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Evaluating the DETERMINE Your Nutritional Health Checklist and the Mini Nutritional Assessment as tools to identify nutritional problems in elderly Europeans

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Objective: To evaluate two short questionnaires for assessing the nutritional situation of elderly people, the DETERMINE Your Nutritional Health Checklist of the Nutrition Screening Initiative (NSI checklist) and the Mini Nutritional Assessment (MNA), by comparing equivalent cumulative scores with data on dietary intake, anthropometrics and blood biochemistries.
Design: Information similar to the questions of the NSI and MNA lists was collected by SENECA: the Survey in Europe on Nutrition and the Elderly, a Concerted Action.
Subjects: Records collected in 1993, could be used from 1161 European elderly men and women born between 1913 and 1918, mostly community dwelling, whose diet, lifestyle and health were studied twice, in 1989 and 1993.
Results: The MNA classified 55% of the examinees as well-nourished, 44% as at risk of malnutrition and 1% as malnourished. The NSI categorised the elderly people differently: 11% as good, 41% at moderate nutritional risk, 48% at high nutritional risk. Biochemical, dietary and anthropometric indices did not differ either between NSI categories or between MNA categories. Using serum albumin values (< 30 g/l) and lymphocyte counts (< 1500/ml) as standards, specificity and sensitivity of both instruments for identifying at-risk groups were below 0.6. Only with body weight loss ($\geq 10\%$) as criterion variable were higher sensitivities (0.75 (NSI), 0.96 (MNA)) and specificities (0.54 (NSI), 0.60 (MNA)) found.
Conclusion: It is concluded that in an apparently healthy elderly population both assessment tools are of limited value.
Descriptors: nutritional assessment; elderly; checklist

Introduction

With aging, many factors including physiological and social changes, the development of chronic diseases, the use of medicines and decreased mobility (Dwyer, 1991; Munro, 1992) tend to put elderly people at risk of malnutrition. If malnutrition refers to dietary intake in reference to dietary needs, intakes of several nutrients (mostly B vitamins) have been shown to be inadequate among those living in the community (van der Wielen, *et al*, 1994; Amorim Cruz, *et al*, 1996). In institutionalised elderly people, inadequate intakes are even more common (Kerstetter, *et al*, 1992; Volkert *et al*, 1992; van der Wielen *et al*, 1994, 1996). However, diet is only one indicator of nutritional status of elderly people and probably not the best given the methodological assessment issues (van Staveren *et al*, 1994) and the uncertainty about standards (Dwyer, 1991; Blumberg, 1994). Therefore, other indicators such as anthropometric, haematological, biochemical and immunological indices, health conditions and diseases need to be considered in addition (Dwyer, 1991) in the evaluation of nutritional health. Many efforts have been directed to discovering factors influencing the nutritional status of elderly people (Davies, 1989; Davies & Knutson, 1991; Dwyer, 1991; Morley, 1995; Vellas & Albarede, 1995) to identify people with poor nutritional status or those who are at high risk of nutritional problems. Based on these factors, some simple and easy to apply nutritional assessment tools have been developed.

The DETERMINE Your Nutritional Health Checklist (NSI checklist) has been developed as part of the US Nutrition Screening Initiative, a collaborative effort between the American Dietetic Association, the American Academy of Family Physicians and the National Council on the Aging, Inc. (Dwyer, 1994; Posner *et al*, 1993). The NSI checklist is the first step in a two-tiered approach to screening and assessment. The checklist is designed to enhance the older person's understanding of the determinants of nutritional well-being and promote the consideration of nutritional problems by health professionals. This self-administered awareness tool is intended for the public and may need a follow-up by professionals for further nutritional and health assessments (Dwyer, 1994). The checklist includes 10 Yes/No items that are given different weights associated with the nutritional well-being of older people. The checklist is not meant to be a clinical diagnostic tool but should predict overall perceived health status and identify persons whose estimated nutrient intakes fall below the Recommended Dietary Allowances. So far it

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has only been validated in the population used to assign scores to the checklist (Posner *et al*, 1993).

Another tool for the application of nutritional screening, similar to the extensive NSI follow-up screen including nutritional assessment, is the Mini Nutritional Assessment (MNA) (Guigoz *et al*, 1995; Vellas & Albarede, 1995) developed in France. The goal of the MNA is to evaluate the risk of malnutrition and to identify those who could benefit from early intervention. It requires a professional to complete it and is composed of 18 simple and quick to measure items encompassing anthropometry, dietary assessments, clinical global assessment and subjective self-perceptions of health and nutritional status. Validation tests were done using the opinion of two expert physicians (clinical status) as gold standard. Although the MNA was specifically developed for the frail elderly, it has been cross-validated in a healthy elderly population (Guigoz *et al*, 1995, 1996).

