ORIGINAL COMMUNICATION

Characteristics of the Mini-Nutritional Assessment in elderly home-care patients

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Objective: To assess the risk of malnutrition among elderly people living at home and receiving regular home-care services using the Mini-Nutritional Assessment (MNA) and to study the characteristics of the instrument in this patient group.
Design: A cross-sectional study using the MNA score to assess the nutritional status of elderly home-care patients.
Setting: Municipal home-care services in rural Finland.
Subjects: A total of 178 (65%) out of 272 eligible patients aged 75–94 y agreed to participate.
Major outcome methods: MNA questionnaire, anthropometrics, structured questionnaire, menu record.
Results: According to MNA, 3% were malnourished (MNA < 17 points), 48% at risk for malnutrition (17–23.5 points) and 49% well nourished (>23.5 points). The mean MNA score was 23.4. Weight loss, psychological stress, nutritional status, decline in food intake, self-perceived health status and mid-arm circumference (MAC) showed the strongest significant correlations ($P = 0.0001$) to total MNA score. MNA questions with the strongest significant intercorrelations ($P = 0.0001$) were body mass index with MAC and calf circumference; and the decline of food intake and self-perceived nutritional status. The number of eating problems correlated significantly to the MNA score ($P = 0.0011$). Those with chewing and swallowing problems ($n = 64$, 36%) had a significantly lower MNA score than others ($P = 0.0001$). Dry mouth together with chewing and swallowing problems ($n = 40$, 22%) reduced the MNA score even further ($P = 0.0001$).
Conclusions: The results suggest that MNA is a useful tool in the identification of elderly home-care patients at risk for malnutrition.
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Introduction

Older adults are a potentially vulnerable group for malnutrition (WHO, 2002). Nutritional status is influenced by numerous factors such as dentition, neuropsychological problems and mobility, and may be related to other health concerns (McGee & Jensen, 2000). Increasing ill health (McCormack, 1997) and increasing disability are linked with nutritional risk indicators (Sharkey, 2002). The nutritional status of newly hospitalised elderly patients or institutiona-

lised elderly is often poor (Sullivan, 1992; Tierney, 1996); even upon discharge these people's nutritional status may remain poor and require strict attention in other care settings (Thomas *et al*, 2002) and at home. In the present situation where old people with disabilities are encouraged to live in their own homes, it is important that accurate information is available about their health and nutritional status.

Nutrition screening of older adults is extremely difficult; the shortcomings of existing screening tools do not make the problem any easier (Schneider & Hebuterne, 2000). Some of the screening methods can only be administered by trained clinicians (Reuben *et al*, 1995). Biochemical markers are time consuming and expensive to use in home situations, and the criteria for their interpretation in old age are unclear (Reuben *et al*, 1995). A comprehensive tool specifically developed for use with elderly people is the Mini-Nutritional Assessment (MNA): this tool is designed for purposes of identifying the risk of malnutrition in the frail elderly and identifying those who may benefit from early intervention (Guigoz *et al*,

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1996). MNA has been validated in three successive studies of more than 600 elderly (Guigoz et al, 1996). It includes the anthropometric measures of weight and height and derived body mass index (BMI), which are reliable and simple tools to use (Reuben et al, 1995).

As the data on home-care patients are still scarce and knowledge about the use of MNA in Finland is limited, the present study set out to obtain information about the nutritional status of home-care patients by using the MNA score and to explore the typical characteristics of the MNA score in this patient group. We also studied the use of services as well as eating and digestion problems and their correlations to the MNA score.

Material and methods

Subjects
The study population comprised home-care patients ($N = 272$) from three rural municipalities in southern Finland with a combined population of 41 400, of whom 7% ($n = 2900$) were aged 75 y or over. The criteria for inclusion were age 75 y or over, receiving a home-care visit at least once every fortnight and the ability to understand and answer questions. Patients with severe cognitive impairment were excluded.

Methods
The data were collected with a structured questionnaire that was divided into three parts: first, MNA questions; second, information about diet and eating problems; and third, other information concerning the use of services and living conditions.

