Malnutrition in subacute care\textsuperscript{1,2}

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ABSTRACT

Background: Dramatic weight loss and hypoalbuminemia often follow acute hospitalization.

Objective: The objective was to examine the prevalence of undernutrition in a subacute-care facility.

Design: We evaluated 837 patients consecutively admitted over 14 mo to a 100-bed subacute-care center. Nutritional status was assessed by anthropometric measurements, biochemical markers, and a Mini Nutritional Assessment (MNA) score. Primary outcome measures included length of stay and death. Secondary measures included readmission to an acute-care hospital and placement at discharge.

Results: The subjects’ mean (±SD) age was 76 ± 13 y and 61% were women. Eighteen percent of the subjects had a body mass index (in kg/m\textsuperscript{2}) <19. With the use of 35 g/L as a cutoff, 53% of the subjects had hypoalbuminemia. Only 8% of the subjects were classified as being well nourished according to the MNA. Almost one-third (29%) of the subjects were malnourished and almost two-thirds (63%) were at risk of malnutrition. Thus, >91% of subjects admitted to subacute care were either malnourished or at risk of malnutrition. The Geriatric Depression Score was higher in malnourished subjects than in nutritionally at-risk subjects ($P = 0.05$). Length of stay differed by 11 d between the malnourished group and the nutritionally at-risk group ($P = 0.007$). In the MNA-assessed group of largely malnourished subjects, 25% of subjects required readmission to an acute-care hospital compared with 11% of the well-nourished group ($P = 0.06$). Mortality was not found to be related to BMI.

Conclusion: Malnutrition reaches epidemic proportions in patients admitted to subacute-care facilities. Whether this reflects nutritional neglect in acute-care hospitals or is the result of profound illness is unclear. Nevertheless, strict attention to nutritional status is mandatory in subacute-care settings. Am J Clin Nutr 2002;75:308–13.

INTRODUCTION

Dramatic weight loss and hypoalbuminemia often follow hospitalization in an acute-care facility. Protein-energy undernutrition is a strong independent risk factor for 1-y mortality after hospitalization for acute illness (1). The severity of undernutrition is a strong independent risk factor for life-threatening morbidity, even when the severity of illness is controlled for (2).

Forty to 60% of patients hospitalized for acute illness are malnourished (3), and nutritional status has been shown to deteriorate in these patients after hospital admission. In patients who had no current nutritional deficits and no predicted risk of developing deficits at the time of hospital admission, significant decreases in albumin, total lymphocyte count, triceps skinfold thickness, and midarm circumference occurred after 3 wk of hospitalization. The only nutritional index remaining unchanged at 3 wk was percentage of ideal body weight (4).

Reasons for the high prevalence of malnutrition in patients hospitalized for an acute illness include poor recognition and monitoring of nutritional status (5–8) and inadequate intake of nutrients for days at a time (9–11). The severity of illness and other factors may limit such patients’ abilities to consume an adequate diet. Additionally, persons with acute illness may present to the hospital already undernourished or nutritionally at risk. Sixteen percent of community-dwelling persons aged >60 y consumed <4184 kJ/d (<1000 kcal/d) before hospital admission for an acute illness, contributing to making undernutrition a primary factor in morbidity and mortality (12). Because the signs of undernutrition may not be adequately addressed during a stay in an acute-care hospital (13), inadequate nutrition is often present at hospital discharge.

Not surprisingly, malnutrition is a major problem among residents of long-term-care facilities who were transferred from acute-care hospitals. Among newly admitted patients to a long-term-care setting, a point prevalence of 54% malnutrition was observed (14). In a Swedish study, 29% of patients admitted to a long-term-care geriatric hospital were malnourished at admission (15).

Little is known about malnutrition at the time of transfer to a subacute-care setting. Frequently, sick and possibly malnourished patients are transferred directly after hospitalization for an acute illness. When undernourished patients are transferred into subacute care, complications of care may result. We therefore examined the prevalence of undernutrition in subacute care.

