nutritional assessment and nutrition risk score I [Prévalence de la malnutrition dans une population ambulatoire de malades du sida]. *Medecine et Hygiene* 1997; 55:2222-2226.
113. Wirth R, Miklis P. Die bioelektrische Impedanzanalyse in der Diagnostik der Malnutrition: Phasenwinkel korreliert mit Parametern des Ernährungsstatus geriatrischer Patienten [Bioelectric impedance analysis in the diagnosis of malnutrition]. *Z Gerontol Geriatr* 2005; 38:315-321.
114. Bauduer F, Scribans C, Dubernet E, Capdupuy C. Evaluation of the nutritional status of patients over 60-year admitted in a hematology department using the mininutritional assessment (MNA). A single centre study of 120 cases. *J Nutr Health Aging* 2003; 7:179-182.
115. Soini H, Routasalo P, Lagstrom H. Characteristics of the Mini-Nutritional Assessment in elderly home-care patients. *Eur J Clin Nutr* 2004; 58:64-70.
116. Ruscin JM, Page RL, Yeager BF, Wallace JI. Tumor necrosis factor-alpha and involuntary weight loss in elderly, community-dwelling adults. *Pharmacotherapy* 2005; 25:313-319.
117. Saava M, Kisper-Hint IR. Nutritional assessment of elderly people in nursing home and at home in Tallinn. *J Nutr Health Aging* 2002; 6:93-95.
118. Fei XF, Cheng QM, Shi YM, Cao WX. Evaluation of the nutritional conditions in community retired residents by nutritional assessment questionnaire and anthropometry. *Chinese Journal of Clinical Rehabilitation* 2004; 8:4364-4365.
119. Peña E, Meertens DR, Solano L. Valoración antropométrica y bioquímica de ancianos venezolanos institucionalizados [Anthropometric and biochemical assessment in elderly geriatric home residents in Venezuela]. *Rev Esp Geriatr Gerontol* 2004; 39:360-366.
120. Wissing U, Lennernäs MAC, Ek AC, Unosson M. Meal patterns and meal quality in patients with leg ulcers. *J Hum Nutr Diet* 2000; 13:3-12.
121. Turnbull PJ, Sinclair AJ. Evaluation of nutritional status and its relationship with functional status in older citizens with diabetes mellitus using the mini nutritional assessment (MNA) tool--a preliminary investigation. *J Nutr Health Aging* 2002; 6:185-189.
122. Ricart CJ, Pinyol MM, de Pedro EB, Devant AM, Benavides RA. Desnutrición en pacientes en atención domiciliaria [Malnutrition of home care patients]. *Aten Primaria* 2004; 34:238-243.
123. Lawrence HP, Fillery ED, Matear DW, Paterson L, Hawkins RJ, Locker D. Salivary sIgA and cortisol: markers for functional dependence in older adults. *Spec Care Dentist* 2005; 25:242-252.
124. Maaravi Y, Berry EM, Ginsberg G, Cohen A, Stessman J. Nutrition and quality of life in the aged: the Jerusalem 70-year olds longitudinal study. *Aging (Milano)* 2000; 12:173-179.
125. Soini H, Routasalo P, Lauri S, Ainamo A. Oral and nutritional status in frail elderly. *Spec Care Dentist* 2003; 23:209-215.
126. Lamy M, Mojon P, Kalykakis G, Legrand R, Butz-Jorgensen E. Oral status and nutrition in the institutionalized elderly. *J Dent* 1999; 27:443-448.
127. Griep MI, Mets TF, Collys K, Ponjaert-Kristoffersen I, Massart DL. Risk of malnutrition in retirement homes elderly persons measured by the "mini-nutritional assessment". *J Gerontol A Biol Sci Med Sci* 2000; 55:M57-M63.
128. Menecier P, Menecier-Ossia L, Bonnet N, Bonin P, Lenoir C, Kaker N. Facteurs associés à la malnutrition protéino-énergétique du sujet âgé en institution [Protein-energy-malnutrition associated factors among nursing home elders]. *Age & Nutrition* 1999; 10:3-6.
129. Spanish Geriatric Oral Health Research Group. Oral health issues of Spanish adults aged 65 and over. *Int Dent J* 2001; 51:228-234.
130. Chen CC, Chang CK, Chyun DA, McCorkle R. Dynamics of nutritional health in a community sample of american elders: a multidimensional approach using roy adaptation model. *ANS Adv Nurs Sci* 2005; 28:376-389.
131. Dumont C, Voisin T, Nourhashemi F, Andrieu S, Koning M, Vellas B. Predictive factors for rapid loss on the mini-mental state examination in Alzheimer's disease. *J Nutr Health Aging* 2005; 9:163-167.
132. Soini H, Routasalo P, Lagstrom H. Nutritional status in cognitively intact older people receiving home care services--a pilot study. *J Nutr Health Aging* 2005; 9:249-253.
133. Johnson CS, Mahon A, McLeod W. Nutritional, functional and psychosocial correlates of disability among older adults. *J Nutr Health Aging* 2006; 10:45-50.
134. Johnson CS. Psychosocial correlates of nutritional risk in older adults. *Can J Diet Pract Res* 2005; 66:95-97.
135. Scheirlinckx K, Vellas B, Garry PJ. The MNA score in people who have aged successfully. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:61-5.
136. Salminen H, Saaf M, Johansson SE, Ringertz H, Strender LE. Nutritional status, as determined by the Mini-Nutritional Assessment, and osteoporosis: a cross-sectional study of an elderly female population. *Eur J Clin Nutr* 2006; 60:486-493.
137. Tsai AC, Liou JC, Chang MC. Food patterns that correlate to health and nutrition status in elderly Taiwanese. *Nutr Research* 2006; 26:71-76.