The present study was undertaken to evaluate both short lists on an independent population of 75–79-year-old Europeans.

Subjects and methods

This evaluation was carried using data from the SENECA (Survey in Europe on Nutrition and the Elderly, a Concerted Action) follow-up studies in 1993. As a follow-up to baseline measurements in 1989, these were conducted in nine towns in eight European countries (Table 1) (de Groot *et al*, 1991, 1996). Data from a total of 1161 74- to-79 year-old elderly European men and women were included in the analyses. The SENECA follow-up studies collected more information similar to the questions in the NSI and MNA checklist than in the baseline studies and were therefore used to derive NSI checklist and MNA equivalents. An evaluation of the checklist was based on dietary, anthropometric and biochemical assessments in the SENECA populations. These measurements were carried out according to strictly standardised methodologies (de Groot & van Staveren, 1988). Only measurements that occurred both in the SENECA studies and in the checklists' validations were used in the present evaluation.

Subjects

The operations manual of the SENECA studies called for enrolment of a random sample of subjects born from 1913 to 1918 and living in towns with a population size of 10 000 to 20 000 inhabitants and a socioeconomic structure comparable to the country as a whole. Owing to selective participation the actual sample tended to represent the healthier and more active population segment (van 't Hof & Burema, 1996). Danish participants had essential data sections missing and were not included in the analyses. Mental health data were not available for participants from Belgium, so an MNA equivalent score could not be calculated for them. For a number of participants, data records were incomplete for either dietary intake or body weight change, so that an NSI equivalent questionnaire could be completed for 918 subjects. This number was further reduced to 783 in the completion of the MNA, mostly due to missing mental health information.

Table 1 The number of SENECA participants for whom equivalent NSI and MNA checklists could be completed, by site

		Checklist	
Town	*Country*	*NSI*	*MNA*
Hamme	Belgium	123	–
Haguenau	France	95	95
Romans	France	131	132
Padua	Italy	124	125
Culemborg	The Netherlands	112	115
Vila Franca de Xira	Portugal	152	147
Betanzos	Spain	69	48
Yverdon	Switzerland	112	121
Total		918	783
Men		446	382
Women		472	401

Dietary intake

Food intake data were collected using a combined record and dietary history method (van Staveren *et al*, 1996). The method comprised a 3-day estimated record and a frequency checklist of foods based on the meal pattern of the country, with the previous month as the reference period. Portion sizes were checked by weighing quantities of foods expressed in household measures. Intakes of nutrients were calculated using local food composition tables (Moreiras *et al*, 1996) and foods were grouped according to the Eurocode system (Kohlmeier & Poortvliet, 1992).

Anthropometry

Body weight was measured to the nearest 0.5 kg and body height to the nearest 0.1 cm with the subjects wearing their underclothes only. When stature could not be measured, missing values were recorded. Body weight change was calculated as the difference between 1993 and 1989 weights. Mid-upper-arm circumference was measured, accurate to 1 mm at a specified level (de Groot & van Staveren, 1988).

Biochemistry

Blood samples were collected by venepuncture after an overnight fast. After collection, aliquots from all centres were sent to central laboratories for determination of serum lipids, blood vitamins and serum proteins so that the same analytical methods were applied to all samples. Haematological parameters and cell differentiation were measured locally, using automated analysers (de Groot *et al*, 1996).

Lifestyle and health questionnaire

A general structured interview was used to obtain information on the living situation, disease, use of medicines, subjective health, the ability to perform activities of daily living and diet habits.

Mental health

In the SENECA study, mental health was assessed by means of the Mini-Mental State Examination (Folstein *et al*, 1975) and the 15-item Geriatric Depression Scale (Yesavage *et al*, 1983).

NSI checklist

Each of the ten items of the NSI checklist is weighted with a numerical score. The cumulative score can range between 0 and 21. Subjects with a score ≥ 6 are considered at high nutritional risk. A 3–5 score indicates moderate nutritional risk, whereas a 0–2 score is classified as 'good'. In answering the NSI questions with information derived

from the SENECA studies, some assumptions had to be made.

Question 1 (yes-score = 2): having an illness or condition that changes the kind of amount of food eaten. This was mirrored by SENECA questions on the inclusion or exclusion of foods for health reasons.

Question 2 (yes-score = 3): eating fewer than 2 meals per day. Information comparable to this question was derived from asking about the use of cooked meals in SENECA.

