European Journal of Clinical Nutrition (2005) 59, 263–270
 0954-3007/05 $30.00
www.nature.com/ejcn

ORIGINAL COMMUNICATION

Nutritional status, well-being and functional ability in frail elderly service flat residents

A Ödlund Olin[1,4]*, A Koochek[2], O Ljungqvist[1,3] and T Cederholm[4]

[1]*Division of Surgery, Centre for Surgical Sciences, Karolinska Institutet, Karolinska University Hospital, Huddinge, Stockholm, Sweden;* [2]*Comprehensive Centre for Elderly Care, Älvsjö, Stockholm, Sweden;* [3]*Centre of Gastrointestinal Disease, Ersta Hospital, Stockholm, Sweden; and* [4]*Department of Geriatric Medicine, Neurotec Department, Karolinska Institutet, Karolinska University Hospital, Huddinge, Stockholm, Sweden*

Objective: To investigate nutritional status and its relationship to cognition, well-being, functional ability and energy intake in frail elderly service flat residents.
Design: Cross-sectional and prospective study.
Setting: Two municipal service flat complexes.
Subjects: A total of 80 residents (median age 85.5 (79–90) y) with regular home care assistance participated. A subgroup of 35 residents took part in a re-examination 1 y later.
Methods: Mini Nutritional Assessment (MNA), Short Portable Mental Status Questionnaire, Barthel Index and Health Index were used for the evaluation of nutritional, cognitive and ADL function and well-being, respectively.
Results: In all, 30% of the frail and chronically ill service flat residents were assessed as malnourished and 59% were at risk of malnutrition. The malnourished residents had worse cognitive conditions ($P<0.001$) and well-being ($P<0.05$), lower functional ability ($P<0.01$) and they had a greater need for daily assistance ($P<0.05$) than the other residents. The median night fast period was 14.0 (12.5–15.0) h. Five subjects classified as malnourished at baseline had lost a median of −9.6 kg (range −11.0 to +7.3 kg) ($P<0.05$) in body weight at the 1-y follow-up, which contrasted significantly from the weight stability in residents classified as at risk for malnutrition or well-nourished.
Conclusion: Out of 10 residents, nine were assessed to have impending nutritional problems that related to impaired well-being, cognition, and functional ability. Malnourished residents had a significant weight loss over one year. Studies are needed to determine whether weight loss and nutrition-related dysfunction in service flat residents are preventable or treatable.
Sponsorship: Karolinska Institutet, Vårdal Foundation and the Swedish Medical Research Council.
European Journal of Clinical Nutrition (2005) **59,** 263–270. doi:10.1038/sj.ejcn.1602067
Published online 13 October 2004

Keywords: frail elderly; municipal care; nutritional status; well-being; activities of daily living

Introduction

In most affluent societies, the segment of the population older than 70 y of age is growing. Frailty leads to an increased need for assistance. To assure support for the frail elderly, Swedish municipalities offer various forms of assisted housing. Service flat living is one such example where the elderly person lives in his/her own needs-adapted flat, but may receive assistance in daily activities, for example, showering and getting dressed, from care personnel. The residents usually have access to a restaurant within the service flat complex as well as to 'meals-on-wheels' service.

Economic restraints have instituted changes in the care of elderly individuals. One consequence of the recent reduction of hospital beds and shorter hospital stays in Sweden, as well as in other countries, is that many elderly, formerly treated in hospitals, for example, long-term geriatric care, are now living in various forms of assisted housing. Accordingly, the care burden on community accommodations has markedly increased. Little information is available on how the

***Correspondence: A Ödlund Olin, Karolinska University Hospital, Huddinge, Nursing Care Research and Development Unit, C1 81, S-141 86 Stockholm, Sweden.**
E-mail: ann.odlund.olin@cfss.ki.se
***Guarantor*: A Ödlund Olin.**
***Contributors*: All authors were engaged in the planning of the study. AÖO, AK performed the study at the service flat complexes. AÖO analysed the data, TC and OL contributed to the interpretation of the analyses. AÖO wrote the manuscript and all authors took part in the final compilation of the manuscript.**
Received 22 March 2004; revised 10 August 2004; accepted 29 August 2004; published online 13 October 2004

increased burden of disease affects the need for medical and nursing care and nutritional support among elderly in assisted housing, for example, service flat residents. Since malnutrition is a common consequence of chronic disease and old age, many elderly people living in service flats are at nutritional risk (Karlsson *et al*, 1999; Saletti *et al*, 2000). Malnutrition is associated with increased infection rates (Chandra, 1993), poor wound healing, and pressure sores (Ek *et al*, 1991). Undernutrition also increases the risk of deterioration in physical condition (Covinsky *et al*, 1999; Potter *et al*, 2001) and thus of hospitalisation and mortality (Larsson *et al*, 1990; Cederholm *et al*, 1995; Flodin *et al*, 2000; Sacks *et al*, 2000).

The objective of this study was to investigate nutritional status and its relationship to cognitive function, well-being, functional ability and energy intake, in frail elderly service flat residents with a regular need for care and assistance. A second objective was to study changes over a 1-y period in a subgroup of these elderly residents.