138. Villaverde Gutiérrez C, Ruiz Villaverde G, Rodríguez Moreno S, Abalos Medina G, Roa Venegas JM, Oliveira Guerra R. Undernutrition prevalence at admission in a nursing home [Prevalencia de malnutrición al ingreso en una residencia geriátrica]. *Geriatrka* 2004; 20:16-19.
139. Kuzu MA, Terzioğlu H, Genc V, et al. Preoperative nutritional risk assessment in predicting postoperative outcome in patients undergoing major surgery. *World J Surg* 2006; 30:378-390.
140. Villamayor BL, Llimera RG, Jorge VV, et al. Valoración nutricional al ingreso hospitalario: Iniciación al estudio entre distintas metodologías [Nutritional assessment at the time of hospital-admission: study initiation among different methodologies]. *Nutr Hosp* 2006; 21:163-172.
141. Beck AM, Ovesen L, Osler M. The 'Mini Nutritional Assessment' (MNA) and the 'Determine Your Nutritional Health' Checklist (NSI Checklist) as predictors of morbidity and mortality in an elderly Danish population. *Br J Nutr* 1999; 81:31-36.
142. Kucukerdonmez O, Koksak E, Rakicoglu N, Pekcan G. Assessment and evaluation of the nutritional status of the elderly using 2 different instruments. *Saudi Med J* 2005; 26:1611-1616.
143. Soderhamn U, Soderhamn O. Reliability and validity of the nutritional form for the elderly (NUFFE). *J Adv Nurs* 2002; 37:28-34.
144. Woo J, Chumlea WC, Sun SS, et al. Development of the Chinese nutrition screen (CNS) for use in institutional settings. *J Nutr Health Aging* 2005; 9:203-210.
145. Charlton KE, Kolbe-Alexander TL, Nel JH. Development of a novel nutrition screening tool for use in elderly South Africans. *Public Health Nutr* 2005; 8:468-479.
146. Omran ML, Morley JE. Assessment of protein energy malnutrition in older persons, part I: history, examination, body composition, and screening tools. *Nutrition* 2000; 16:50-63.
147. Morley JE. Anorexia of aging: physiologic and pathologic. *Am J Clin Nutr* 1997; 66:760-773.
148. Lauque S, Arnaud-Battandier F, Mansourian R, et al. Protein-energy oral supplementation in malnourished nursing-home residents. A controlled trial. *Age Ageing* 2000; 29:51-56.
149. Gazzotti C, Arnaud-Battandier F, Parello M, et al. Prevention of malnutrition in older people during and after hospitalisation: results from a randomised controlled clinical trial. *Age Ageing* 2003; 32:321-325.
150. Lauque S, Arnaud-Battandier F, Gillette S, et al. Improvement of weight and fat-free mass with oral nutritional supplementation in patients with Alzheimer's disease at risk of malnutrition: a prospective randomized study. *J Am Geriatr Soc* 2004; 52:1702-1707.
151. Joosten E, Vander Elst B. Does nutritional supplementation influence the voluntary dietary intake in an acute geriatric hospitalized population? *Aging (Milano)* 2001; 13:391-394.
152. Beck AM, Ovesen L, Schroll M. Home-made oral supplement as nutritional support of old nursing home residents, who are undernourished or at risk of undernutrition based on the MNA®. A pilot trial. *Mini Nutritional Assessment. Aging Clin Exp Res* 2002; 14:212-215.
153. Rypkema G, Adang E, Dicke H, Naber T, De Swart B, Disselhorst L et al. Cost-effectiveness of an interdisciplinary intervention in geriatric inpatients to prevent malnutrition. *J Nutr Health Aging* 2003; 8:122-127.
154. Bunout D, Barrera G, de la Maza P, Avendano M, Gattas V, Petermann M et al. Effects of nutritional supplementation and resistance training on muscle strength in free living elders. Results of one year follow. *J Nutr Health Aging* 2004; 8:68-75.
155. Salas-Salvado J, Torres M, Planas M, Altimir S, Pagan C, Gonzalez ME et al. Effect of oral administration of a whole formula diet on nutritional and cognitive status in patients with Alzheimer's disease. *Clin Nutr* 2005; 24:390-397.
156. Arnaud-Battandier F, Malvy D, Jeandel C, Schmitt C, Aussage P, Beaufreire B et al. Use of oral supplements in malnourished elderly patients living in the community: a pharmaco-economic study. *Clin Nutr* 2004; 23:1096-1103.
157. Compan B, di Castri A, Plaze JM, Arnaud-Battandier F. Epidemiological study of malnutrition in elderly patients in acute, sub-acute and long-term care using the MNA [Epidemiological study of malnutrition in elderly patients in acute, sub-acute and long-term care using the MNA]. *J Nutr Health Aging* 1999; 3:146-151.
158. Thomas DR, Zdrodowski CD, Wilson MM, Conright KC, Diebold M, Morley JE. A prospective, randomized clinical study of adjunctive peripheral parenteral nutrition in adult subacute care patients. *J Nutr Health Aging* 2005; 9:321-325.
159. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. ESPEN guidelines for nutrition screening 2002. *Clin Nutr* 2003; 22:415-421.
160. Balducci L, Extermann M. Management of cancer in the older person: A practical approach. *Oncologist* 2000; 5:224-237.
161. Johnsen C, East JM, Glassman P. Management of malnutrition in the elderly and the appropriate use of commercially manufactured oral nutritional supplements. *J Nutr Health Aging* 2000; 4:42-46.
162. Gerry S, Edwards L. Implementing change - the mini nutritional assessment tool to enhance leg ulcer healing. *J Community Nurs* 2003; 17:28-34.
163. Bauer JM, Volkert D, Wirth R, Vellas B, Thomas D, Kondrup J et al. Diagnostik der