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### SUBJECTS AND METHODS

Eight hundred thirty-seven subjects admitted consecutively over a 14-mo period to a 100-bed subacute-care center in St Louis were examined. Subjects were generally referred from area acute-care hospitals. Most patients were admitted for rehabilitation under Medicare payment guidelines. The most common reasons for admission included orthopedic or neurologic rehabilitation, acute and chronic wounds, or infections requiring antibiotic therapy. Only the subject’s first subacute-care admission was considered. Subjects readmitted to the subacute-care facility; subjects with cancer, end-stage renal disease, or terminal illness defined by a do-not-resuscitate status; and subjects already classified with the use of the MNA (16) were excluded. About 25–30% of subjects had an MNA score in the well-nourished range. Because the size of this group was small relative to the malnourished and at-risk groups, this group was considered a separate group distinct from the well-nourished range.

Nutritional status was evaluated in the remaining 489 subjects. Admissions from nursing homes, admissions from the subjects’ own homes, and acute-care hospital transfers were included in the data collection. Nutritional status was assessed by anthropometric measurements recorded by a single, trained observer and by measurements of biochemical markers. Height (defined as the patient’s height before the age of 50 y, before the possible onset of osteoporosis or kyphosis) was recorded. Weight was measured by using a standing scale with the patient in nightclothes and hospital slippers. If the patient was wheelchair bound, weight was measured with the patient in the wheelchair. Then, the wheelchair was weighed alone and the latter weight subtracted from the former. If the patient was bed bound, a bed scale was used for weighing.

Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Subjects were asked about their history of weight loss in the past 6 mo. Biochemical data, when present, were collected for the following: albumin, cholesterol, sodium, serum urea nitrogen, and creatinine. The laboratory data were collected within 10 d of, or on, the admission day. The ratio of serum urea nitrogen to creatinine was calculated as an index of dehydration at the time of admission.

A Mini Nutritional Assessment (MNA; 16) score was obtained at the time of admission in patients admitted over 2 nonconsecutive, 1-mo periods during the study (n = 104). The MNA is a rapid and simple assessment test and has been cross-validated in 3 studies involving >600 elderly persons in Europe and the United States. About 75% of elderly subjects can be correctly classified with the use of the MNA (16). About 25–30% of subjects fall into an intermediate zone between well-nourished and undernourished. These subjects are classified as borderline or at risk of malnutrition and require further assessment through measurement of biochemical markers or additional clinical evaluation. With the use of the validated cutoffs of adequate nutritional status (MNA score ≥ 23.5), at risk of malnutrition (MNA score between 17 and 23.5), and malnutrition (MNA score < 17), the sensitivity of the MNA score is 96%, the specificity is 98%, and the positive predictive value is 97% for malnutrition (17, 18).

Depression was evaluated by using the Geriatric Depression Scale (GDS), a validated and reliable self-report scale that detects depressive symptoms in elderly persons (19, 20). The long form of the GDS is a 30-item questionnaire with depression indicated by a cutoff score of 11. Scores on the short form range from 0 to 15, with higher scores indicating more symptoms of depression and a cutoff score of 6 indicating depression. This cutoff has a sensitivity of 88% and a specificity of 62% compared with a structured clinical interview for depression (21).

The SCALES protocol for evaluating risk of malnutrition in the elderly was used to assess malnutrition (13). The SCALES mnemonic (sadness, cholesterol, albumin, loss of weight, eating, and shopping) includes a score on the GDS of >15 out of 30, a cholesterol concentration < 4.14 mmol/L, an albumin concentration < 4 g/L, a loss of 0.91 kg (2 lb) body weight in 1 mo or 2.27 kg (5 lb) in 6 mo, problems with feeding oneself, and having sufficient money to buy and prepare food. The S for shopping was not included in the present calculation because this was not applicable to the subacute-care population.