Material and methods

Subjects

The subjects who participated in the study lived in two complexes of service flats in the southern greater Stockholm area. In this study, only those needing regular assistance from the service flat buildings' care personnel were included. Out of a total of 198 residents, 130 had regular assistance. Of these 130 subjects, 43 (33%) subjects were unwilling to participate, four (3%) subjects were too ill to participate and three (2%) were admitted for hospital care at the time of the study. Thus, the participation rate was 61% and in total 58 women (73%) and 22 men (27%) participated in the study. The median age of the participants was 85.5 (range 68–96) y.

The care level was graded from 1 to 7. Care level 1–2 corresponded to assistance once or twice per week, care level 3 to assistance more than twice per week or, care level 4–5 to assistance every day at day time or at afternoon, care level 6 to assistance every day at day time and sometimes at night and care level 7 to assistance regularly during 24 h per day. The assistance received corresponded to a median care level of 5 (3–5, 25–75th percentile). All participants were essentially homebound.

There were no significant differences regarding age, gender or level of care between the participants ($n=80$) and those who declined to participate ($n=43$) (data not shown). The participants suffered from sequele after stroke (16%), chronic heart failure (11%), joint disorders (11%), chronic ischaemic heart disorder (10%), dementia (9%) and diabetes mellitus (8%). In total, 10% had multiple disorders and 14% had other diagnoses. Nine subjects (11%) had no defined disorder and were classified as frail.

Study design

All participants underwent a series of examinations to determine nutritional status, well-being, cognitive function, activities of daily living and energy intake (see below). The examinations were performed in the residents' flats by two of the authors (AÖO and AK).

A subgroup of 35 residents 86 (80–91) y (83% women) took part in a re-examination in which the development of their nutritional status, well-being and cognitive function during the course of 1 y was studied (see below). The selection of the residents was based on willingness and capacity to participate twice with 1-y interval.

Nutritional status

Nutritional status was assessed by the Mini Nutritional Assessment (MNA) (Guigoz *et al*, 1996) compiled of 18 questions regarding anthropometry, for example, body mass index, BMI (kg/m^2), global assessment, for example, living independently, occurrence of acute disease or psychological stress and mobility, dietary questions, for example, number of whole meals eaten per day and a subjective assessment, that is, self-perception of nutritional and health status. The maximum score is 30. Less than 17 points is regarded as an indicator of malnutrition, 17–23.5 points indicate a risk for malnutrition, and ≥ 24 points indicate that the person is well-nourished.

The residents were weighed with light indoor clothing without shoes on an electronic portable scale (Seca 882, Ergon Nordic AB, Sweden) or on a digital electronic wheelchair (Tamita BWB 660, Umedica AB, Sweden). Height was measured with the resident standing up or in a stretched position lying in the bed if the resident was bed-ridden or bound to a wheel chair.

Energy intake

Two methods were used for the food registration. The first was a 24-h recall made at a first visit (Gibson, 1990). The residents were asked to recall the type and amount of all food and fluid consumed at each eating occasion during the previous day and night. The 24-h recall was used as a checklist for a 1-day estimated dietary record, which was made during a second visit. The examiners (AÖO, AK) registered the food and fluid intake at all eating occasions in one day. For those residents who stayed up late in the evening a telephone call was made to inquire about any additional intake.

Moreover, energy intake was estimated from 4-day dietary records in 21 individuals. The coefficient of variation (CV) from day to day was calculated from the 4-day dietary recording. Energy and nutrient intake was calculated from the dietary records using a computer programme, 'Dietist' (Kost- och näringsdata, Stockholm, Sweden).

Energy requirement

The energy requirement was calculated using predicted basal metabolic rate (BMR) according to the equation for men

>75 y: $0.035 \times$ body. weight $+ 3.43$ and for women: >75 y $0.0410 \times$ body weight $+ 2.61$ recommended by WHO (FAO/WHO/UNU, 1985). In order to calculate the energy requirement the estimated BMR was multiplied by the estimated physical activity level (PAL). A PAL factor of 1.2 was used for subjects bedridden or transported by wheel chair. For subjects who were able to walk, a PAL factor of 1.5 was used (Nordic Council of Ministers, 1996).

The ratio between the energy intake (EI) estimated from the 1-day dietary records and the predicted BMR was calculated (Hambraeus, 1998). The EI/BMR ratio was used to evaluate the reliability of the dietary record. Under weight stable conditions the calculated EI/BMR ratio should correspond to the estimated PAL factor.

Cognitive function

Cognitive deficit was assessed by the short portable mental status questionnaire (SPMSQ) (Pfeiffer, 1975). It consists of 10 questions; current date, day of the week, where the person is situated, home address, age, year of birth, name of the prime minister, name of the past prime minister, name of the residents mother and the task of subtracting 3 from 20 and so on. The maximum score is 10. A score of 0–2 indicates severe intellectual impairment, whereas 3–5 and 6–7 show that the examined subject has a moderate or a mild intellectual impairment, respectively. A score of 8–10 indicates intact functioning.