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

- mangelernährung des älteren Menschen [Diagnosing malnutrition in the elderly]. *Dtsch Med Wochenschr* 2006; 131:223-227.
164. Huffman GB. Evaluating and treating unintentional weight loss in the elderly. *Am Fam Physician* 2002; 65:640-650.
165. Ribera Casado JM. Nutritional problems in nursing homes with special reference to Spain. *J Nutr Health Aging* 2002; 6:84-90.
166. Balducci L. New paradigms for treating elderly patients with cancer: the comprehensive geriatric assessment and guidelines for supportive care. *J Support Oncol* 2003; 1:30-37.
167. Stechmiller JK. Early nutritional screening of older adults: review of nutritional support. *J Infus Nurs* 2003; 26:170-177.
168. DiMaria-Ghalili RA, Amella E. Nutrition in older adults. *Am J Nurs* 2005; 105:40-50.
169. Ferry M, Sidobre B, Lambertin A, Barberger-Gateau P. The SOLINUT study: analysis of the interaction between nutrition and loneliness in persons aged over 70 years. *J Nutr Health Aging* 2005; 9:261-268.
170. Formiga F, Chivite D, Sole A, Manito N, Ramon JM, Pujol R. Functional outcomes of elderly patients after the first hospital admission for decompensated heart failure (HF) a prospective study. *Arch Gerontol Geriatr* 2005.
171. Huhmann MB, Cunningham RS. Importance of nutritional screening in treatment of cancer-related weight loss. *Lancet Oncol* 2005; 6:334-343.
172. Volkert D. Nutritional assessment in the elderly - The Mini Nutritional Assessment (MNA) [Erfassung der Ernährungssituation älterer Menschen - Das Mini Nutritional Assessment (MNA)]. *Aktuelle Ernährungsmedizin* 2005; 30:142-146.
173. Durfee SM, Gallagher-Allred C, Pasquale JA, Stechmiller J. American Society for Parenteral and Enteral Nutrition Board of Directors, Task Force on Standards for Specialized Nutrition Support for Adult Residents of Long Term Care Facilities. Standards for Specialized Nutrition Support for Adult Residents of Long-Term Care Facilities. *Nutr Clin Pract* 2006; 21:96-104.
174. Salva A, Jose BM, Bolibar I. The Mini Nutritional Assessment in clinical practice. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:123-129.
175. Guigoz Y, Vellas BJ. Malnutrition im Alter: Das Mini Nutritional Assessment (MNA) [Malnutrition in the elderly: the Mini Nutritional Assessment (MNA)]. *Ther Umsch* 1997; 54(6):345-350.
176. de Groot LC, 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.
177. Beck AM, Ovesen LF. Den prædiktive værdi af screeningsinstrumentet "Mini-vurdering af ernæringsstilstand" [Predictive value of the screening instrument "Mini-assessment of nutritional status"]. *Ugeskr Laeger* 1997; 159:6377-6381.
178. Pareo-Tubbeh SL, Romero LJ, Baumgartner RN, Garry PJ, Lindeman RD, Koehler KM. Comparison of energy and nutrient sources of elderly Hispanics and non-Hispanic whites in New Mexico. *J Am Diet Assoc* 1999; 99:572-582.
179. Miller DK, Perry HM, III, Morley JE. Associations among the Mini Nutritional Assessment instrument, dehydration, and functional status among older African Americans in St. Louis, Mo., USA. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:79-86.
180. Morley JE, Miller DK, Perry HM, III, Patrick P, Guigoz Y, Vellas B. Anorexia of aging, leptin, and the Mini Nutritional Assessment. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:67-76.
181. Chazewska J, Chabros E, Rogalska-Niedzwiedz M, Wajszczyk B, Wartanowicz M, Ziemiński S. Mini Nutritional Assessment in elderly people living at home in Warsaw. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:161.
182. Spatharakis GC, Asimakopoulou FA, Koustagianni Z, Pontikis C, Mastrapa C, Tsoutsos D. Assessment of the nutritional risk in community-dwelling elderly in Greece using the Mini Nutritional Assessment scale. *J Nutr Health Aging* 2002; 6(Suppl):19.
183. Kicklighter JR, Duchon D. Nutritional risk among urban, community-dwelling older hispanics: Influence of demographic and cultural characteristics. *J Appl Gerontol* 2002; 21:119-133.
184. Davidson J, Getz M. Nutritional risk and body composition in free-living elderly participating in congregate meal-site programs. *J Nutr Elder* 2004; 24:53-68.
185. Rolland Y, Pillard F, Garrigue E, Amouyal K, Riviere D, Vellas B. Nutritional intake and recreational physical activity in healthy elderly women living in the community. *J Nutr Health Aging* 2005; 9:397-402.
186. Wissing U, Unosson M. The relationship between nutritional status and physical activity, ulcer history and ulcer-related problems in patients with leg and foot ulcers. *Scand J Caring Sci* 1999; 13:123-128.
187. Ridder D, Vandenbroele R, Wouters R, Geys L. Monitoring malnutrition in home nursing: A three-step model using ADL and MNA. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:162.
188. Decrey H, Vauthier F, Tappy L, Büla C. Nutritional assessment in primary care - A pilot study. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:163.
189. Cottee M, Lee C, Bell A. Screening nutritional status in outpatients. *J Nutr Health Aging* 2001; 6(Suppl):19.
190. Visvanathan R, Macintosh C, Callary M, Penhall R, Horowitz M, Chapman I. The nutritional status of 250 older Australian recipients of domiciliary care services and its association with outcomes at 12 months. *J Am Geriatr Soc* 2003; 51:1007-1011.