Question 3 (yes-score = 2): eating few fruits or vegetables, or milk products. SENECA participants were given score 2 if they used: < 1 serving of fruit per day (< 125 g); < 3 spoonfuls of vegetables per day (< 150 g); < 1 serving of milk or milk products per day (< 150 ml).

Question 4 (yes-score = 2): having 3 or more alcoholic drinks per day. Similar information could be derived from SENECA's dietary history.

Question 5 (yes-score = 2): having tooth or mouth problems that make it hard to eat. This information is comparable to the SENECA question that asked subjects whether they had problems chewing.

Question 6 (yes-score = 4): not having enough money to buy food. SENECA participants were given score 4 if they always/often found it difficult to budget their food. If this was sometimes so, a score of 2 was given.

Question 7 (yes-score = 1): eating alone most of the time. SENECA collected the number of lunches and suppers that subjects ate alone. Having lunch or supper alone at least 4 times per week was used as a positive reply to question 7.

Question 8 (yes-score = 1): 3 or more different prescribed or over-the-counter drugs a day. SENECA collected detailed information on the frequency and type of drugs used.

Question 9 (yes-score = 2): Unintended gain or loss of 10 pounds in the previous 6 months. Only body weight change over a 4-year interval could be derived. It is unknown whether weight changes that occurred were voluntary. A weight change of at least 5 kg was coded as a positive reply to question 9.

Question 10 (yes-score = 2): not being able to shop, cook and/or feed one self. Positive replies to SENECA questions 'Are you able to carry a heavy thing, e.g. a shopping bag of 5 kg, for a hundred meters?' 'Are you able to cook a meal on your own?', or 'Are you able to feed yourself?' resulted in score of 2.

Mini Nutritional Assessment

The Mini Nutritional Assessment includes 18 items and assigns points on nutritional adequacy. The maximum score is 30 with cut-off values at 24 points (≥ 24: well-nourished) and 17 points ($17-23.5$ = at risk of malnutrition, < 17 = malnourished). For most items SENECA had comparable data.

Items 1 (BMI) and 2 (mid-arm circumference) were part of the SENECA protocol. Item 3 (calf circumference) was not measured. Each SENECA participant was given the best score (circumference ≥ 31 cm = 1 point). Item 4 (weight loss within the previous 3 months) was unknown. Only weight loss over a 4-year period was available. A weight loss of 5 kg or more (rather than 3 kg during the previous 3 months) was given a score of 0. If less than 1 kg of body weight was lost, subjects were given 3 points. Equivalents for questions on living independently (item 5), taking more than 3 prescribed drugs per day (item 6) and suffering from psychological stress or acute disease (item 7) could be found in SENECA's general questionnaire. However, instead of a reference period of 3 months, a period of 6 months was employed in item 7. Information on the ability to perform several activities of daily living could be used for item 8 (mobility). Neuropsychological problems (item 9) could be scored on the basis of the MMSE and GDS. For this, 17 and 23 were used as MMSE cut-off values and a score of 5 for the GDS (Folstein *et al*, 1975; Yesavage *et al*, 1983). No information was collected on pressure sores or skin ulcers (item 10). The best score (1 point) was assigned to each subject. A question on the daily use of cooked meals in SENECA was taken as a proxy for item 11 (number of full meals eaten daily). Dietary history data were used to answer item 12 (markers for protein intake) and item 13 (consumption of fruits and vegetables). Three SENECA questions were used to complete item 14 (decline of food intake over the previous three months due to loss of appetite, digestive problems, chewing or swallowing difficulties): Do you have chewing difficulties? Do you avoid certain foods and foodstuffs? What is the main reason for avoiding these foods? Fluid intake (item 15) was copied from SENECA's dietary assessments and the ability to eat without assistance (item 16) and relative self-perceived health (item 18) from the lifestyle and health questionnaire. MNA item 17 asks whether the individual views him/herself as having nutritional problems. No similar question was available; therefore each subject received 1 point (does not know).

Evaluation procedure and statistical analyses

Cumulative scores were calculated for both checklists. Based on the pre-set cut-off values, subjects were classified in nutritional risk categories according to either score.