Well-being

General well-being was assessed by the Health Index (HI) (Nordström *et al*, 1992, Forsberg & Björvell, 1993). The HI refers to how people feel when they are experiencing different forms of ill-health. The HI has been tested with regard to reliability and validity. The HI consists of nine questions concerning energy, temper, fatigue, loneliness, sleep, vertigo, bowel function, pain and mobility. Each question has four response categories; very poor, rather poor, rather good and very good. The questions are summarised to an index from 9 to 36 points. The higher the score, the better the perceived general health. Only residents with a fairly good cognitive function, that is, a score of six or more on the SPMSQ questionnaire, were asked to rate their perceived well-being.

Functional ability

Activities of daily living (ADL) were evaluated by the Barthel's Index (BI) (Mahoney & Barthel, 1965; Colin *et al*, 1988). The BI is based on observed functions and the instrument was developed to measure functional ability before and after treatment, and to indicate the amount of nursing care required (Bowling, 1997). The BI scoring system involves a weighted scale, ranging from 0 to 100 points in 5-point increments. The questionnaire measures performance in basic self-care in seven areas: feeding, bathing, personal toilet, dressing, bowel/bladder control, getting on/off the toilet and locomotion (moving between a bed and a chair, ambulation and stair climbing). A score of 100 indicates that the patient is independent in physical function and the lowest score, 0, represents a totally dependent bedridden state.

Statistics and ethics

Nonparametric descriptive statistics and tests were used. Data are presented as medians and 25th and 75th percentiles (P_{25}–P_{75}). Differences between MNA groups were tested by the Kruskal–Wallis test. Mann–Whitney *U*-test was used for *post hoc* tests. Spearman rank order correlation was used for correlation analyses. Wilcoxon's signed rank test was used to evaluate changes over time in the 1-y follow-up.

Oral and written information was given to all participants or their next of kin and informed consent was obtained. The study was reviewed and approved by the local ethics committee at the Huddinge University Hospital.

Results

Nutritional status and energy intake

At baseline, 30% of the residents were assessed to be malnourished, 59% were at risk of malnutrition and 11% were considered well-nourished according to the MNA (Table 1). The median MNA score for the entire study group was 19.5 (15.5–22.5).

The median BMI for all residents was 23.6 (20.3–27.2) kg/m^2. In total, 20% of the residents had a BMI value <20 kg/m^2, 55% had a BMI ≤ 24 kg/m^2 and in 16% of the residents BMI was >30 kg/m^2. Table 1 displays nutritional data in relationship to MNA classification. As expected, the subjects who were scored as malnourished had a significantly lower BMI value and body weight compared to the subjects at risk of malnutrition and the well-nourished subjects. This was also the case when the groups were divided by gender (Table 1). There were no differences between women and men according to MNA and BMI.

The median estimated energy intake for all residents was 1546 (1243–1798) kcal/day and the estimated energy requirement was 1792 (1626–2035) kcal/day. The energy intake was below the estimated energy requirements in subjects classified as malnourished or subjects at risk for malnutrition, whereas the well-nourished group appeared to be able to fulfil their energy requirements (Table 1). Only 24 (30%) of the 80 residents reached their estimated energy requirement. For all residents, the median EI/BMR ratio was 1.2 and the median estimated PAL factor was 1.5. The EI/BMR ratio varied between 0.5 and 2.3. One-fourth ($n = 19$) displayed EI/BMR ratios <1. BMI in this group of possible under-reporters ranged from 18.3 to 38.0 (median 25.8 kg/m^2). The calculated coefficient of variation (CV) for energy intake in 21 individuals with 4-day records was 17%. The median night

Table 1 Age, nutritional status, energy requirement, energy intake and EI/BMR ratios in service flats residents classified as malnourished, at risk for malnutrition or well-nourished

