Feeding Dependence and Nutritional Status
After Acute Stroke

Mitra Unosson, RN, DMSc; Anna-Christina Ek, RN, DMSc; Per Bjurulf, MD, PhD; Henning von Schenck, MD, PhD; Jörgen Larsson, MD, PhD

**Background and Purpose** We assessed the nutritional status of patients with acute stroke and evaluated it in relation to the patients' dependence on assistance with feeding.

**Methods** Fifty patients aged 70 years or older, admitted from their homes, were included. Weight index, triceps skinfold thickness, arm muscle circumference, serum proteins, delayed hypersensitivity, body composition measured by bio-electric impedance, and functional condition were determined on admission and 2 and 9 weeks after admission. Food and fluid consumption were also recorded.

**Results** On admission, four patients were regarded as protein-energy malnourished. Those who required assistance with feeding after admission (n=18, 36%) had lower serum albumin (P<.05), lower body cell mass (P<.01), and were more anergic than the independent patients (P<.01) on admission. The mean food consumption was 72% of the food served without significant difference between dependent and independent patients. Nine weeks after the onset of stroke symptoms, the patients who were dependent on assisted feeding showed a decrease in body cell mass. The loss of body cell mass was related to their activity and feeding dependence.

**Conclusions** Low serum albumin and anergy commonly occur in elderly patients with acute stroke, and they occur more prevalently among those with a severely impaired functional condition. During the recovery period, the patients use body fat to compensate for energy needs, and immobility leads to loss of body cell mass. (Stroke. 1994;25:366-371.)

**Key Words** diet • elderly • stroke

**Subjects and Methods**

All patients aged 70 years or older, living at home, who were admitted to a neurological unit from April to October 1991 with a clinically diagnosed stroke were included. Patients suffering from renal, hepatic, or malignant diseases were excluded. Informed consent was obtained from either the patients or their next of kin after written and oral information about the investigation. The study was approved by the Research Ethical Committee of the Faculty of Health Science, Linköping University, Sweden.

Of 60 consecutive patients, 10 refused. Of the 50 patients included in the study, 27 were female and 23 male, the mean age being 80.2±4.3 years and 77.7±4.4 years, respectively. During the interval of observation, 8 (16%) patients died (2 men and 6 women; mean age, 81.6±5.0 years), and 4 refused to participate further. On the basis of their medical records, 35 patients were diagnosed as having cerebral infarction, 4 intracerebral hemorrhage, 8 unspecified stroke, and 3 transient ischemic attack, of whom 29 had hemiparesis and 2 hemianopsia.

Nutritional status was assessed within 48 hours after admission and after 2 and 9 weeks. The patient's height was measured in the supine position on a flat bed. The measuring equipment had a fixed head and foot part, adjustable in the middle. Weight was measured with an electronic bed scale (Viola-scale, KEBO Care, Sweden) and a portable bathroom scale for the ambulatory patients. The two scales were checked for accuracy by a precise set of weights. Weight index was calculated according to the following equation: actual weight/standard weight for age being 80.2±4.3 years and 77.7±4.4 years, respectively. Delayed hypersensitivity was determined with a clinically diagnosed stroke were included. Patients suffering from renal, hepatic, or malignant diseases were excluded. Informed consent was obtained from either the patients or their next of kin after written and oral information about the investigation. The study was approved by the Research Ethical Committee of the Faculty of Health Science, Linköping University, Sweden.

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anthropometric measurements were performed by the same investigator. Serum protein analysis included serum albumin, transthyretin, and α1-antitrypsin. The assays were performed applying the Behring Nephelometer Analyzer with standards and antisera from Behringwerke (Svenska Hoechst, Stockholm, Sweden). The interassay coefficients of variation were 3.8%, 3.4%, and 4.5%, respectively. Delayed hypersensitivity skin testing was performed on admission and at 9 weeks, using three antigens: purified protein derivative, Candida, and mumps. The patients were regarded as reactive if the sum of two perpendicular diameters, read at 48 hours, in at least one of the tests was >10 mm; they were regarded as anergic if the reaction was <10 mm. The patients were classified as protein-energy malnutrition if at least three nutritional variables were lower than the following values, including one of each of the anthropometric, serum protein, and skin test measurements. The cutoff values for men and women, respectively, were as follows: weight index, <80% and <80%; TSF, ≤6 mm and ≤12 mm; AMC, ≤23 cm and ≤19 cm in those aged ≤79 years and ≤21 cm and ≤18 cm in those aged >79 years; transthyretin, ≤0.20 g/L and ≤0.18 g/L; albumin, <36 g/L and ≤36 g/L; and skin test, ≤10 mm and ≤10 mm.

Body fat mass, body lean mass, total body water, and body cell mass were assessed by a bioelectric impedance analyzer (model BIA-101, RJL Systems, Detroit, Mich) on admission and after 2 and 9 weeks. Bioelectric impedance was measured between the hand and the foot of the left side with the patient in the supine position, with the arms and the legs abducted. Formulas provided by the manufacturer of the instrument were used. Eleven patients were not assessed because of technical problems, edema, or the presence of a pacemaker.