Primary outcome measures included length of stay and death. Secondary measures included transfer back to an acute-care hospital and long-term discharge disposition.

Statistical analysis was performed with STATSOFT (version 5.1; Statistica Inc, Tulsa, OK). Simple descriptive statistics were used for demographic analysis. Student’s t test was used to compare the means of 2 independent groups. Odds ratios were calculated from contingency tables. The method of chi-square was used to compare categorical variables. Analysis of variance was used to compare groups of ≥3 and was followed by a post hoc test when significantly different. Only 9 subjects had an MNA score in the well-nourished range. Because the size of this group was small relative to the malnourished and at-risk groups, this group was excluded from further analysis. This exclusion affected only the analysis using the MNA score.

### RESULTS

#### Demographic data of total population

The subjects’ mean (±SD) age was 76.1 ± 12.6 y (range: 23–102 y), and 61% of the subjects were women (Table 1). Body mass index averaged 25.6 ± 7.6. Only 132 subjects reported a history of weight loss. The subjects’ mean serum albumin concentration was low at 32 ± 6.2 g/L. Cholesterol was <4.14 mmol/L in 54.8% of subjects and ≥4.14 mmol/L in 45.2% of subjects. The average length of stay was 22.4 ± 15.3 d.

Only 12% of the subjects had a serum albumin concentration ≥ 40 g/L. Twenty-eight percent of the subjects had a serum albumin concentration of 35–40 g/L, and 23% had a serum albumin concentration between 32 and 35 g/L. Most subjects (37%) had profound hypoalbuminemia (<32 g/L). When 35 g/L was used as a cutoff, 67% of subjects had hypoalbuminemia. BMI was calculated for 390 subjects (47%). Inability to assess accurate height was the chief cause of failure to calculate a BMI. BMI

### TABLE 1

<table>
<thead>
<tr>
<th>Population demographics</th>
</tr>
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<tbody>
<tr>
<td>Value</td>
</tr>
<tr>
<td>Age (y)</td>
</tr>
<tr>
<td>Sex [n (%)]</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
</tr>
<tr>
<td>Men</td>
</tr>
<tr>
<td>Women</td>
</tr>
<tr>
<td>Weight loss (kg)</td>
</tr>
<tr>
<td>Length of stay (d)</td>
</tr>
</tbody>
</table>

a± SD; range in parentheses; n in brackets.
was <19 in 17% of subjects and <22 in 36% of subjects. BMI was >27 in 33% of subjects.

Length of stay did not differ significantly in subjects grouped by BMI cutoffs of 19, 21, or 22. This may reflect a reimbursement imperative to discharge subjects close to the Medicare maximum of 21 d and not the subjects’ true clinical condition.

**Mini Nutritional Assessment**

The mean age of the subgroup evaluated with the MNA was 75.8 y (range: 33–96 y). Two-thirds of the subjects in the subgroup were women (n = 69) and one-third were men (n = 35). The average length of stay for the subgroup was 25.1 d. The subgroup did not differ significantly from the whole population in age, sex, BMI, albumin concentration, cholesterol concentration, or length of stay, suggesting that these results can be generalized to the whole population.

As shown in Table 2, only 8.7% of the subjects were well nourished. Almost one-third of the subjects were malnourished and almost two-thirds were at risk of malnutrition. Thus, >91% of subjects admitted to subacute care were malnourished or at risk of malnutrition. The length of stay differed by 11 d between the malnourished group and the nutritionally at-risk group (Figure 1).

The MNA score was highly correlated with BMI (Figure 2). The highest sensitivity occurred at a BMI of 22, whereas the highest specificity occurred at a BMI of <19. The high correlation of MNA score with BMI suggests that this simple measure can be used as a first screening tool at admission.

With the use of the MNA as a gold standard, a BMI of <19 was poorly sensitive but very specific for malnutrition. The best cutoff for BMI in relation to the MNA appeared to be 21 (Table 3).