	Malnourished			*Risk for malnutrition*			*Well-nourished*			
	All	*Women*	*Men*	*All*	*Women*	*Men*	*All*	*Women*	*Men*	P[a]
n	24	20	4	47	32	15	9	6	3	
Age (y)	87.5 (82.5–90.5)	89 (82.5–92.0)	84 (80.0–86.0)	84 (77.0–89.0)	85 (77.5–89.0)	82 (77.0–90.0)	88 (85.0–91.0)	90 (87.0–92.0)	84 (68.0–88.0)	NS
MNA (0–30 points)	13.5 (12.5–15.0)	13.5 (12.5–15.0)	14 (12.8–14.8)	20.5 (18.5–22.0)	20.3 (17.8–22.5)	20.5 (19.5–21.5)	24.5 (24.0–24.5)	24.3 (24.0–24.5)	24.5 (24.0–25.0)	
Body weight (kg)	52 (44.2–60.2)	47.9 (42.9–57.5)	64.8‡ (61.1–71.5)	69.3 (59.0–80.4)	62.5 (56.3–77.9)	73.7‡‡ (69.3–81.0)	69.7 (62.8–79.9)	62.9 (59.4–79.9)	70.6 (69.7–91.3)	<0.001[c]
BMI (kg/m^2)	19.8 (17.7–22.7)	19.8 (16.8–22.5)	21.1 (19.4–23.2)	25.6 (22.5–29.0)	25.6 (22.4–29.4)	25.6 (24.4–26.7)	24.2 (23.9–31.3)	25.4 (23.1–35.5)	24.2 (23.9–31.3)	<0.001[c]
Energy requirement[b] (kcal/day)	1615 (1468–1786)	1603 (1359–1780)	1836 (1611–2109)	1812 (1722–2073)	1798 (1693–1926)	1812‡ (1722–2073)	1894 (1859–2110)	1860 (1809–1894)	2116‡ (2104–2375)	<0.01[c]
Energy intake (kcal/day)	1410* (1187–1721)	1381 (1187–1747)	1463 (1205–1584)	1573** (1234–1874)	1594 (1238–1839)	1535 (1221–2456)	1769 (1366–1965)	1859 (1809–1894)	1915 (1769–1965)	NS
Energy intake (kcal/kg/day)	24.4 (19.6–34.5)	24.7 (20.6–36.1)	21.2 (17.7–24.5)	22.3 (16.1–30.7)	22.6 (17.9–30.2)	19.4 (15.2–33.2)	22.6 (19.4–27.8)	22.2 (19.0–31.7)	27.5 (19.4–27.8)	NS
EI/BMR ratio	1.2 (1.0–1.4)	1.3 (1.0–1.5)	1 (0.9–1.2)	1.1 (0.9–1.5)	1.2 (1.0–1.5)	1.1 (0.8–1.7)	1.2 (1.1–1.4)	1.1 (1.0–1.9)	1.4 (1.1–1.4)	NS

Median (P_{25}–P_{75}).
MNA = mini nutritional assessment, BMI = body mass index, EI = energy intake, BMR = basal metabolic rate.
[a]Comparison between residents in the three MNA-categories (Kruskal–Wallis).
[b]BMR × estimated physical activity level (PAL).
[c]*Post-hoc* test using Mann–Whitney *U*-test showed that the malnourished subjects differed from the two other groups, otherwise there were no significant (NS) variations between the groups.
*$P<0.05$, **$P<0.01$, comparison between energy intake and energy requirement within groups by Wilcoxon.
‡$P<0.05$, ‡‡$P<0.01$, comparison between women and men within groups by Mann–Whitney *U*-test.

fast period was 14 (12.5–15.0) h, ranging from 7 to 17 h. There was no correlation between the night fast period and the energy intake.

Cognitive function, well-being, activities of daily living and care level

Table 2 shows cognitive function (SPMSQ), well-being (HI), activities of daily living (BI) and care level in relation to the nutritional status. The median SPMSQ score for all subjects was 8.0 (7.0–9.0). In total, 70% of the residents had a score ≥ 8 indicating that cognitive function was intact. The malnourished residents had a significantly worse cognitive condition than the other residents (Table 2).

The median HI score was 24.0 (22.0–29.0) (range 17–31). HI was significantly lower in the malnourished subjects as compared to the other subjects. Two-thirds of the residents rated very poor/rather poor on energy and corresponding figures for fatigue were 46%. The malnourished subjects had a greater need for daily assistance and care (Table 2).

Median Barthel score for the whole group was 75.0 (55.0–85.0) and ranged from 30 to 100, indicating that the residents were not severely disabled. Three residents had a score of 100 indicating they were independent in their ADL-functions. The BI was significantly lower in the malnourished group as compared to the other two groups (Table 2).

Men had a better cognitive function than women, that is, SPMSQ 9.0 (8.0–10.0) and 8.0 (7.0–9.0), respectively ($P<0.05$) as well as lower care level; 3.5 (2.0–5.0) compared to 5.0 (4.0–5.0) ($P<0.05$). Otherwise, there were no differences between genders in the functional variables (data not shown). The level of care correlated inversely to MNA, $r=-0.53$ ($P<0.001$), SPMSQ, $r=-0.26$ ($P<0.02$) and BI, $r=-0.61$ ($P<0.001$).

One-year follow-up

A total of 35 residents were re-examined after 1 y. Age, gender, nutritional status and care level did not differ between re-examined and nonre-examined residents (data not shown). Although median body weight did not change in the whole group, that is, 61.6 (54.6–72.0) *vs* 61.2 (51.8–75.0) kg (ns) at the two time-points, there were large variations in weight change ranging from −11.0 kg (23.4% of b.wt) to 7.3 kg (14.5% of b.wt) among the residents.

The five subjects who were classified as malnourished at baseline declined from a median of 47.0 (45.5–61.6) kg to 36.0 (35.1–60.9) kg ($P<0.05$) during the observation period, while those at risk for malnutrition and the well-nourished subjects were weight stable, that is, +0.6 (−1.9 to −3.2) kg and +0.7 (−3.8 to +3.8) kg, respectively. In 11 subjects with EI/BMR ratios <1 available data showed that six subjects lost in median 4.9 (−7.8 to −0.2) kg and five subjects gained in median 1.7 (1.1–6.1) kg in weight over the year of observation. Otherwise, there were no significant differences in nutritional status (MNA), well-being (HI) or cognitive function (SPMSQ) at the 1-y examination either within or between the groups with various nutritional status (Table 3).