191. Salminen H, Saaf M, Johansson S, Ringertz H, Strender LE. The association between nutritional risk determined by Mini-Nutritional Assessment (MNA) and osteoporosis in elderly women: A cross-sectional study. *Osteoporos Int* 2004; 15: S52 (abstr).
192. Sakarya M, Karadag F, Luleci N, Tezcan KG, Topcu I, Erincler T. Der Zusammenhang von Ernährungszustand und ASA-Klassifikation bei älteren Patienten [Relationship between nutrition and ASA-classification in the elderly]. *Anesthesiol Intensivmed Notfallmed Schmerzther* 2004; 39:400-405.
193. Gazzotti C, Pepinster A, Petermans J, Albert A. Interobserver agreement on MNA nutritional scale of hospitalized elderly patients. *J Nutr Health Aging* 1997; 1:23-27.
194. Joosten E, Vanderelst B, Pelemans W. The effect of different diagnostic criteria on the prevalence of malnutrition in a hospitalized geriatric population. *Aging (Milano)* 1999; 11:390-394.
195. Cohendy R. The Mini Nutritional Assessment for preoperative nutritional evaluation: a study on 419 elderly surgical patients. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:117-121.
196. Gin H, Rabemanantsoa C, Daniel-Lamaziere D, Poirier F, Petitpierre MN, Morizot F. Le risque de dénutrition et la dénutrition à l'hôpital: Enquête un jour donné [Risk of undernutrition in hospital settings: A one-day survey]. *Cah Nutr Diet* 2001; 36:185-188.
197. Toliušiene J, Lesauskaite V. The nutritional status of older men with advanced prostate cancer and factors affecting it. *Support Care Cancer* 2004; 12:716-719.
198. Toliušiene J, Lesauskaite V. Vyresnio amžiaus zmoniu, serganciu priesines liaukos veziu, mitybos bukles ivertinimas pagal Mitybos mini anketa [Nutritional status evaluation of elderly patients with prostatic cancer: a mini questionnaire on nutrition]. *Medicina (Kaunas)* 2002; 38:929-932.
199. Gomez Ramos MJ, Gonzalez Valverde FM. Alta prevalencia de la desnutrición en ancianos españoles ingresados en un hospital general y factores asociados [High prevalence of undernutrition in Spanish elders admitted to a general hospital and associated factors]. *Arch Latinoam Nutr* 2005; 55:71-76.
200. Rodríguez N, Hernandez R, Herrera H, Barbosa J, Hernandez-Valera Y. Estado nutricional de adultos mayores institucionalizados Venezolanos [Nutritional status of institutionalized Venezuelan elderly]. *Invest Clin* 2005; 46:219-228.
201. Hrabinská L, Kráček S, Sobolová A, Sausa M. MNA in residential home residents. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:169.
202. Adamska-Skula M, Lutynsky R. Health and nutritional status of retirement home residents. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:169.
203. Molaschi M, Massaia M, Pallavicino di Ceva A, et al. Mini Nutritional Assessment in nursing home residents. *Nestlé Nutr Workshop Ser Clin Perform Programme* 1999; 1:159.
204. Christensson L, Unosson M, Ek AC. Malnutrition in elderly people newly admitted to a community resident home. *J Nutr Health Aging* 1999; 3:133-139.
205. Donini LM, De Felice MR, Tagliacocca A, Palazzotto A, De Bernardini L, Cannella C. MNA predictive value in long term care. *Age & Nutrition* 2000; 11:2-5.
206. de Mendonca Lima CA, Pertoldi W, Delgado A, Renson N. Assessment of nutritional status in patients in a psychogeriatric day hospital. *Age & Nutrition* 1999; 10:9-13.
207. Fallon C, Bruce I, Eustace A, et al. Nutritional status of community dwelling subjects attending a memory clinic. *J Nutr Health Aging* 2002; 6(Suppl):21.
208. Arellano M, Garcia-Caselles MP, Pi-Figuera M, et al. Clinical impact of different scores of the mini nutritional assessment (MNA) in the diagnosis of malnutrition in patients with cognitive impairment. *Arch Gerontol Geriatr Suppl* 2004; 27-31.
209. Payette H, Guigoz Y, Vellas BJ. Study Design for Nutritional Assessments in the Elderly. In: Yu BP, editor. *Methods in Aging Research*. Boca Raton: CRC Press LLC; 1999: 301-320.
210. Lauque S, Nourhashemi F, Vellas B. Testwerkzeuge für die Ernährungsanamnese bei älteren Personen [A tool for nutritional anamnesis of elderly patients]. *Z Gerontol Geriatr* 1999; 32:145-154.
211. Cederholm T. Assessment of nutritional status in elderly: Methodology and problems I [Bestämning av nutritionsstatus hos äldre - Metodik och problem]. *Scandinavian Journal of Nutrition/Naringsforskning* 1999; 43:23-26.
212. Schneider SM, Hebuterne X. Use of nutritional scores to predict clinical outcomes in chronic diseases. *Nutr Rev* 2000; 58:31-38.
213. Position of the American Dietetic Association: Nutrition, aging, and the continuum of care. *J Am Diet Assoc* 2000; 100:580-595.
- 213a. Committee on Nutrition Services for Medicare Beneficiaries Food and Nutrition Board. The Role of Nutrition in Maintaining Health in the Nation's Elderly: Evaluating Coverage of Nutrition Services for the Medicare Population. Washington, DC: National Academies Press; 2001.
214. Vellas B, Lauque S, Andrieu S, et al. Nutrition assessment in the elderly. *Curr Opin Clin Nutr Metab Care* 2001; 4:5-8.
215. Bozzetti F. Surgery in the elderly: the role of nutritional support. *Clin Nutr* 2001; 20:103-116.
216. Salva A, Pera G. Screening for malnutrition in dwelling elderly. *Public Health Nutrition* 2001; 4:1375-1378.
217. Duguet A, Bachmann P, Lallemand Y, Blanc-Vincent MP. Good clinical practice in nutritional management in cancer patients: Malnutrition and nutritional assessment [Bonnes pratiques diététiques en cancérologie: Dénutrition et évaluation