Mini Nutritional Assessment
The MNA consists of four parts: anthropometric measurements, general status, diet information and subjective assessment (Guigoz et al, 1996). A score of less than 17 points (out of a maximum of 30) is regarded as an indication of malnutrition, 17–23.5 points indicate a risk for malnutrition and >23.5 points indicate that the person is well nourished. In this study, the assessment was carried out using a modified Finnish translation of the MNA scale (www.gernet.fi, 1997). The modifications were designed to make the questions easier to understand, so that they could be repeated each time in a like manner by the investigator. In addition, the aim was to obtain more accurate information about eating habits for further use. The modifications did not affect the MNA scoring. The modifications made were as follows: those in regular respite care were classified as institutionalised and scored 0 points. Psychological stress was defined as an acute disease or an aggravation of a chronic disease in the past 3 months. The consumption of fruit and berries and vegetables was covered in two separate questions, each giving 0.5 points. Consumption of eggs was asked, but beans were excluded because they are not part of

the staple diet in Finland (Lahti-Koski & Kilkkinen, 2001). Neuropsychological problems in the case of mild dementia were recorded on the basis of the assessor's subjective impression. Patients on medication for depression were recorded and they were given 0 points.

Dietary analysis
A menu record was collected using a Finnish formula used in population surveys. The question concerning drinks used an estimated record for different drinks (milk, coffee or tea, water, juice and soft drinks, home-made sweet beer) (National Public Health Institute, 1998). Fluid intake was assessed and recorded separately according to how many glasses or cups of different fluids were drunk per day. Alcoholic beverages were covered in a separate question. Special diets ordered by a physician were also covered and recorded.

Structured questionnaire
A structured questionnaire was administered to obtain information on housing and living arrangements, the amount of home-care received, home help services, meals on wheels services and problems related to eating and digestion. These problems were named as chewing and swallowing problems, problems in eating because of dry mouth, constipation, diarrhoea, indigestion and other problems.

Data collection
The study protocol was pilot tested with 10 home-care patients who were not included in the study. Minor changes were made on the basis of the feedback received for greater clarity. One registered nurse, experienced in elderly home-care, was responsible for data collection in the patients' homes. The subjects were weighed with a floor scale to the nearest 0.1 kg and their standing height, mid upper-arm (MAC) and calf circumferences (CCs) measured to the nearest 0.1 cm. In the case of patients who had degenerative changes in stature, knee height was measured (Chumlea et al, 1985). Knee height was used for 16 patients. BMI was calculated accordingly (kg/m^2).

Ethics
The Director of Medicine of the primary health-care services approved the research protocol. Prior to the launch of the study, all home-care nurses were informed in writing about its aims. Home-care nurses asked the patients to give their consent before participating in the study; all the participants signed a written informed consent document.

Statistical analysis
Statistical analysis was carried out with SAS 6.12 software. Means, standard deviations, crosstabulation and frequency tables were used as descriptive statistics. Spearman's correla-

tion coefficients were determined in correlation analysis. For statistical comparisons, analysis of variance was used for normally distributed data and nonparametric methods, such as the Wilcoxon two-sample test and the Kruskal–Wallis test, were used for data that had a skewed distribution. P-values of less than 0.05 were considered statistically significant.

Results

Participants
A total of 178 patients (65%) out of an eligible population of 272 took part. The main reasons for nonparticipation were fatigue or being too ill to meet new people. Within the study group, 3% (n = 6) were regarded as malnourished, scoring less than 17 MNA points; 48% (n = 85) were at risk for malnutrition (17–23.5 points); and 49% (n = 87) were well nourished. The mean MNA score was 23.4. The mean age of the participants was 83.5 y (s.d. ± 4.6). One-third (n = 52, 30%) had a BMI of 30 kg/m^2 or more and 10 participants (6%) had a BMI of under 20 kg/m^2. There was a significant negative correlation between age and BMI (P = 0.0016). Some basic data of the study group are shown in Table 1.

Correlation between total MNA score and individual questions
The significant correlations between the total MNA score and individual questions are shown in Table 2. All, but three, MNA questions (use of drinks, protein intake and independency) showed a significant correlation to the total MNA score.

MNA questions and their intercorrelations
Some significant correlations were found between the different MNA questions. The strongest correlations (P = 0.0001) were found between BMI and CC (r_s = 0.60); BMI and MAC (r_s = 0.54); MAC and CC (r_s = 0.52); and the decline in food intake and self-perceived nutritional status (r_s = 0.34). Skin problems and the amount of drinks consumed did not correlate significantly to any other question.