**Depression and SCALE scores**

GDS scores were higher in malnourished subjects than in nutritionally at-risk subjects (Table 4). The SCALE score was also higher in malnourished subjects than in nutritionally at-risk subjects. The SCALE score correlated well with the MNA because both instruments share common variables (r = 0.461, P = 0.002).

**Hydration status**

There was a high correlation between poor hydration and MNA score (Table 4). Subjects with an MNA score <17 were 6 times more likely to be dehydrated than were subjects who had an MNA score of 17–23.5. It is likely that subjects who are malnourished are not meeting their hydration needs because of poor intake.

**Discharge disposition and death**

Most subjects were discharged to their homes after their stay in the subacute-care facility (Table 5); almost 20% of subjects were transferred back to an acute-care hospital and 16.8% were transferred to a nursing home facility. The discharge disposition of subjects by BMI category is shown in Table 6. In subjects

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**Table 2**

Assessment of malnutrition according to Mini Nutritional Assessment (MNA) score

<table>
<thead>
<tr>
<th>MNA score</th>
<th>No. of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malnourished (&lt;17)</td>
<td>30 (28.8)</td>
</tr>
<tr>
<td>At risk (17–23.5)</td>
<td>65 (62.5)</td>
</tr>
<tr>
<td>Well nourished (&gt;23.5)</td>
<td>9 (8.7)</td>
</tr>
</tbody>
</table>

1 MNA, reference 16.

**Figure 1**

Length of stay by nutritional status. Length of stay was higher in the malnourished group [n = 30; those with a Mini Nutritional Assessment (MNA) score <17] than in the at-risk group [n = 65; those with an MNA score of 17–23.5] (P = 0.007). The small box indicates the mean, the larger box the SE, and the error bars the SD.

**Figure 2**

Correlation between BMI (in kg/m²) and Mini Nutritional Assessment score (r = 0.40, P < 0.05; n = 93). The regression line (solid) and 95% CIs (dotted) are shown.

There was no significant difference in length of stay when the subgroup was grouped by albumin concentrations. Length of stay was 22 d for those with an albumin concentration <32 g/L, 25.2 d for those with an albumin concentration of 32–35 g/L, 20.7 d for those with an albumin concentration of 36–40 g/L, and 19.9 d for those with an albumin concentration >40 g/L.

**Table 3**

Sensitivity and specificity of BMI by Mini Nutritional Assessment (MNA)

<table>
<thead>
<tr>
<th></th>
<th>Malnourished (MNA score &lt;17)</th>
<th>At risk (MNA score of 17–23.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>BMI &lt; 19</td>
<td>11 (41)</td>
<td>8 (14)</td>
</tr>
<tr>
<td>BMI ≥ 19</td>
<td>16 (59)</td>
<td>51 (86)</td>
</tr>
<tr>
<td>BMI &lt; 21</td>
<td>16 (59)</td>
<td>13 (22)</td>
</tr>
<tr>
<td>BMI ≥ 21</td>
<td>11 (41)</td>
<td>46 (78)</td>
</tr>
<tr>
<td>BMI &lt; 22</td>
<td>19 (70)</td>
<td>17 (29)</td>
</tr>
<tr>
<td>BMI ≥ 22</td>
<td>8 (30)</td>
<td>42 (71)</td>
</tr>
</tbody>
</table>

1 MNA, reference 16.
with a low BMI, 18.7% were transferred to an acute-care hospital; 59.8% went home; 19.6% were transferred to either a nursing home, a skilled nursing facility, or a respite care facility; and 1.9% died. Death was infrequent, occurring in 8 subjects. In those subjects for whom BMI data were available, 2 subjects in each category of BMI (<22, 22–27, and >27) died. There were no significant differences in the discharge disposition of subjects between those with a BMI < 22 and those with a BMI > 22. The low mortality rate probably reflects referral bias for patients who are candidates for rehabilitation therapy.