- nutritionnelle]. *Nutr Clin Metab* 2002; 16:97-124.
218. Rainfray M, Bourdel-Marchasson I, Dehail P, Richard-Harston S. L'évaluation gérontologique: un outil de prévention des situations à risques chez la personne âgées [Comprehensive geriatric assessment: a useful tool for prevention of acute situations in the elderly]. *Ann Med Interne (Paris)* 2002; 153:397-402.
219. Garcia-Lorda P, Foz M, Salas-Salvado J. Estado nutricional de la población anciana de Cataluña [Nutritional status of the elderly population of Catalonia, Spain]. *Rev Med (Barc)* 2002; 118:707-715.
220. Jones JM. The methodology of nutritional screening and assessment tools. *J Hum Nutr Diet* 2002; 15:59-71.
221. Meyyazhagan S, Palmer RM. Nutritional requirements with aging. *Prevention of disease. Clin Geriatr Med* 2002; 18:557-576.
222. Ritchie CS, Joshupura K, Hung HC, Douglass CW. Nutrition as a mediator in the relation between oral and systemic disease: associations between specific measures of adult oral health and nutrition outcomes. *Crit Rev Oral Biol Med* 2002; 13:291-300.
223. Visvanathan R. Under-Nutrition in Older People: A Serious and Growing Global Problem! *J Postgrad Med* 2003; 49:352-360.
224. Waitzberg DL, Correia MITD. Nutritional assessment in the hospitalized patient. *Curr Opin Clin Nutr Metab Care* 2003; 6:531-538
225. de Chambine S, Poisson-Salomon AS, Puissant MC, et al. État des lieux de la prise en charge de l'alimentation et de la nutrition dans 11 hôpitaux de médecine gériatrique de l'assistance publique-hôpitaux de Paris [Situation of dietary and nutrition practice in 11 geriatric hospital of assistance publique-hôpitaux de Paris]. *Nutr Clin Metab* 2003; 17:155-167.
226. Agence Nationale D'accreditation Et D'evaluation En Sante (ANAES). Evaluation diagnostique de la malnutrition protéino-énergétique des adultes hospitalisés [Diagnostic assessment of protein-energy malnutrition in hospitalized adults]. Service des recommandations professionnelles. 2003. Available at [http://anaes.fr/anaes/Publications.nsf/nPDFFile/GU_LILF-5X7NAE/\\$File/malnutrition.pdf](http://anaes.fr/anaes/Publications.nsf/nPDFFile/GU_LILF-5X7NAE/$File/malnutrition.pdf). Accessed June 27, 2006.
227. Bruggmann J, Jung C, Kreck C, Kurzmann K, Lucke M, Schulte C, et al. Ernährung und Flüssigkeitsversorgung älterer Menschen (Grundsatzstellungnahme). Abschlussbericht Projektgruppe P 39. 2003. Essen, Germany, Medizinischer Dienst der Spitzenverbände der Krankenkassen e.V.(MDS).
228. Berner YN. Assessment tools for nutritional status in the elderly. *Isr Med Assoc J* 2003; 5:365-367.
229. Ruiperez Cantera I. ¿Se nutren bien las personas mayores? [Are old people well nourished?]. *Med Clin (Barc)* 2003; 120:175-176.
230. Cornette P, Schoevaerdt D, Swine C. Evaluation de la fragilité de la personne âgée. *Louvain Medical* 2004; 123:S228-S230.
231. Muller F, Denis B, Valentin C, Teillet L. Vieillesse humaine: évolution démographique et implications médicales [Human ageing: Demographic trends and medical implications]. *Nutr Clin Metab* 2004; 18:171-174.
232. Salva A, Corman B, Andrieu S, Salas J, Vellas B. International Association of Gerontology/International Academy of Nutrition and Aging Task Force. Minimum Data Set for Nutritional Intervention Studies in Elderly People. *J Gerontol A Biol Sci Med Sci* 2004; 59:M724-M729.
233. Oria E, Petrina E, Zugasti A. Problemas agudos de la nutrición en el paciente oncológico [Acute nutritional problems in the oncology patient]. *An Sist Sanit Navar* 2004; 27(suppl 3):77-86.
234. Mathus-Vliegen EMH. Old age, malnutrition, and pressure sores: An ill-fated alliance. *J Gerontol A Biol Sci Med Sci* 2004; 59:M355-M360.
235. Cowan DT, Roberts JD, Fitzpatrick JM, While AE, Baldwin J. Nutritional status of older people in long term care settings: current status and future directions. *Int J Nurs Stud* 2004; 41:225-237.
236. Amella E. Feeding and hydration issues for older adults with dementia. *Nurs Clin North Am* 2004; 39(3):607-623.
237. Furman EF. Undernutrition in older adults across the continuum of care: nutritional assessment, barriers, and interventions. *J Gerontol Nurs* 2004; 32:22-27.
238. Hudgens J, Langkamp-Henken B. The Mini Nutritional Assessment as an assessment tool in elders in long-term care. *Nutr Clin Pract* 2004; 19:463-470.
239. Lawrence JF, Amella E. Assessing nutrition in older adults. *Best Pract Nurs Care Older Adults - Try This* 2004; 9:revised Summer 2004.
240. Morley JE, Thomas DR, Kamel H. Nutritional deficiencies in long-term care. Part I - Detection and diagnosis. *Annals of Long-Term Care* 2004; 12(Suppl February):1-14.
241. Pilot F, Standridge JB, Swagerty D. Caring for the elderly: A case-based approach. An American Family Physician Monograph. Gillette RD, Guzman SE, Bittner B, et al., editors. American Academy of Family Physicians, 1-25. 2004. Annual Clinical Focus 2004. Caring for america's Aging Population.
242. Robertson RG, Montagnini M. Geriatric failure to thrive. *Am Fam Physician* 2004; 70:343-350.
243. Alibhai SMH, Greenwood C, Payette H. An approach to the management of unintentional weight loss in elderly people. *CMAJ* 2005; 172:773-780.
244. Raynaud-Simon A. Complémentation orale: Spécificités gériatriques [Nutritional supplementation in elderly people]. *Nutr Clin Metab* 2005; 19:90-94.
245. Nikolaus T. Ernährung im Alter [Nutrition for the elderly]. *Z Gerontol Geriatr* 2005; 38:313-314.
246. Miralles R, Esperanza A, Vazquez O. Valoración geriátrica en el hospital: Unidades de postagudos [Comprehensive geriatric assessment in a hospital: Postacute care units]. *Rev Mult Gerontol* 2005; 15(1):30-35.
247. Kyle UG, Genton L, Pichard C. Hospital length of stay and nutritional status. *Curr Opin Clin Nutr Metab Care* 2005; 8(4):397-402.
248. Harris D, Haboubi N. Malnutrition screening in the elderly population. *J R Soc Med* 2005; 98:411-414.
249. Volkert D, Berner YN, Berry E, et al. ESPEN Guidelines on Enteral Nutrition: Geriatrics. *Clin Nutr* 2006; 25(2):330-360.