MNA questions with the highest frequencies of zero responses
The frequencies of zero points in the MNA questions revealed that 82% (n = 146) took more than three prescription drugs per day, 36% (n = 64) had suffered psychological stress in the past 3 months, 17% (n = 30) regarded their health status as poorer than others and 37% (n = 65) were unable to give such an estimate. One in six or 15% (n = 26) had skin problems, 13% (n = 23) regarded themselves as malnourished and 15% (n = 26) were unable to estimate their nutritional status. In all, 12% (n = 21) reported a loss of weight of more than 3 kg during the preceding 3 months and 12% (n = 21) had neuropsychological problems. The questions concerning diet revealed that more than one in three did not eat vegetables (n = 54, 30%) or fruit (n = 47, 26%) daily and one in 10 (n = 19, 11%) did not eat protein products every day. One in 10 (n = 17, 10%) had a reduced total food intake because of loss of appetite.

MNA subgroup questions related to anthropometrics, global, diet and subjective assessments
The at-risk, malnourished and well-nourished groups differed significantly from each other in the MNA subgroup questions related to anthropometrics, global and diet assessments (Table 3).

Table 1 MNA scores, anthropometry and living arrangements in 178 home-care patients

	Whole group (n=178) Mean ± s.d.	Malnourished (n=6) Mean ± s.d.	At risk (n=85) Mean ± s.d.	Well-nourished (n=87) Mean ± s.d.
MNA total (max score 30)	23.4 ± 3.0	15.3 ± 1.9*,a	21.4 ± 1.7*,a	25.8 ± 1.3*,a
Anthropometry				
BMI (kg/m^2)	27.4 ± 5.0	25.5 ± 4.4	26.8 ± 5.5b	28.0 ± 4.5
BMI (kg/m^2) female (n=137)	27.2 ± 4.6	25.1 ± 4.8	27.1 ± 5.9b	28.2 ± 4.6
BMI (kg/m^2) male (n=40)	28.0 ± 6.3	27.0c	25.9 ± 3.4	27.5 ± 4.4
MAC (cm)	30.5 ± 4.8	28.6 ± 5.5	29.7 ± 5.1	31.3 ± 4.4
CC (cm)	36.0 ± 3.8	35.5 ± 3.6	35.2 ± 4.1**,d	36.9 ± 3.4**,d
Living arrangements				
Lives alone (%)	117 (66)	6 (100)	57 (67)	54 (62)
Home health care weekly (%)	78 (44)	4 (67)	41 (48)	33 (38)
Home help daily (%)	53 (30)	4 (67)	28 (33)	21 (24)
Meals on wheels (%)	79 (44)	0	39 (46)	40 (46)

*P<0.001; **P<0.05.
[a]Kruskal-Wallis test.
[b]one data missing.
[c]one observation.
[d]Analysis of variance.

Table 2 Correlations of MNA questions to total MNA score (n=178)

MNA question	Spearman's r	P-values
Weight loss during the last 3 months	0.52	*
Psychological stress	0.48	*
Self-perceived nutritional status	0.43	*
Food intake declined	0.42	*
Self-perceived health status	0.42	*
MAC	0.30	*
Mobility	0.28	*
BMI	0.27	*
Number of meals eaten per day	0.27	*
CC	0.24	**
Three prescription drugs per day	0.24	**
Use of vegetables	0.23	**
Ability to eat	0.22	**
Neuropsychological problems	0.17	***
Skin problems	0.16	***
Use of fruits	0.16	***
Use of drinks	0.10	0.19
Protein intake	0.09	0.25
Independence	0.06	0.41

*$P<0.001$; **$P<0.01$; ***$P<0.05$.

Problems related to eating and digestion

Most of the patients ($n=166$, 93%) had at least one problem associated with eating and digestion. The most frequent problems were constipation ($n=94$, 53%), dry mouth ($n=103$, 58%) and indigestion ($n=86$, 48%). Chewing and swallowing were a problem for 36% ($n=64$). Diarrhoea was a problem for a few participants ($n=9$, 5%). The number of problems varied from one ($n=52$, 29%) to four ($n=20$, 11%). Those who had chewing and swallowing problems ($n=64$, 36%) had a significantly lower MNA score than others ($P=0.0001$). Dry mouth together with chewing and swallowing problems ($n=40$, 22%) lowered the MNA score even further ($P=0.0001$). The number of problems showed a significant correlation to the MNA score ($P=0.0011$): the higher the number of problems, the lower the MNA score. Almost half ($n=81$, 46%) reported that they had a special diet ordered by a physician. The most common of these was a diabetic diet ($n=53$, 30%).