Differences in nutritional status indices between these categories were tested by Student's *t*-tests, after combining the low-number categories with the proximate categories as follows: for the NSI checklist 'good' with 'moderate risk', and for the MNA 'malnourished' with 'at risk of malnutrition'. In case of skewness, tests were carried out on log-transformed variables or by nonparametric tests. An $\alpha < 0.05$ was considered significant. Using serum albumin values (< 30 g/l) and lymphocyte counts (< 1500/ml), body mass index (< 20 kg/m^2) and weight loss ($\geq 10\%$)

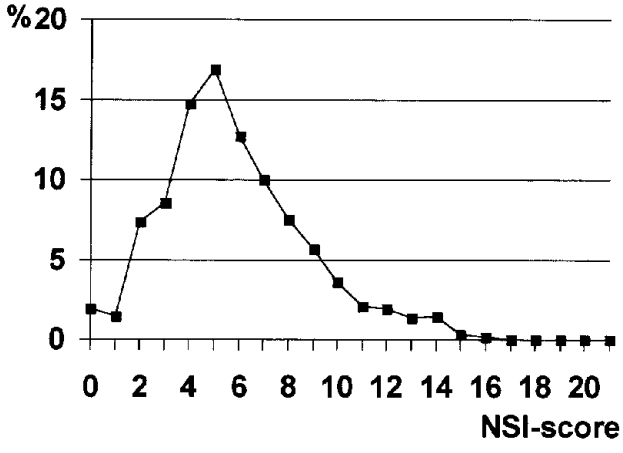

Figure 1 The distribution of equivalent NSI scores in SENECA participants.

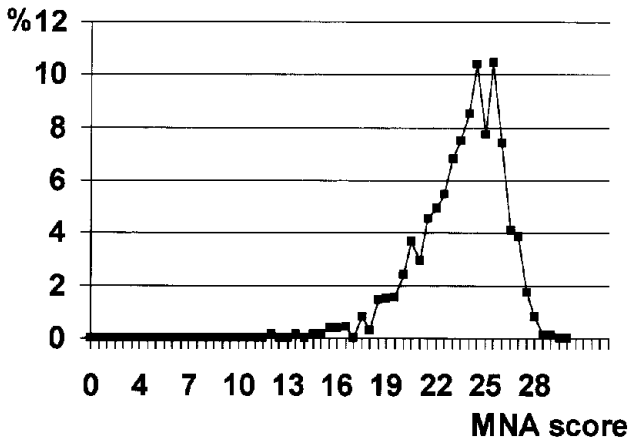

Figure 2 The distribution of equivalent MNA scores in SENECA participants.

as standards, specificity and sensitivity of both instruments for identifying groups at risk were calculated. All analytical procedures on data were performed using the SAS statistical software package.

Results

Equivalent scores (Figures 1, 2)
Based on the NSI equivalent questionnaire, 48% of the examinees were classified at high nutritional risk and 41% were considered at moderate nutritional risk. The score of only 11% was within the 'good' range. NSI items 1 (illness affecting diet), 3 (few fruits and vegetables), 8 (the use of 3 or more drugs) were frequently assigned a positive response (60%, 75% and 51%, respectively), thus contributing markedly to high and unfavourable scores. The Mini Nutritional Assessment identified malnutrition in 1%, whereas 44% were at risk of malnutrition and 55% were considered well-nourished. Psychological stress or acute disease (reported by 80%) and neuropsychological problems (reported by 20%) were the most important contributors to low, unfavourable MNA sum-scores.

According to cross-classification based on both instruments, only 1% were classified at high nutritional risk/malnourished; 11% of the examinees were at moderate risk and 10% were well-nourished.

Average biochemical, anthropometric and dietary evaluation criteria did not differ either between NSI categories (Table 2) or between MNA-categories (Table 3), except that the body mass index of women at moderate or low nutritional risk according to the equivalent NSI checklist exceeded that of women at high nutritional risk. Table 4 presents sensitivities and specificities for both checklists when used to identify nutritional risk, relative to serum albumin values, lymphocyte counts, body mass index, and body weight loss. The screening instruments had most success in identifying at-risk individuals with body weight loss or a low body mass index as standards: 75% and 96% of those who had lost weight were classified as being at risk by the NSI and MNA, respectively. These percentages amounted to 59% and 97% with a low body mass index as criterion variable. The instruments' ability to classify correctly those without low criterion values varied between 0.51 and 0.60 when at-risk individuals were sought. Since the prevalence of malnutrition (lowest MNA scores) was very low in the rather healthy SENECA population, relatively few false positives were found. On the other hand, sensitivity was low for each criterion variable.