DISCUSSION

Gordon Jensen, MD, Vanderbilt University, Nashville, TN, USA: *We highlighted this a little bit in the prior discussion. The power of the MNA® in predicting adverse outcomes in hospitalized patients is clearly because it identifies people who are in pro-inflammatory states with active disease processes. If you look at the data that you presented, actually relatively few of the severely malnourished people did not have elevated CRPs. That was a pretty small number of individuals. That, in and of itself, is going to be fascinating to focus on, who are these patients that have pure malnutrition without a high stress state? The power of this tool in predicting bad outcomes is probably not in its capacity of identifying malnourished patients. It is in its role of identifying people who are very sick.*

Yves Guigoz, PhD, Nestlé Product Technology Center, Konolfingen CH: *I think the main problem will be in the at-risk population. In this there are two populations: people who are recovering from malnutrition and people becoming malnourished or having disease process. These are quite different people. That is why I think we need to analyse some of the data here, to see if there are people with inflammation in this group and how they are in the MNA® compared to people without inflammation in this group. It is difficult or practically impossible to differentiate between disease and malnutrition. That is very difficult.*

David Thomas, MD, Saint Louis University, St. Louis, MO, USA: *Just following up on that, Yves, I do not recall when you did the validation, if you said whether there was any adjustment for co-morbid conditions or co-morbid diseases in the database. That is one option if you are going to look at re-adjusting things. I really suggest this very hesitantly, because I think the tool is almost perfect the way it is. We know the disease states that are associated with cachexia. We might be able to add one question such as 'Does the patient have one of these disease states?' We may be able to separate out disease states associated with cachexia and higher mortality from persons with undernutrition who may have a lower mortality. That is just a suggestion. I think the tool performs really well the way it is, whatever it is measuring.*