Discussion

The study found that one-third of frail service flat residents were malnourished according to MNA. One of 10 residents was assessed as well-nourished. The malnourished residents had a significantly worse cognitive condition and well-being, lower functional ability and they had a greater need for daily assistance and care than the other residents. The median night fast period was 14 h. Subjects classified as malnourished at baseline had a marked weight loss during the observation year.

The subjects in this study were elderly and suffered from a variety of chronic diseases that are often associated with malnutrition. We report a higher prevalence of malnutrition or risk for malnutrition in service flat residents as compared to a recent Swedish study (Saletti *et al*, 2000). One possible explanation for this is that our study only included subjects with regular assistance from community care personnel, whereas the study by Saletti also included subjects without regular assistance. Disease, increased age, social isolation and low socioeconomic status may contribute to nutritional

Table 2 Cognitive function (SPMSQ), well-being (HI), activities of daily living (BI) and care level in service flat residents classified as malnourished, at risk for malnutrition or well-nourished

	Malnourished n = *24*	*Risk for mal-nutrition* n = *47*	*Well-nourished* n = *9*	P[a]
SPMSQ (0–10p)	7.0 (5.5–8)	9.0 (8–9)	9.0 (8–10)	<0.001[b]
HI (9–36p)	21.0 (19–24)[c]	25.5 (22–29)[d]	27.0 (23–29)	<0.05[b]
BI (0–100p)	62.5 (45–75)	80.0 (55–85)	85.0 (80–85)	<0.01[b]
Care level (1–7)	5.0 (5–5.5)	4.0 (2–5)	2.0 (2–4)	<0.001[b]

Median (P_{25}–P_{75}).
SPMSQ = short portable mental status questionnaire, HI = health index, BI = barthel index.
[a]Comparison between residents in the three MNA-categories (Kruskal–Wallis).
[b]*Post-hoc* test using Mann–Whitney *U*-test showed that the malnourished differed significantly ($P<0.05$) from the well-nourished and those at risk, whereas the two latter groups did not differ. For HI, the malnourished subjects only varied from the well-nourished group.
[c]$n=14$.
[d]$n=44$.

Table 3 Changes in MNA, HI and SPMSQ over 1 y in malnourished, at risk for malnutrition and well-nourished service flat residents

	Malnourished (n = *5*)	*Risk for malnutrition* (n = *25*)	*Well-nourished* (n = *5*)	P[a]
MNA	−3.0 (−3.5 to −0.5)	0 (−1.5 to +2.0)	−1.5 (−1.5 to −0.5)	NS
HI	−4.0 (−4.0 to +4.0)	0 (−1.0 to +1.0)[b]	−1.0 (−1.0 to 0)	NS
SPMSQ	+1.0 (0 to +1.0)	0 (−2.0 to +1.0)	0	NS

Median change (P_{25}–P_{75}).
[a]Comparison of differences in change among groups by Kruskal–Wallis test.
[b]$n = 21$.
Changes within groups over time were also nonsignificant (NS), evaluated by Wilcoxon's signed rank test.

deficiencies in elderly people (McCormack, 1997). Insufficient nutritional routines may also add to the high prevalence of malnutrition or risk of malnutrition among the elderly partly dependent on assistance.

The objective of the study was to investigate nutritional status and its relationship to cognition, well-being, functional ability and energy intake in frail elderly service flat residents. The malnourished residents had worse cognitive functions. Whether malnutrition in demented patients may be due to reduced food intake, increased energy expenditure or to metabolic changes due to the disease is uncertain (Grundman *et al*, 1996; Poehlman & Dvorak, 2000; Greenwood, 2003) and it is still unclear whether cognitive function can be improved by nutritional support. The functional ability was significantly lower in the malnourished group as compared to that of the other groups. Our data support previous observations of reduced functional ability and greater need for nursing care among elderly malnourished subjects (Landi *et al*, 1999; Romagnoni *et al*, 1999). Insufficient nutritional intake leads to increased muscle fatiguability and impaired muscle function (Bourdel-Marchasson *et al*, 2001; Bonnefoy *et al*, 2003) and there are reports indicating that nutritional treatment in frail elderly will improve functional ability (Unosson *et al*, 1992; Potter *et al*, 2001).

The malnourished residents rated their well-being lower in comparison with the other groups. Of the nine conditions in HI, the subject's perceived energy was the condition that was most often reported as 'very poor' or 'rather poor'. This is in agreement with findings reported by Christensson *et al* (2003), who found that energy was the most powerful dimension in the Nottingham Health Profile to predict elderly people at risk of malnutrition. Social interaction is a central factor for a high quality of life. Preparing and eating food is for most people a social event and social isolation may play an important role in decreased food intake. Improved social interaction at mealtimes has been shown to enhance food intake for the elderly (de Castro *et al*, 1990).