Discussion

The present study shows that the two risk-appraisal questionnaires classified the 75- to 79-year-old SENECA participants differently. It questions the applicability of both

Table 2 Biochemical, dietary and anthropometric indices of nutritional status of SENECA participants by sex and NSI categories 'high nutritional risk' and 'moderate/low nutritional risk'

	Men						*Women*					
	High			*Moderate/low*			*High*			*Moderate/low*		
Nutritional risk	*n*	*Mean*	*s.d.*	*n*	*Mean*	*s.d.*	*n*	*Mean*	*s.d.*	*n*	*Mean*	*s.d.*
Biochemical indices												
Haemoglobin (g/l)	203	151	13	199	150	14	191	139	12	209	139	11
Haematocrit (10^{-1} vol%)	208	44.9	4.1	200	44.4	4.1	192	41.3	3.7	209	41.5	3.5
White blood cell count (10^3 μl^{-1})	208	6.7	1.8	197	6.8	2.1	192	5.9	1.4	207	6.2	1.4
Albumin (g/l)	205	42.2	3.3	196	41.9	3.1	189	41.8	3.3	209	41.5	3.3
α1-Acid glycoprotein (g/l)	205	0.99	0.28	196	0.96	0.27	189	0.95	0.23	209	0.98	0.24
C-reactive protein (mg/l)[a]	205	1.0		196	1.0		189	1.0		209	1.0	
Plasma retinol (μmol/l)	204	1.87	0.49	201	1.92	0.53	193	1.80	0.48	215	1.79	0.45
α-Tocopherol (μmol/l)	204	30	8	201	28	7	193	33	8	215	33	9
Cobalamin (pmol/l)[a]	204	260		201	249		192	273		214	264	
Folic acid (nmol/l)[a]	204	14.4		201	15.0		192	15.0		214	14.5	
Pyridoxal 5′-phosphate (nmol/l)[a]	61	47		66	43		45	38		71	38	
Cholesterol (mmol/l)	210	5.65	1.00	204	5.50	0.93	195	6.31	1.13	215	6.14	1.17
Dietary intake												
Energy (MJ/d)	220	9.2	2.6	240	9.1	2.3	218	7.1	1.9	238	7.0	1.9
Protein (g/d)	220	75.1	20.3	240	76.0	19.6	218	63.0	16.6	238	61.9	17.5
Anthropometric indices												
Body mass index (kg/m^2)	195	28.2	5.9	226	29.2	5.1	226	24.1	5.3	220	25.4	5.1*
Arm circumference (cm)	194	29.2	3.5	226	28.8	3.3	225	28.6	3.1	221	28.8	3.6
Health												
Chronic disease (%)		76			78			77			80	

[a]Median values rather than means.
*$P = 0.01$.

Table 3 Biochemical and dietary indices of nutritional status of SENECA participants by sex and MNA categories 'at risk of malnutrition/malnourished' and 'well nourished'[a]

	Men						*Women*					
	At risk/malnourished			*Well nourished*			*At risk/malnourished*			*Well nourished*		
Nutritional risk	*n*	*Mean*	*s.d.*	*n*	*Mean*	*s.d.*	*n*	*Mean*	*s.d.*	*n*	*Mean*	*s.d.*
Biochemical indices												
Haemoglobin (g/l)	159	151	14	186	151	13	153	140	12	195	138	12
Haematocrit (10^{-1} vol%)	162	44.7	4.2	189	44.7	4.0	153	41.7	3.6	196	41.2	3.7
White blood cell count (10^3 μl^{-1})	162	6.8	2.3	186	6.7	1.6	153	6.1	1.4	194	5.9	1.3
Albumin (g/l)	161	42.5	3.3	191	41.8	3.2	156	41.6	3.3	197	41.6	3.4
α1-Acid glycoprotein (g/l)	161	0.97	0.27	191	0.98	0.28	156	0.98	0.23	197	0.95	0.25
C-reactive protein (mg/l)[6]	161	3.0		191	3.0		156	1.0		197	1.0	
Plasma retinol (μmol/l)	159	1.88	0.48	188	1.87	0.52	157	1.81	0.44	195	1.82	0.49
α-Tocopherol (μmol/l)	159	29	8	188	29	8	157	33	10	195	33	8
Cobalamine (pmol/l)*	159	243		188	264		157	252		195	278	
Folic acid (nmol/l)[b]	159	14.7		188	14.7		157	14.7		195	15.0	
Pyridoxal 5′-phosphate (nmol/l)[b]	47	39		63	47		34	35		63	40	
Cholesterol (mmol/l)	165	5.65	0.93	192	5.60	0.99	157	6.15	1.19	198	6.35	1.11
Dietary intake												
Energy (MJ/d)	185	9.4	2.6	203	9.2	2.2	166	7.2	1.6	227	7.3	2.1
Protein (g/d)	185	75.9	19.1	203	75.2	18.9	166	63.5	14.8	227	63.6	17.5
Vitamin B6 (mg/d)	141	1.52	0.48	178	1.52	0.48	131	1.20	0.31	196	1.21	0.36
Health												
Chronic disease (%)		75			76			73			77	

[a]Anthropometric indices not included (body mass index, arm circumference) as they are part of the MNA.
[b]Median values rather than means.