Yves Guigoz: *That would be one possibility to have another question if people are at-risk to see if there is presence of disease.*

Bruno Vellas, MD, Toulouse University, Toulouse, FR: *What we can do is add that in the guideline to the MNA®.*

Yves Guigoz: *There is one point that I noticed but I have not found the publication. There was one poster at the 4th European Congress on Nutrition, Health and Aging in 2004 on a nursing home using the short form (Perrson M et al. JNHA 2004;8:470 Abstract P4.4). Then you have*

THE MINI NUTRITIONAL ASSESSMENT (MNA®) REVIEW OF THE LITERATURE – WHAT DOES IT TELL US?

about 25 % of elderly that you take falsely as at-risk of malnutrition and they get the 24 points when they have the total MNA®. You have to pay attention when you use the short form in nursing homes.

Tommy Cederholm, MD, Karolinska University Hospital Huddinge, Stockholm, SW: I was a little confused about the fact that a great majority of those with low MNA® scores had elevated CRP levels. That must depend on the setting.

Yves Guigoz: It is one study with 73 advanced cancer patients (Slaviero KA et al. *Nutrition & Cancer* 2003;46:148-157). It is one study that I pulled the data out from the literature. Together with a statistician in Lausanne, I tried to see if we could do something with the data as presented in the publication. It is very difficult, however. We can say in France there are many similar data but we cannot correlate with the outcome, as there is no data. That is what I mean when I say that what we need is raw data from the studies to pool them together and then analyze it.

Tommy Cederholm: I think the question, you Jensen, addressed is whether it is possible to identify the catabolic patients or patients with inflammatory activity. I think that the MNA® is probably not the test to do that. We need to do blood sampling and test for high sensitivity to CRPs or something.

Bruno Vellas: What would also be interesting is to see if we could find the score that is most likely to correlate with inflammation, maybe one other score. The same goes for frailty. Maybe it would be interesting to look at different scores for frailty using the MNA® tool to assess frailty.

Cameron Chumlea, PhD, Wright State University, Dayton, OH, USA: Correct me if I am wrong. I think all the studies you reported were basically all studies of middle-class white people.

Bruno Vellas: I do not know, it depends –

Cameron Chumlea: I want to throw the question over to Dave here. The question is, is race a factor in this? Within the United States with a multi-ethnic population, do we have enough information on the use of the MNA® that means that we should consider race as a factor in the MNA® or something along that line like ethnicity?

David Thomas: We have some data on this that we can look at. Yves and I are looking at a data set right now that will give us some answers to this. We have CRP and we have MNA® scores, so we can do a correlation on that. When I did the initial correlations, and we have not done all the analysis yet, we did not see a correlation. We had a very highly functional group of people, so it may be a little skewed. Race was also not a factor. As far as I know, in all the data I have looked at, and Bruno may want to correct this, we have not seen any correlation with race. Race is generally not a factor in multiple regression models. There is no biological reason why race should be a problem. However, race may be correlated with lower socio-economic status, which could be a risk factor for undernutrition.

Yves Guigoz: There was a study in Mexico City using the MNA®.

Gordon Jensen: One way it sure would be different is that obesity is over-represented among African Americans and Hispanics. There is a very strong correlation between elevated CRP and adiposity, especially truncal adiposity. Not only are the associated co-morbid conditions inflammatory, but there is a growing mindset that truncal obesity itself is pro-inflammatory. Race and ethnicity are important considerations.

Bruno Vellas: And how much is alpha acidic protein used in the States? In Europe it is used as an inflammatory marker.

Riva Touger-Decker, PhD, RD, University of Medicine & Dentistry of New Jersey, Newark, NJ, USA: I would like to comment on two things. One is what Gordon just said. I am thinking of the 52-country heart study which shows that in certain populations, I think it was Middle East and South Asia, the MNA® may not be as sensitive because waist circumference and waist hip ratio were more sensitive indices of truncal obesity than BMI in the type of patient you would see there. We have to think of the problems with the NSI (Nutrition Screening Initiative) DETERMINE Checklist, which was validated in a 98% white population. Look at it in today's society, particularly here where we have multi-cultural, Hispanic, and a variety of other countries. We would need to look at it across those population groups. The other piece I wanted to pick up on was in the earlier talk in which I have not seen any studies that looked at this yet. I think one area to look at for both the MNA® and the MNA® short form would be a growing situation in this country, which is only what I know, in terms of residential living for the elderly. To me this would pick up the very important area of screening the non-hospitalized. They are not really in sub-acute. They are in residential communities where many people are going instead of the nursing home. It would be interesting to apply this there and look at the results to really get at those at risk.

Cameron Chumlea: Does anybody here have any information on the proportion of the population that is in nursing homes? My impression is that it has kind of stabilized and the number of elderly people within residential communities is actually growing.

Bruno Vellas: I think 5 %.

Cameron Chumlea: It has been pretty much constant for years.

Bruno Vellas: There was a study in Europe on nursing home residency for the elderly.

Yves Guigoz: Not with the short form, though.

Bruno Vellas: No, not with the short form. They conducted a study in this kind of population with the complete MNA®.

Riva Touger-Decker: It would be interesting to repeat it in this country and see what happens.

Bruno Vellas: It is easy to do and useful to target the patients with moderate malnutrition.

Cameron Chumlea: You just use all of Florida.