The discharge disposition of subjects by MNA score is shown in Figure 3. Of the malnourished subjects, a large proportion required readmission to an acute-care hospital (25%). About one-half of the malnourished subjects were discharged to their homes (54.2%) and 20.8% were transferred to long-term-care facilities.

### DISCUSSION

Undernutrition as measured by BMI and albumin concentrations is extremely common in subjects being admitted to a subacute-care facility. Before this study, few data were available on the prevalence of undernutrition specifically in subacute-care facilities. There is no gold standard for the definition of undernutrition. Markers for nutritional status, such as albumin, are affected by comorbid conditions and may not independently reflect nutritional status.

Age and sex-adjusted BMI <10th decile has been used to define undernutrition (<19 in men and <19.4 in women; 22). The increase in mortality is linear: the lower the BMI, the greater the risk. Increased risk of death was shown to begin at a BMI of <22. This simple anthropometric measure can be calculated at admission to predict risk of malnutrition. Excess mortality in relation to the BMI cutoffs of <22, 22–27, and >27 was not shown in our study because of the few deaths and the relatively short period of observation. There was also no observable difference in length of stay when BMI alone was used as a predictor. However, there was a clear difference in length of stay between the malnourished and at-risk groups defined by the MNA score. Malnourished subjects stayed in the facility an average of 11 d longer than did subjects who were only at risk of malnutrition. Whether malnutrition prolongs the clinical course or is merely a marker for sicker persons is not clear.

More than one-half of the subjects admitted to subacute care had low serum albumin concentrations. Serum albumin is a consistent predictor of mortality and morbidity. Severity of protein-energy undernutrition, as indicated by a low serum albumin concentration or a history of recent involuntary weight loss, is a strong independent risk factor for life-threatening morbidity after discharge from a rehabilitation facility, even when the severity of illness is controlled for (1). Serum albumin is a predictor of mortality in community-dwelling older persons. The effect is linear:

### TABLE 5

<table>
<thead>
<tr>
<th>Discharge disposition</th>
<th>No. of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>Nursing home</td>
<td>60 (16.8)</td>
</tr>
<tr>
<td>Home</td>
<td>218 (61.1)</td>
</tr>
<tr>
<td>Acute-care hospital</td>
<td>71 (19.9)</td>
</tr>
<tr>
<td>Death</td>
<td>8 (2.2)</td>
</tr>
</tbody>
</table>

* n = 357.

### TABLE 4

<table>
<thead>
<tr>
<th>Measurement</th>
<th>MNA score &lt; 17</th>
<th>MNA score of 17–23.5</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDS</td>
<td>12.2 ± 6.4 [30]</td>
<td>8.7 ± 5.8 [52]</td>
<td>0.05</td>
</tr>
<tr>
<td>Modified SCALES score</td>
<td>5.3 ± 1.5 [20]</td>
<td>3.9 ± 1.6 [35]</td>
<td>0.004</td>
</tr>
<tr>
<td>Hydration status (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum urea nitrogen:creatine &gt; 25</td>
<td>11</td>
<td>6</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Serum urea nitrogen:creatine &lt; 25</td>
<td>15</td>
<td>49</td>
<td></td>
</tr>
</tbody>
</table>

1 MNA; reference 16; GDS (Geriatric Depression Scale), references 19 and 20; SCALES score, reference 13.
2 ± SD; n in brackets.
3 Serum urea nitrogen = 10.25 ± 4.32 mmol/L (28.7 ± 12.1 mg/dL); creatinine = 80 ± 44 μmol/L (0.9 ± 0.5 mg/dL).
4 Serum urea nitrogen = 11.6 ± 5.2 mmol/L (32.5 ± 14.6 mg/dL); creatinine = 80 ± 26 μmol/L (0.9 ± 0.3 mg/dL).
5 Chi-square test.
6 Serum urea nitrogen = 5.4 ± 2.5 mmol/L (15.2 ± 6.9 mg/dL); creatinine = 80 ± 18 μmol/L (0.9 ± 0.2 mg/dL).
7 Serum urea nitrogen = 6 ± 3.0 mmol/L (17.0 ± 8.4 mg/dL); creatinine = 97 ± 44 μmol/L (1.1 ± 0.5 mg/dL).