Table 4 Sensitivity and specificity of the NSI checklist and the MNA for identifying nutritional risk, using serum albumin, lymphocyte count, body mass index and weight loss as criterion variables

	NSI: high nutritional risk		*MNA: malnutrition*		*MNA: risk of malnutrition*	
	Sensitivity	*Specificity*	*Sensitivity*	*Specificity*	*Sensitivity*	*Specificity*
serum albumin < 30 g/l	0.25	0.52	0	0.99	0.25	0.55
lymphocyte count < 1500/ml	0.52	0.51	0	0.98	0.43	0.54
QI < 20 kg/m^2	0.59	0.53	0.12	0.99	0.97	0.57
Weight loss $\geq 10\%$	0.75	0.54	0.08	0.99	0.96	0.60

instruments in the SENECA populations based on the absence of differences in biochemical, dietary and anthropometric indices of nutritional status between the NSI and MNA categories.

The SENECA populations included mostly rather healthy elderly people. This is underpinned by a low prevalence of low serum albumin values (0.4%) and anaemia (5–6%) (Lesourd, *et al*, 1996) and by uncovering selective participation of the most healthy and active elderly people (van 't Hof & Burema, 1996). In spite of this, the NSI checklist classified 48% of the examinees as being at high nutritional risk. The low observed specificity of the instrument indicates that about 50% were incorrectly labelled as at high risk. So far data on the sensitivity and specificity of the NSI checklist in relationship to nutritional status items have been lacking, but given its awareness character, over-referral has previously been a matter of concern (Rush, 1993). The specificity of 85% reported by Posner *et al* (1993) in relation to low nutrient intake and health problems was considered overstated because it was based on the sample used to develop the NSI scores. Also, the specificity in relation to weight loss in the present analyses might be somewhat biased, as weight change was one of the items in the checklist.

As in the present study, a high prevalence of being at risk for poor nutritional status according to the NSI checklist has been reported in several US studies (range: 48–98%). These however, do not allow an inter-study comparison because they included different population segments: meals on wheels applicants (Coulston *et al*, 1996), participants in a Commodity Supplemental Food Programme (Koughan & Atkinson, 1993) and inner-city-dwelling black Americans (Miller *et al*, 1996). Further, it is not certain whether the NSI scoring systems applies to European populations. The checklist items and their scores have been adopted on the basis of a checklist analysis with a representative sample of non-institutionalised persons aged 70 years and older in New England. In this, the culturally defined meaning of several questions may well have influenced the final item content and scores of the checklist.

This would help to explain the absence of differences in nutritional status indices between NSI categories. In addition, the equivalent scoring system developed for the present analysis may have caused misclassification. The extent of this is hard to estimate. For most questions a comparable or similar SENECA question could be found. Only for recent (previous 6 months) weight change did a long-term variant (previous 4 years) have to be used.

The MNA classified only 1% of the SENECA subjects (11 elderly persons) as malnourished. Such low prevalence is not surprising as the MNA is specifically intended for the frail elderly (Guigoz *et al*, 1996). However, based on a

cross-validation study in 347 healthy older persons in New Mexico, the use of the MNA has been recommended for uncovering the *risk* of malnutrition rather than malnutrition (Guigoz *et al*, 1995) in community-dwelling or healthy elderly people. In this study, the MNA categorised $< 1\%$ of individuals as malnourished, whereas 18% were classified as borderline and 80% were classified as well-nourished. According to the presently observed sensitivities, the MNA would be able to identify over 95% of true at-risk cases when anthropometric indices are used as standards, but it is estimated to identify 40–50% false positives. These estimates must be somewhat over-rated as the MNA includes items on body weight loss and body mass index.

SENECA had equivalent questions for many of the MNA items. No information was collected on three items: calf circumference, pressure sores and self-reported nutritional problems. It was considered preferable to give the best scores for calf circumference and pressure sores (Guralnik *et al*, 1988) to the 'healthy' SENECA examinees. In answer to the question on nutritional problems a 'Do not know' reply was possible as part of the MNA. Most dissimilar to the MNA items was the substitute weight loss item. Rather than referring to the previous 3 months, the equivalent SENECA item referred to the previous 4 years. As a consequence of the assumptions made, misclassification of the SENECA subjects might have occurred to some extent. Despite the similarity of most items, such misclassification might help to explain the absence of differences between MNA risk groups in indices of nutritional status, especially because of the relative homogeneity of the health situation of the elderly people studied (Lesourd *et al*, 1996; Schroll *et al*, 1996). Better discrimination by the MNA might be expected in elderly people more heterogeneous in their health status, e.g. the institutionalised elderly. However, a parallel pilot study in a nursing home resulted in disappointing results, mostly because early nutritional intervention was common practice in that nursing home.