Bruno Vellas: But that would be very interesting to do, to get those data.

Gordon Jensen: Hand in hand with that, would be my perception, there is a growing number of the truly homebound older persons, in the United States. In the data that you showed, there was a mix of people who were probably not homebound. We have been doing studies with the truly homebound individuals, who are at great nutritional risk. Many of them are certainly undernourished and would be a very interesting group to focus on as a growing target for the MNA®.

Cameron Chumlea: Of course, you have homebound that are on dialysis and a bunch of other care situations, not just being homebound and frail.

Kathleen Niedert, RD, Western Home Communities, Cedar Falls, IA, USA: I think that we have brought up an interesting point about how

THE JOURNAL OF NUTRITION, HEALTH & AGING©

frail and elderly the people are that are in the nursing home now. People that I first started working with in the nursing home 30 years ago are the types of people who are still in their homes today. I work in a CCRC (Continuing-Care Retirement Community). I have 400 people who live in retirement communities, who may move to assisted living and then finally to the medical unit. Those 100 that are in the medical unit are extremely ill. Probably all of them have some type of inflammatory disease. It would be interesting to see how that would all fall out in a study.

Cameron Chumlea: I think that raises an issue. The question is where you want to use this instrument. If they are already in the nursing home, then you can do so many other things that it seems like the MNA® is an inappropriate instrument to use in that setting. It is maybe better off being used in some type of assisted living.

Kathleen Niedert: I think what happens is that in most nursing homes where they use this, most of these people would fall into the high risk. At least in Iowa they would. Otherwise they would be in assisted living or on their own.

Bruno Vellas: What would be interesting would be to differentiate between MNA® less than 17 and MNA® between 17 and 22.5. Intervention would be different for those two.

Riva Touger-Decker: I have one question. Given the complexity of who we see in the nursing home now as opposed to even a decade ago when this came out, would 17 still be the cut-off? Do we know that?

Bruno Vellas: That is a good question indeed. That would be interesting to see if there is another cut-off that is more related to mortality and morbidity in nursing homes.

Yves Guigoz: This has been analyzed but we need to do it again. The data is published and we can see it.

Cameron Chumlea: Some of this data is old, though. I think for the MNA® in the United States you would need new data.

Bruno Vellas: What could also be interesting is to have a score where it is sometimes too late to do the intervention. Do not wait. That is important!

Tommy Cederholm: I would like to bring up a question that is related to what we are discussing. It is body mass indexes between various populations. I have been engaged in study of an elderly population in Bangladesh. It is a bit difficult to use the same kind of body mass indexes that we use for European populations and especially for American populations, I think. One question is, whether the low cut-off could be changed to 18.5, which would then correspond to what the WHO advocates. Or whether we should have body mass indexes which are more adjusted to the part of the world the formula is used in.

Bruno Vellas: Yes. Originally, the MNA® was designed for Europe and the US.

Cameron Chumlea: Part of the issue we are dealing with is the availability of suitable reference data. In China, when we collected data there, the cut-off points for BMI that we used were the WHO, i.e. 25 and over was overweight. Since then, the Chinese have produced their own reference data and the cut-off point for overweight in China is a BMI of 23. Therefore, based on that data, in actual fact we have a much higher prevalence of overweight within the Chinese population than we see with the Western criteria. The Chinese, however, collected the data and have it there for use. In Bangladesh, some decision will have to be made to what would be the correct reference points for those. Some countries have these types of data but a lot of countries do not.

Yves Guigoz: You also have to remember that the BMI is only three points out of 30. It is not the whole test.

Annalynn Skipper, PhD, Nutrition Consultant, Chicago, IL, USA: It also seems interesting to consider if the tool could be extended to identify non-nutrition problems. I think you said "beyond help". Certainly, that is one class of people. However, at some point in time, there may be limited resources and a limited availability to intervene. Can we identify an inflammatory process that is creating what looks like a nutrition problem? With limited resources, answers to these two questions would make the lives of dietitians much easier.

Kathleen Niedert: You brought up an interesting point about the use of the MNA® because of the limited resources, especially in the United States for nursing home residents. Resources are going to get even more limited as the baby boomers get into this mix. Is there a way that we can use the MNA® to identify the people who are at risk while they are still in their homes, in assisted living or some type of retirement community, before they get to the nursing home and/or before they end up in some type of welfare situation? Can we use the MNA® as a tool to help keep these people in home settings longer before placement in a nursing home?

Antonio Salva, MD, Barcelona University, Barcelona, ES: Talking about using the MNA® in the nursing home, some years ago we performed a study about the reliability. There was a problem because in the nursing home there are many people with dementia. In this study there were only 3 items of the MNA® with kappa scores lower than 0.4. One of these questions was the self-perceived health. When I asked the nurses who are currently using the MNA®, what are the most important problems using the test, they said that is this question because about 50% of residents have a dementia. Maybe it could be interesting to analyze our data excluding the questions about self-perceived health.

Bruno Vellas: What we do in our practice with people with severe dementia is to ask the professional caregiver to respond, if the people seem to be malnourished.

Yves Guigoz: This is what you should do. This is the solution.

Bruno Vellas: And it works. It worked in most of the studies in dementia, if the nurse or the dietitian or the physician felt that the patient seemed to be malnourished. We need to add that in the recommendations for the MNA®. If the patient with dementia cannot respond, it is up to the health professional to respond.