The participation rate in this study was high compared to other studies with similar study populations. Response rates in dietary studies are often low and participation rates decrease with increasing age (Van't Hof *et al*, 1991; Wright *et al*, 1995). A total of 33% of the eligible subjects were unwilling to participate in the present study, but there were no differences in age, gender or care level in the nonparticipating subjects compared to the participants, which suggests that the study-group was representative of the entire group of care-needing residents. A number of the residents who declined participation declared that no one had earlier shown an interest in the elderly and frail and they expressed no wish to tell others about their situation. This is in agreement with Sidenvall *et al* (2002) who reported that the four most common reasons for declining participation in a food survey among elderly women were lack of time, tiredness, unwillingness to participate in scientific studies and increased age and therefore had no contribution to make.

The MNA instrument was used for the nutritional assessment. MNA has been developed especially for the elderly (Guigoz *et al*, 1997), and it was recently reported that MNA classification of geriatric patients was related to anthropometric, body composition and functional measurements (Persson *et al*, 2002). In a comparison between MNA and SGA, MNA was suggested to be most useful in identifying subjects who need preventive nutritional measures, whereas SGA appeared to be better at detecting residents with established malnutrition (Christensson *et al*, 2002).

In total, 20% of the study group had a BMI value lower than 20 kg/m^2 , that is, a value that is often regarded as an indication of underweight. Healthy elderly individuals in Sweden have an average BMI of 26–27 kg/m^2 (Björkelund *et al*, 1997, Dey *et al*, 1999). A BMI value between 24 and 27 kg/m^2 has been found to be associated with low mortality in free-living elderly persons (Volkert *et al*, 1992). It has been argued that the BMI for elderly chronically ill populations should range between 24 and 29 kg/m^2 (Beck & Ovesen, 1998). The use of BMI <24 kg/m^2 as a cutoff value in the present study would have resulted in an underweight prevalence of 55%.

There are several methods to measure dietary intake of energy. These include a diet or food record, diet recall (24-h), diet history and food frequency questionnaire. All these methods have limitations. To optimise participation rate in a food survey of elderly, the method chosen has to be quick and uncomplicated. For this reason, an estimated dietary record combined with a 24-h recall was used in this study. One limitation of short-term dietary recording is the large day-to-day variation of dietary intake (Bingham, 1987). In this study, the coefficient of variation (CV) for the energy intake in 21 subjects with a 4-day record was 17% with no

major differences in the CV comparing malnourished with those at risk and the well-nourished individuals. This was less than the 25% variation for 5 days 24-h recalls reported by Oh and Hong (1999), among 83 older Korean people. Elderly people have been reported to have more stable food choices than younger subjects (Nes *et al*, 1991). Nevertheless, the data in the present study have to be interpreted cautiously due to the short registration period. For all residents, the EI/BMR ratio was 1.2 and the PAL factor was 1.5. The EI/BMR ratio in the residents of this study is similar to the EI/BMR ratio previously found in elderly nursing home residents (Ödlund Olin *et al*, 2003). Of the service flat residents, 20% had EI/BMR ratios below 1.0, which indicates that the food intake in these cases may have been underestimated. However, half of the subjects with EI/BMR ratios <1 lost weight in the subsequent year. In this subgroup of subjects, the low-recorded food intake may have been correct. Under-reporting is more common among overweight subjects (Goldberg & Black, 1998). Our data appear to support this assumption, which is also in line with other studies on dietary intake in elderly people living in their own homes (Tomoyasu *et al*, 1999, Lührmann *et al*, 2001).

Although less than half of the residents took part in the 1-y follow-up, interesting observations were made in this subgroup. In the 35 subjects that were examined two times the median change over 1 y in most variables was small, but there were large variations among the residents. Subjects classified as malnourished at baseline showed a pronounced weight loss at the follow-up. Such a weight loss in already malnourished subjects indicates an ominous development. Concurrently, there was numerical, but not statistically significant, deteriorations in MNA and HI in the malnourished subjects. It is possible that if the study sample had been larger these variations might have become statistically significant.

There were no indications that the regular care organisation observed or gave any attention to the weight development of their care-takers. Even with guidelines available, studies in hospitals have shown that nutritional care may still be poor (Kondrup *et al*, 2002). This suggests that other factors such as prioritising nutritional care within the caregiving organisation is likely to be of importance.

We may conclude that nine out of 10 frail and chronically ill service flat residents were assessed to have impending nutritional problems. The malnourished residents had a significantly worse cognitive condition and well-being, lower functional ability and they had a greater need for daily assistance and care than the other residents. Subjects classified as malnourished at baseline had a marked weight loss during the subsequent year. This indicates that the caregiving organisation in community assisted housing is not able to provide sufficient care to prevent nutritional deterioration and improve nutritional status in individuals with severe nutritional problems. The findings emphasise the need for routines in community care and the duty for nurses and other care personnel to identify residents in assisted housing who are at nutritional risk and to organise appropriate nutritional support based on individual nutritional requirements. Studies are needed to determine whether weight loss in malnourished service flat residents can be prevented.

Acknowledgements

We thank the residents and staff at Älvsjö and Enskededalens service flat buildings. The Department of Geriatrics, Karolinska University Hospital, Huddinge is gratefully acknowledged. The study was supported by grants from Karolinska Institutet Board of Research for Health and Caring Sciences, Vårdal Foundation 97416 and from the Swedish Medical Research Council 09101 and K 2002-72Vx-14308-01A.