### TABLE 6

<table>
<thead>
<tr>
<th>BMI &lt; 22</th>
<th>BMI 22–27</th>
<th>BMI &gt; 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency [n (%)]</td>
<td>117 (36.4)</td>
<td>94 (30.5)</td>
</tr>
<tr>
<td>Length of stay (d)</td>
<td>21.2</td>
<td>21.0</td>
</tr>
<tr>
<td>Discharge disposition [n (%)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing home</td>
<td>20 (38.5)</td>
<td>17 (32.7)</td>
</tr>
<tr>
<td>Home</td>
<td>64 (34.8)</td>
<td>54 (29.3)</td>
</tr>
<tr>
<td>Acute-care hospital</td>
<td>21 (38.9)</td>
<td>16 (26.4)</td>
</tr>
<tr>
<td>Death</td>
<td>2 (33.3)</td>
<td>2 (33.3)</td>
</tr>
</tbody>
</table>

* Data for BMI and length of stay were available for 319 subjects; data for BMI and discharge disposition were available for 296 subjects. There were no significant differences between groups.
as albumin decreases, risk increases. This effect is independent of BMI, physical status, age, education, and race, but differs by sex (27). The increased risk associated with serum albumin is found at 6 mo and 1 y, but short-term risk is less strongly associated. In the present study, we did not find an association between short-term risk and albumin in terms of death or length of stay.

Reductions in serum albumin may reflect inflammatory conditions rather than nutritional status. Cytokines such as tumor necrosis factor α, interleukin 2, and interleukin 6 inhibit albumin production (28). Whether related to cytokines or nutritional state, serum albumin concentrations can still be used to identify subjects at baseline risk (29).

The MNA is attractive for use in subacute care to determine undernourishment because measurement of biochemical markers (eg, albumin and cholesterol) is not required. The MNA correctly characterizes 88% of malnourished subjects with and without the use of biochemical variables (17). In the present study, length of stay was higher in the subjects who were malnourished than in those who were at risk of malnourishment according to MNA score. Future studies should determine whether MNA scores alone prove to be simply a marker for nutritional status or an impetus to initiate therapy.

This study confirms previous work showing that depression is highly associated with malnutrition. Morley and Kraenzle (30) conducted a retrospective chart review to determine the cause of weight loss in nursing home residents. They concluded that depression is the most common cause of weight loss, that psychotropic drug reduction may cause weight loss, and that most causes of weight loss in the nursing home are potentially treatable. Depression scores, measured by the GDS, were higher in the malnourished subjects in the present study.

The SCALES questionnaire has been suggested as a useful screening tool for malnutrition. Unlike the MNA, however, the SCALES tool requires biochemical measurements. The SCALES questionnaire was previously cross-validated with the MNA in a community study (31). In acute-care hospital or nursing home studies, the SCALES questionnaire without the S for shopping can be used as a nutrition screen. The performance of the SCALES questionnaire compared with the MNA further suggests that it may be a useful tool for diagnosing malnutrition.

Severity of illness or inattention to nutrition during a hospital stay for an acute illness contributes to the prevalence of undernutrition in subacute care. Most persons admitted to a subacute-care facility are either malnourished or at risk of malnutrition. It is imperative that interdisciplinary teams pay close attention to the nutritional status of patients newly admitted to subacute-care facilities after a stay in an acute-care hospital.

REFERENCES


FIGURE 3. Discharge disposition of subjects by Mini Nutritional Assessment (MNA) score: malnourished subjects, MNA score < 17: at-risk subjects, MNA score of 17–23.5. There were no significant differences between groups.