Discussion

According to MNA, one-half of all patients in this study receiving homecare were at risk for malnutrition and 3% were malnourished. Both of these groups were characterised by lower BMI, more home-care services, more home help and living alone, although the differences were not significant. The study population consisted of the frail elderly receiving regular home-care services in one rural area in Finland. The main reasons for nonparticipation were fatigue or being too ill to meet new people. Patients with severe cognitive impairment were excluded. The sample thus represents the healthier home-care patients living in this area. The data were collected by one registered nurse, which improves the internal reliability of the estimations made.

The mean MNA score was 23.4. The figures reported in earlier studies have been somewhat lower; Saletti et al (1999) reported a figure of 22.7 for 80 home-care patients and Murphy et al (2000) reported a figure of 22.1 in 49 elderly orthopaedic patients interviewed on the fifth day after admission. The number of malnourished persons was similar to that found by Saletti et al (1999) (3%), but substantially lower than in the study by Murphy et al (2000) (16%) in hospitalised patients. The difference in the mean MNA points is influenced by the major difference in BMI: in our study four in five scored maximum points compared to two in five in the study by Saletti et al (1999). The mean BMI value in our study was $27.4 \, \text{kg/m}^2$. One-third of the study group had BMI values higher than 30, which is regarded as obese, while only 6% had an index of less than 20. One-fifth had a BMI of $<23 \, \text{kg/m}^2$, the limit for the maximum score of three points in the MNA. Earlier studies have reported lower BMI values, such as a mean BMI of $23.7 \, \text{kg/m}^2$ (Murphy et al, 2000), and higher proportions of underweight, with up to one-third showing a BMI of less than $20 \, \text{kg/m}^2$ and 64% under $23 \, \text{kg/m}^2$ (Saletti et al, 1999). One possible explanation for this difference in BMI might be that we opted to exclude patients with severe cognitive impairment. Research has shown that patients with memory problems are at risk for malnutrition and low body weight (White et al, 1996). In the study by Saletti et al (1999), 5% of the patients were demented. Here, 80 out of a total of 85 eligible patients took part, thus constituting a more representative sample of home-care patients. In our study, healthier people were over-represented among the participants. In the study by Murphy et al (2000) demented patients were excluded, but the small sample represented hip fracture patients — a group highly vulnerable in regard to nutrition.

Table 3 Comparison of the MNA subgroup questions in the malnourished, at-risk and well-nourished groups of 178 home-care patients

MNA subgroup questions	Whole group (n=178)		Malnourished (n=6)		At risk (n=85)		Well nourished (n=87)	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
I MNA anthropometrics	6.84	6.62–7.05	4.67*	3.09–6.25	6.26*	5.92–6.60	7.55*	7.38–7.73
II MNA global assessment	9.90	9.62–10.18	7.00*	5.67–8.33	9.04*	8.65–9.42	10.94*	10.68–11.21
III MNA dietary assessment	8.23	8.07–8.40	5.67*	3.74–7.59	7.92*	7.70–8.13	8.72*	8.55–8.89
IV MNA subjective assessment	2.33	2.19–2.47	2.08	1.69–2.48	2.28	2.06–2.50	2.39	2.19–2.59

Kruskal–Wallis test, *$P<0.001$; CI, confidence interval.

According to the results of the longitudinal population study by Dey *et al* (2001), the BMI ranges with the lowest risks for 15-y mortality after age 70 y were 25–27 kg/m^2 for female subjects and 27–29 kg/m^2 for male subjects, both in the nonsmoking population. If the BMI values recommended by Dey *et al* (2001) were applied, 33% of the women and 55% of the men in our study would remain below those values compared to almost all participants in the studies by Saletti *et al* (1999) and Murphy *et al* (2000). Our results yielded a higher prevalence of obesity (BMI ≥ 30 kg/m^2) than those of Beck *et al* (2001), but the figures are at more or less the same level as in the Finrisk population study in Finland (Lahti-Koski & Kilkkinen, 2001).