References

Beck AM & Ovesen L (1998): At which body mass index and degree of weight loss should hospitalized elderly patients be considered at nutritional risk. *Clin. Nutr.* **17**, 195–198.

Bingham SA (1987): The dietary assessment of individuals; methods, accuracy, new techniques and recommendations. *Nutr. Abstr. Rev.* **57**, 705–742.

Björkelund C, Hultén B, Larsson B, Lissner L, Rothenberg E, Bengtsson C, Steen B & Tibblin G (1997): New weight-height standards for middle-aged and elderly. Weight increases more than height. *Läkartidningen* **94**, 332–335. (in Swedish).

Bonnefoy M, Conru C, Normand S, Boutitie F, Bugnard F, Rahmani A, Lacour JR & Laville M (2003): The effects of exercise and protein-energy supplements on body composition and muscle function in frail elderly individuals: a long-term controlled randomised study. *Br. J. Nutr.* **89**, 731–738.

Bourdel-Marchasson I, Joseph PA, Dehail P, Biram M, Faux P, Rainfray M, Emerican JP, Canioni P & Thiaudière E (2001): Functional and metabolic early changes in calf muscle occurring during nutritional repletion in malnourished elderly patients. *Am J. Clin. Nutr.* **73**, 832–838.

Bowling A (1997): *Measuring Disease: A Review of Disease Specific Quality of Life Measurements Scales* pp 182–185. Suffolk: St Edumndsbury Press.

de Castro JM, Brewer EM, Elmore DK & Orazco S (1990): Social facilitation of the spontaneous meal size of human occurs regardless of time, place, alcohol or snacks. *Appetite* **15**, 89–101.

Cederholm T, Jägrén C & Hellström K (1995): Outcome of protein-energy malnutrition in elderly medical patients. *Am. J. Med.* **98**, 67–74.

Chandra RK (1993): Nutrition and the immune system. *Proc. Nutr. Soc.* **52**, 77–84.

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.

Christensson L, Unosson M & Ek A-C (2003): Measurement of perceived health problems as a means of detecting elderly people at risk of malnutrition. *J. Nutr. Health Aging* **4**, 257–262.

Colin C, Wade DT, Davies S & Horne V (1988): The Barhtel ADL index. A reliability study. *Int. Disabil. Stud.* **10**, 61–63.

Covinsky KE, Martin GE, Beyh RJ, Justice AC, Sehgal AR & Landefeld CS (1999): The relationship between clinical assessments of nutritional status and adverse outcomes in older hospitalised medical patients. *J. Am. Geriatr. Soc.* **47**, S32–S38.

Dey DK, Rothenberg E, Sundh V, Bosaeus I & Steen B (1999): Height and body weight in the elderly. A 25-year longitudinal study of a population aged 70 to 95 years. *Eur. J. Clin. Nutr.* **53**, 905–914.

Ek AC, Unosson M, Larsson J, Von Schenk H & Bjurulf P (1991): The development and healing of pressure sores related to the nutritional state. *Clin. Nutr.* **10**, 245–250.

FAO/WHO/UNU (1985): *Report of a Joint Expert Consultation: Energy and Nutrient Requirements* Technical Report Series 724, WHO, Geneva.

Flodin L, Svensson S & Cederholm T (2000): Body mass index as a predictor of 1 year mortality in geriatric patients. *Clin. Nutr.* **19**, 121–125.

Forsberg C & Björvell H (1993): Swedish population norms for the GHRI, HI and STAI state. *Qual. Life Res.* **2**, 349–356.

Gibson R (1990): *Principles of Nutritional Assessment* pp 37–39, Oxford University Press.

Goldberg GR & Black AE (1998): Assessment of the validity of reported energy intake—review and recent developments. *Scand. J. Nutr.* **1**, 6–9.

Greenwood CE (2003): Dietary, carbohydrate, glucose regulation and cognitive performance in elderly persons. *Nutr. Rev.* **61**, S68–S74.

Grundman M, Corey-Bloom J, Jernigan T, Archibald S & Thal LJ (1996): Low body weight in Alzheimeŕs disease is associated with mesial temporal cortex atrophy. *Neurology* **46**, 1585–1591.

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** (Suppl), S59–S65.

Guigoz Y, Vellas B & Garry PJ (1997): Nutritional Assessment as part of the geriatric evaluation: The Mini Nutritional Assessment. In *Nutrition in the Elderly. The Mini Nutritional Assessment (MNA). Facts and Research in Geriatrics* eds. BJ Vellas, Y Guigoz, PJ Garry & JL Albarede, 4th Edition, pp 15–61. Paris, France: Serdi Publishing Company.

Hambraeus L (1998): Dietary assessments: how to validate primary data before conclusions can be drawn. *Scand. J. Nutr.* **42**, 66–68.

Karlsson P, Apelgren J, Brismar K, Karlström B, Lindblad L & Cederholm T (1999): Nutritional status and food intake in a 1-year follow-up in a group of elderly residents in adapted housing. *Scand. J. Nutr.* **2**, 70–73.