In the present study, analyses were based on SENECA's follow-up studies since only 12 of the 18 MNA items and 8 of the 10 NSI questions could be derived from the baseline studies. This incompleteness of baseline data hampered both the exploration of the predictive value of cumulative scores and the assessment of the association between 4-year mortality and each of the similar NSI or MNA questions in comparison to the cumulative scores. Most importantly, at baseline, information on weight loss was not available. In particular, weight loss is regarded clinically important as a predictor of increased mortality (Wallace *et al*, 1995). Analyses based on incomplete baseline MNA and NSI scores revealed that 1988/1989 scores were comparable for those who survived up to 1993 and for those who did not. Concurrently, Sahyoun *et al* (1997) have shown that a poor score on the NSI checklist is at best a weak predictor of mortality.

The nutritional screening tools evaluated in the present paper try to step beyond the nonspecific assessment of body weight change and have the worthy goal of identifying nutritional problems soon enough to allow them to be remedied. None of the tools seems to be well applicable in the SENECA studies. Yet, in these studies the intakes of energy and nutrients have been shown to decline with age (Amorim Cruz *et al*, 1996; Moreiras *et al*, 1996). Such a trend puts an increasing number of elderly people at risk for inadequate nutrient intake, which emphasises the importance of timely signalling of impending poor nutritional status. Further evaluation studies are needed to confirm our findings and possibly to recommend checklist and assessment modifications, based on input from users.

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References

Amorim Cruz JA, Moreiras O & Brzozowska A (1996): Longitudinal changes in the intake of vitamins and minerals of elderly Europeans. *Eur. J. Clin. Nutr.* 50, Suppl. 2, S77–86.

Blumberg J (1994): Nutrient requirements of the healthy elderly — should there be specific RDAs? *Nutr. Rev.* **52**, S15–18.

Coulston AM, Craig L & Coble Voss A (1996): Meals on wheels applicants are a population at risk for poor nutritional status. *J. Am. Diet. Assoc.* **96**, 570–573.

Davies L (1989): Risk factors for malnutrition. In *Nutrition in the Elderly,* ed. A Horwitz, DM Macfadyen, H Munro, NS Scrimshaw, B Steen & TF Williams, 153–167. New York: Oxford University Press.

Davies L & Knutson KC (1991): Warning signs for malnutrition in the elderly. *J. Am. Diet. Assoc.* **91** (11), 1413–1417.

de Groot CPGM & van Staveren WA (1988): *Nutrition and the Elderly: Manual of Operations.* Euronut report 11. Wageningen, The Netherlands.

de Groot CPGM, van Staveren WA & Hautvast JGAJ (eds) (1991): EURONUT-SENECA. Nutrition and the elderly in Europe. *Eur. J. Clin. Nutr.* 45, Suppl. 3, 1–196.

de Groot CPGM, van Staveren WA, Dirren H & Hautvast JGAJ (1996): SENECA— Nutrition and the elderly in Europe. Follow-up study and longitudinal analysis *Eur. J. Clin. Nutr.* 50, Suppl. 2, S1–127.

Dwyer JT (1991): *Screening Older Americans' Nutritional Health: Current Practices and Future Possibilities.* Washington, DC: Nutrition Screening Initiative.

Dwyer J (1994): Strategies to detect and prevent malnutrition in the elderly; the Nutrition Screening Initiative. *Nutr. Today* **29**, 14–24.

Folstein MF, Folstein SE & McHugh PR (1975): Mini-Mental State. A practical method for grading the cognitive state of patients for the clinician. *J. Psychiat. Res.* **12**, 189–198.

Guigoz Y, Vellas BJ & Garry PJ (1995): The Mini Nutritional Assessment (MNA): a practical assessment tool for grading the nutritional state of elderly patients. In: *Nutrition in the Elderly — The Mini Nutritional Assessment (MNA),* 2nd edn, ed. BJ Vellas, Y Guigoz, PJ Garry & JL Albarede, 15–61. Facts and Research in Gerontology 1994/1995 (supplement).

Guigoz Y, Vellas B & Garry PJ (1996): Assessing the nutritional status of the elderly: the Mini Nutritional Assessment as part of the geriatric evaluation. *Nutr. Rev.* **54** (II), S59–65.

Guralnik JM, Harris TB, White LR & Cornoni Huntley JC (1988): Occurrence and predictors of pressure sores in the National Health and Nutrition Examination Survey Follow-up. *J. Am. Geriatr. Soc.* **36**, 807–812.