People at risk for malnutrition tend to use support services more often than others, as has been shown earlier in the context of general practice (Beck *et al*, 2001). However, none of the malnourished patients in our study received meals-on-wheels service, and they all lived alone. There are two possible explanations: either the patient's refusal to take the service or the failure of home-care staff to identify the problem.

Weight loss, psychological stress, decline in food intake, self-perceived nutritional and health status and MAC showed the strongest correlations to total MNA score. These factors were followed by reduced mobility, BMI and number of meals eaten per day. Murphy *et al* (2000) reported similar results, with the exception that BMI had the strongest predictive effect on total score. In our study, the BMI values were substantially higher than in Murphy *et al* (2000), which might have contributed to the different results. As has been reported earlier (Rubenstein *et al*, 2001), the proportion of 'don't' know' responses was very high for self-perceived nutritional status and health status. In addition, 15% of our respondents were unable to estimate their nutritional status and 37% their health status, thus scoring less points in these questions. Earlier research has nonetheless shown that subjective assessments of health do have predictive value (Griep *et al*, 2000). Christensson *et al* (2002) concluded that 'self-experienced health status' had the most predictive value in MNA classifications.

The questions concerning the amount of drinks, protein intake and independence did not show significant correlations to the total MNA score. In earlier studies, too, these have been among the items with the weakest correlations (Rubenstein *et al*, 2001). Our results may be explained by the fact that in our study those who had problems with eating such as a dry mouth tended to drink more than others. In contrast to earlier findings (Saletti *et al*, 1999), the amount of liquids consumed by the participants in this study was quite satisfactory. The score for protein intake was reduced for 80% of the patients because they consumed less than two eggs per week, which is roughly the same as the average for the whole population (National Public Health Institute, 1998). One possible explanation is that people harbour fears of high cholesterol, an issue that recently has attracted considerable public attention in Finland (Pietinen *et al*, 2001). The

question concerning independence left only two persons regularly in respite care without points. All others lived in their own homes.

The MNA questions showing significant intercorrelations formed logical patterns between anthropometrics (BMI, MAC, CC), food intake decline with weight loss, self-perceived nutritional status, ability to eat and use of fruit and vegetables. Protein intake was related to other dietary factors and psychological stress with weight loss and use of drugs. These patterns support earlier findings on the complex causes of poor nutritional status (Sharkey, 2002). When testing the MNA subgroup questions related to anthropometrics and global, dietary and subjective assessments, we found that the malnourished, at-risk and well-nourished groups differed significantly in all but the subjective assessment questions. This indicates that poor nutritional status according to MNA is a result of deterioration in all areas. In their follow-up study on general practice patients, Beck *et al* (2001) found a significant difference between at-risk and well-nourished groups at baseline, but only in anthropometrics after the 6-month follow-up.

An investigation of zero points in different questions also sheds interesting light on the MNA assessment. The highest number of respondents with zero points occurred in the question concerning medical drugs. Four in five patients took more than three prescription drugs daily. Medication goes hand in hand with chronic diseases: chronically ill patients will probably have medication. Chronic diseases can affect energy intake (Rissanen *et al*, 1996) and contribute to poor nutritional status. On the other hand, different drugs reduce saliva production (Närhi *et al*, 1992) and can further threaten oral health (Närhi, 1994). In the study by Griep *et al* (2000), the number of medications appeared to be the clinically most relevant parameter explaining low MNA score in retirement homes for the elderly. Problems related to eating were rather common in our study and were found to affect the MNA score. Chewing problems and reduced appetite together with the inability to buy food and cook one's dinner can lead to a reduced nutritional intake and thus to a poor nutritional status (Mowé *et al*, 1994). The complex relation between oral health and nutrition has been highlighted in earlier studies (Lamy *et al*, 1999). The same applies to the relation of nutrition and function (Sharkey, 2002).

The number of eating problems and their relation to the MNA score clearly revealed the importance of identifying special problems related to eating and digestion. As has been shown earlier (Mowé *et al*, 1994), these problems need to be given closer attention in patient care because of their cumulative effects and influence on diet intake. Alternative meals as well as concrete guidelines have to be made available to older people, so that they can replace the food that is causing trouble to them. Our study population had a more balanced diet than older adults living in the community in Finland (Sulander *et al*, 2001). Contrary to expectations, we found that the MNA results for those people with a

special diet, a risk factor for poor nutritional status (Axen & Schnoll, 1995), did not differ from those of others.