Kondrup J, Johamsen N, Plum LM, Bak L, Hojdlund Larsen J, Martinsen A, Andersen JR, Baernthsen H & Bunch E (2002): Incidence of nutritional risk and causes of inadequate nutritional care in hospitals. *Clin. Nutr.* **21**, 461–468.

Landi F, Zuccalà G, Gambassi G, Incalzi RA, Manigrasso L, Pagano F, Carbonin P & Bernabei R (1999): Body mass index and mortality among older people living in the community. *J. Am. Geriatr. Soc.* **47**, 1072–1076.

Larsson J, Unosson M, Ek AC, Nilsson L & Thorslund L (1990): Effect of dietary supplementation on nutritional status and clinical outcome in 501 geriatric patients—a randomised study. *Clin. Nutr.* **9**, 179–184.

Lührmann PM, Herbert BM & Neuhäuser-Berthold M (2001): Underreporting of energy intake in an elderly German population. *Nutrition* **11/12**, 912–916.

Mahoney FI & Barthel DW (1965): Functional evaluation: the Barthel index. *Mary State Med. J.* **14**, 61–65.

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

Nes M, Van Staveren WA, Zajkas G, Inelman EM & Moreiras-Varela O (1991): Validity of the dietary history method in elderly subjects. *Eur. J. Clin. Nutr.* **45** (Suppl 3), 97–104.

Nordic Council of Ministers (1996): *Nordic Nutrition Recommendations*. 28 Copenhagen: Nordic Council of Ministers.

Nordström G, Nyman GR & Theorell T (1992): Psychosocial adjustment and general health in patients with ileal conduit urinary diversion. *Scand. J. Urol. Nephrol.* **26**, 139–147.

Ödlund Olin A, Armyr I, Soop M, Jerström S, Classon I, Cederholm T, Ljunggren G & Ljungqvist O (2003): Energy-dense meals improve energy intake in elderly residents in a nursing home. *Clin. Nutr.* **22**, 125–131.

Oh S-Y & Hong MH (1999): Within- and between-person variation of nutrient intakes of older people in Korea. *Eur. J. Clin. Nutr.* **53**, 629–652.

Persson M, Brismar KE, Katzarski K, Nordenström J & Cederholm TE (2002): Nutritional status using Mini Nutritional Assessment and Subjective Global Assessment predict mortality in geriatric patients. *J. Am. Geriatr. Soc.* **50**, 1996–2002.

Pfeiffer EA (1975): A short portable mental state questionnaire for the assessment of organic brain deficit in elderly patients. *J. Am. Geriatr. Soc.* **23**, 433–441.

Poehlman ET & Dvorak RV (2000): Energy expenditure, energy intake and weight loss in Alzheimers disease. *Am. J. Clin. Nutr.* **71** (Suppl), S650–S655.

Potter JM, Roberts MA, McColl J & Reilly JJ (2001): Protein energy supplements in unwell elderly patients—a randomized controlled trial. *J. Parent. Enteral Nutr.* **25**, 323–329.

Romagnoni F, Zuliani G, Bollini C, Leoci V, Soattin L, Dotto S, Rizzotti P, Valerio G, Lotto D & Fellin R (1999): Disability is associated with malnutrition in institutionalized elderly people. The I.R.A. Study. *Aging* **11**, 194–199.

Sacks GS, Dearman K, Replogle WH, Cora VL, Meeks M & Canada T (2000): Use of subjective global assessment to identify nutrition associated complications and death in geriatric long-term care facility residents. *J. Am. Coll. Nutr.* **19**, 570–577.

Saletti A, Yifter Lindgren E, Johansson L & Cederholm T (2000): Nutritional status according to Mini Nutritional Assessment in an institutionalized elderly population in Sweden. *Gerontology* **46**, 139–145.

Sidenvall B, Fjellström C, Andersson J, Gustafsson K, Nygren U & Nydahl M (2002): Reasons among older Swedish women of not participating in a food survey. *Eur. J. Clin. Nutr.* **56**, 561–567.

Tomoyasu NJ, Toth MJ & Poehlmann ET (1999): Misreporting of total energy intake in older men and women. *J. Am. Geriatr. Soc.* **47**, 710–715.

Unosson M, Ek AC, Nilsson L, Thorslund L & Bjurulf P (1992): Effects of dietary supplement on functional condition and clinical outcome measured with a modified Nortons cale. *Clin. Nutr.* **11**, 134–139.

Van't Hof MA, Hautvast JGAJ, Schroll M & Vlachonikolis IG (1991): Design, methods and participation. *Eur J Clin Nutr.* **45** (Suppl 3), 5–22.

Volkert D, Faruenrath C, Micol W, Kruse W, Oster P & Schlierf G (1992): Nutritional status of the very old: anthropometric and biochemical findings in apparently healthy women in old peoples' homes. *Aging* **4**, 21–28.

Wright AJA, Southon S, Bailey AL, Finglas PM, Maisy S & Fulcker KA (1995): Nutrient intake and biochemical status of non-institutionalized elderly subjects in Norwich: comparison with younger adults and adolescents from the same general community. *Br. J. Nutr.* **74**, 453–475.