Kerstetter JE, Holthausen BA & Fitz PA (1992): Malnutrition in the institutionalised older adult. *J. Am. Diet. Assoc.* **92**, 1109–1116.

Kohlmeier L & Poortvliet EJ (1992): *Eurocode 2 Food Coding System.* Berlin:Institute for Social Medicine and Epidemiology.

Koughan N & Atkinson C (1993): Nutrition Screening Initiative and the Louisiana food for seniors experience. *J. La State Med. Soc.* **145**, 447–449.

Lesourd B, Decarli B & Dirren H (1996): Longitudinal changes in iron and protein status of elderly Europeans. *Eur. J. Clin. Nutr.* 50, Suppl. 2, S16–25.

Miller DK, Carter ME & Sigmund RH *et al*. (1996): Nutritional risk in inner-city-dwelling older black Americans. *J. Am. Geriatr. Soc.* **44**, 959–962.

Moreiras OM, van Staveren WA, Amorim Cruz JA, Carbajal A, de Henauw S, Grunenberger F & Roszkowski W (1996): Longitudinal changes in the intake of energy and macronutrients of elderly Europeans. *Eur. J. Clin. Nutr.* **50**, Suppl. 2, S67–77.

Morley JE (1995): Nutrition assessment is a key component of geriatric assessment. In *Nutrition in the Elderly — The Mini Nutritional Assessment (MNA),* 2nd edn, ed. BJ Vellas, Y Guigoz, PJ Garry & JL Albarede, 5–11. Facts and Research in Gerontology 1994/1995 (supplement).

Munro HN (1992): Nutrition of the elderly: Introduction. In *Nutrition of the Elderly,* ed. HN Munro & G Schlief, Nestlé Nutrition Workshop Series, vol 29, 1–5. Vevey: Nestec; New York: Raven Press.

Posner BM, Jette AM, Smith KW & Miller DR (1993): Nutrition and health risks in the elderly: the Nutrition Screening Initiative. *Am. J. Public Health* **83**, 972–978.

Rush D (1993): Evaluating the Nutrition Screening Initiative (editorial). *Am. J. Public Health* **83**, 944–945.

Sahyoun NR, Jacques PF, Dallal GE & Russell RM (1997): Nutrition Initiative Checklist may be a better awareness/educational tool than a screening one. *J. Am. Diet. Assoc.* **97** (7), 760–764.

Schroll M, Bjø rsnbo-Schroll K, Ferry M & Livingstone MBE (1996): Health and physical performance of elderly Europeans. *Eur. J. Clin. Nutr.* **50**, Suppl. 2, S105–112.

van 't Hof MA & Burema J (1996): Assessment of bias in the SENECA study. *Eur. J. Clin. Nutr.* 50, Suppl. 2, S47–56.

van der Wielen RPJ, de Groot CPGM & van Staveren WA (1994): Dietary intake of water soluble vitamins in elderly people living in a Western society (1980–1993). *Nutr. Res.* **14**, 605–638.

van der Wielen RPJ, de Wild GM, de Groot CPGM, Hoefnagels WHL & van Staveren WA (1996): Dietary intakes of energy and water soluble vitamins in different categories of ageing. *J. Gerontol. A, Biol. Sci. Med. Sci.* **51**, B100–107.

van Staveren WA, de Groot CPGM, Blauw YH & van der Wielen RPJ (1994): Assessing diets of elderly people: problems and approaches. *Am. J. Clin. Nutr.* **59**, 221S–223S.

van Staveren WA, Burema J, Livingstone MBE, van den Broek T & Kaaks R (1996): Evaluation of the dietary history method used in the SENECA study. *Eur. J. Clin. Nutr.* **50**, Suppl. 2, S47–56.

Vellas BJ & Albarede JL (1995): Nutritional assessment as part of the geriatric evaluation: the Mini Nutritional Assessment In: *Nutrition in the Elderly — The Mini Nutritional Assessment (MNA),* 2nd edn, ed. BJ Vellas, Y Guigoz, PJ Garry & JL Albarede, 11–15. Facts and Research in Gerontology 1994/1995 (supplement).

Volkert D, Kruse W, Oster P & Schlierf G (1992): Malnutrition in geriatric patients: diagnostic and prognostic significance of nutritional parameters. *Ann. Nutr. Metab.* **36**, 97–112.

Wallace JI, Schwartz RS, LaCroix AZ, Uhlmann RF & Peralman RA (1995): Unvoluntary weight loss in older outpatients: incidence and clinical significance. *J. Am. Geriatr. Soc.* **43**, 329–337.

Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adey M & Leirer VO (1983): Development and validation of a geriatric depression screening scale: a preliminary report. *J. Psychiat. Res.* **17**, 37–49.