In contrast to many other studies where general assessments are made by a physician and the diet information is collected by a dietician, all the data in this study were collected by a registered nurse. Some modifications were made to the MNA with a view to facilitating data collection. The everyday care of home-care patients is generally the responsibility of nurses under the direction of a physician, and in this job nurses need to have a functional screening tool for the assessment of nutrition. The MNA provides such a tool that can be used with home-care patients. Given the vulnerability of this patient group, special attention needs to be paid to the actions after screening. To this end, the MNA might benefit from some clarifications and adjustment of the cutoff point according to the individual country context (Christensson et al, 2002). One of these clarifications could be a dietary question, which should include a short qualitative assessment of meals and snacks (Wissing et al, 1998). In addition, as the measurement of height may cause difficulties, professionals should be guided to use other reliable information of height (Willett, 1998). As Vellas et al (1999) have observed, the MNA is mostly useful as part of a geriatric assessment and for preventive measures among the frail elderly (Christensson et al, 2002). Nursing staff working in home-care should have basic knowledge about certain MNA issues such as mobility, drugs, skin problems and BMI. With the MNA, these questions can be related to nutritional status and with the guidelines compiled for interventions possibly resolved (Rivière et al, 1999). The MNA seems to provide a useful tool for the identification of those home-care patients who are at risk for malnutrition. It offers a solid starting point for interventions which should include all the people involved in the nutritional support of home-care patients such as home-care nurses, home helpers, physicians, dieticians, meals-on-wheels services, day centres, informal carers and, most importantly, the patients themselves. The number of old home-care patients is set to increase in the near future, and these people will be needing assistance in their everyday activities, including nutrition at home. The prevention of nutritional problems is crucial.

References

Axen K & Schnoll R (1995): Nutritional issues in the frail older person. *Top. Geriatr. Rehabjil*. **11**, 1–10.

Beck AM, Ovesen L & Schroll M (2001): 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*. **55**, 1028–1033.

Christensson L, Unosson M & Ek A-C (2002): Evaluation of nutritional assessment techniques in elderly people newly admitted to municipal care. *Eur. J. Clin. Nutr*. **56**, 810–818.

Chumlea WC, Roche AF & Steinbaugh ML (1985): Estimating stature from knee height for persons 60 to 90 years of age. *J. Am. Geriatr. Soc*. **33**, 116–120.

Dey DK, Rothenberg E, Sundh V, Bosaeus I & Steen B (2001): Body mass index, weight change and mortality in the elderly. A 15 y longitudinal population study of 70 y olds. *Eur. J. Clin. Nutr*. **55**, 482–492.

Government Advisory Committee for Nutrition (Valtion ravitsemus‾ neuvottelukunta) (1998): *Finnish Nutrition Recommendations*. Helsinki: Edita (in Finnish).

Griep MI, Mets TF, Collys K, Ponjaert-Kristoffersen I & Massart DL (2000): Risk of malnutrition in retirement homes elderly persons measured by the ''Mini-Nutritional Assessment''. *J. Gerontol. Med. Sci*. **55A**, M57–M63.

Guigoz Y, Vellas B & Garry P (1996): Assessing the nutritional status of the elderly: the Mini Nutritional Assessment as part of the geriatric evaluation. *Nutr. Rev*. **54**(Suppl 2), 59–65.

Lahti-Koski M & Kilkkinen A (2001): *Nutrition Report 2000* (Ravitsemuskertomus 2000). (English summary). Helsinki: Publications of the National Public Health Institute B1/2001.

Lamy M, Mojon P, Kalykakis G, Legrand R & Butz-Jorgensen E (1999): Oral status and nutrition in the institutionalised elderly. *J. Dent*. **27**, 443–448.

McCormack P (1997): Undernutrition in the elderly population living at home in the community: a review of the literature. *J. Adv. Nurs*. **26**, 856–863.

McGee M & Jensen G (2000): Nutrition in the elderly. *J. Clin. Gastroenterol*. **30**, 372–380.

Mowé M, Bohmer T & Kindt E (1994): Reduced nutritional status in an elderly population (>70 y) is probable before disease and possibly contributes to the development of disease. *Am. J. Clin. Nutr*. **59**, 317–324.

Murphy MC, Brooks CN, New SA & Lumbers ML (2000): The use of the Mini-Nutritional Assessment (MNA) tool in elderly orthopaedic patients. *Eur. J. Clin. Nutr*. **54**, 555–562.

National Public Health Institute (1998): *The 1997 Dietary Survey of Finnish Adults*. Helsinki B8/1998, Finland.

Närhi TO (1994): Salivary findings in the elderly. Thesis, University of Helsinki, Finland.

Närhi TO, Meurman JH, Ainamo A, Nevalainen MJ, Schmidt-Kaunisaho K-G, Siukonsaari P, Valvanne J, Erkinjuntti T, Tilvis R & Mäkilä E (1992): Association between salivary flow rate and the use of systemic medication among 76-, 81-, and 86-year-old inhabitants in Helsinki, Finland. *J. Dent. Res*. **71**, 1875–1880.

Pietinen P, Lahti-Koski M, Vartiainen E & Puska P (2001): Nutrition and cardiovascular disease in Finland since the early 1970s: a success story. *J. Nutr. Health Aging* **5**, 150–154.

Reuben DB, Greendale GA & Harrison GG (1995): Nutrition screening in older persons. *J. Am. Geriat. Soc*. **43**, 415–425.

Rivière S, Gillette-Guyonnet S, Nourhashemi F & Vellas B (1999): Nutrition and Alzheimer's disease. *Nutr. Rev*. **57**, 363–367.

Rissanen PM, Laakkonen EI, Suntioinen S, Penttilä IM & Uusitupa MI (1996): The nutritional status of Finnish home-living elderly people and the relationship between energy intake and chronic diseases. *Age Ageing* **25**, 133–138.

Rubenstein LZ, Harker JO, Salva A, Guigoz Y & Vellas B (2001): Screening for undernutrition in geriatric practice: developing the Short-Form Mini Nutritional Assessment (MNA-SF). *J. Gerontol. Med. Sci*. **56A**, M366–M372.

Saletti A, Johansson L & Cederholm T (1999): Mini-Nutritional Assessment in elderly subjects receiving home nursing care. *J. Hum. Nutr. Dietet*. **12**, 381–387.

Schneider SM & Hebuterne X (2000): Use of nutritional scores to predict clinical outcomes in chronic diseases. *Nutr. Rev*. **58**, 31–38.

Sharkey JR (2002): The interrelationship of nutritional risk factors, indicators of nutritional risk, and severity of disability among home-delivered meal participants. *Gerontologist* **42**, 373–380.

Sulander T, Helakorpi S, Nissinen A & Uutela A (2001): *Health Behaviour and Health Among Finnish Elderly, Spring 2001, with Trends 1993–2001* (English summary). Helsinki: Publications of the National Public Health Institute B17/2001, Finland.

Sullivan DH (1992): Risk factors for early hospital readmission in a select population of geriatric rehabilitation patients: the significance of nutritional status. *J. Am. Geriatr. Soc*. **40**, 792–798.

Tierney A (1996): Undernutrition and elderly hospital patients: a review. *J. Adv. Nurs*. **23**, 228–236.

Thomas DR, Zdrowski CD, Wilson M-M, Conright KC, Lewis C, Tariq S & Morley JE (2002): Malnutrition in subacute care. *Am. J. Clin. Nutr*. **75**, 308–313.

Vellas B, Guigoz Y, Garry P, Nourhashemi F, Bennahum D, Laque S & Albadere J-L (1999): The Mini Nutritional Assessment (MNA) and its use in grading the nutritional state of elderly patients. *Nutrition* **15**, 116–122.

White H, Pieper C, Schmader K & Fillenbaum G (1996): Weight change in Alzheimer's disease. *J. Am. Geriatr. Soc*. **44**, 265–272.

WHO (2002): *Active Ageing: A Policy Framework*. Geneva. www.who.int/hpr/ageing/ActiveAgeingPolicyFrame.pdf

Willett W (1998): *Nutritional Epidemiology*, 2nd edition. New York: Oxford University Press.

Wissing U, Lennernäs A-C, Ek A-C & Unosson M (1998): Monitoring of dietary quality in outpatients by qualitative meal classification method. *J. Hum. Nutr. Dietet*. **11**, 125–133.