The patients were divided into two groups according to feeding dependence in the first week after admission: independent (12 of 32 with hemiparesis), those who fed themselves without assistance; and dependent (17 of 18 with hemiparesis), those who received assistance such as cutting the food or spoon feeding or those who were fed partly through intravenous fluids. To assess the patients' mental condition, activity, mobility, incontinence, and general physical condition, the Norton scale was used, modified by including food and fluid intake. Each variable was scored 1 through 4, with 1 representing lack of function and 4 representing full or almost full function. When the patients were in the hospital, the ratings were performed by the research nurse and the practical nurses responsible for the patients' care. When the patients were at home the ratings were performed by two research nurses.

The patients' voluntary food and fluid intake was recorded for 26 patients (10 dependent and 16 independent) on 2 consecutive days 1 and 2 weeks after admission for those patients who remained at the neurological ward and consumed solid foods. The amount of food eaten was calculated by weighing the food before and after the consumption of three main meals (breakfast, lunch, and dinner) using an electronic scale (EKS International AB, Sweden) accurate to ±1 g. All fluids were registered. The patients were given ordinary hospital food and were offered the same menu during the first and second week when the food was recorded. The amount of food served was calculated by weighing 255 portions, excluding the packing. The mean was 1228 g/d, containing 6552 kJ and 70 g of protein. The amount of food consumed was estimated as a mean of the 4 recorded days.

The occurrence of complications during the stay at the neurological unit was collected from the patients' medical records.

The statistical analyses were performed with Student's t test for dependent and independent groups, Fisher's exact test, Mann-Whitney U test, and multiple regression analysis. For regression analysis, the dependent variable was the change of body cell mass between admission and 9 weeks after admission. The independent variables were the values of activity (1, ambulant; 0, walks with help or worse), food intake (1, normal; 0, insufficient or parenteral), and feeding capacity (1, feeds self; 0, needs assistance) on week 2. The independent variables were tested all together, in pairs, and singly.

### Results

The patients' nutritional status and body composition on admission are described in Table 1. Initially serum albumin and transthyretin values below the cutoff limits used were noted in 31 (62%) and 9 (18%) patients, respectively. Four of the patients met criteria for protein-energy malnutrition (2 women and 2 men), and these were also judged to be malnourished with the skin tests excluded.

One week after admission, 18 (36%) of the patients required assistance with feeding, while 32 (64%) were independent. Of those who were dependent, three patients were fed partly with intravenous fluids. The patients who required assistance were older (mean age, 81.2±4.1 years [range, 73 to 89 years]) than those who were independent (mean age, 77.8±4.1 years [range, 70 to 87 years]) (P<.01). More women than men were dependent (P<.05) (Table 2), but there were no differences in coexisting diseases.

During the course of the study 30 patients (60%) were discharged to their homes, and 17 were transferred to geriatric clinics. The proportion of the patients who required transfer to geriatric clinics was higher in the dependent than in the independent group (P<.0001) (Table 2). All those who died before leaving the neurological ward (n=3) or the geriatric hospital (n=5) belonged to the dependent group. The mean inpatient stay in the neurological ward for the dependent patients was 18±8.9 days, compared with 9.5±4 days for the independent patients (P<.001).

On admission the serum albumin concentration and body cell mass were lower in the dependent group than in the independent (Table 3). Thirteen (72%) of the dependent patients were anergic on admission, com-
TABLE 2. Sex, Residence, Social Condition, and Clinical Outcome Among Dependent and Independent Patients

<table>
<thead>
<tr>
<th></th>
<th>Dependent Feeding (n=18)</th>
<th>Independent Feeding (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Women</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td><strong>Residence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own house/apartment</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>Service apartment</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Social condition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Cohabitant</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td><strong>Clinical outcome</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharged to home</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Transferred to geriatric clinic</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Died in neurological ward</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Compared with 8 (25%) of the independent patients (P<.01).

Two weeks after admission the dependent patients had lower concentrations of serum albumin and transthyretin, a higher concentration of α1-antitrypsin, and lower body cell mass compared with the independent patients (Table 4). Paired t tests between admission and the 2-week follow-up showed that both TSF (P<.05) and serum albumin concentration decreased (P<.01) in the patients who were dependent, whereas the patients who were independent showed a decline in TSF and body fat (P<.05).

TABLE 3. Anthropometry, Serum Proteins, and Body Composition on Admission In Dependent and Independent Patients

<table>
<thead>
<tr>
<th></th>
<th>Dependent Feeding (n=18)</th>
<th>Independent Feeding (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight, kg</strong></td>
<td>65.8±14.7</td>
<td>68.5±11.0</td>
</tr>
<tr>
<td><strong>Weight Index, %</strong></td>
<td>97.3±20.3</td>
<td>95.4±13.7</td>
</tr>
<tr>
<td><strong>TSF, mm</strong></td>
<td>16.2±7.6</td>
<td>14.5±5.7</td>
</tr>
<tr>
<td><strong>AMC, cm</strong></td>
<td>24.7±3.5</td>
<td>25.0±2.6</td>
</tr>
<tr>
<td><strong>Albumin, g/L</strong></td>
<td>32.5±3.9</td>
<td>35.1±4.4*</td>
</tr>
<tr>
<td><strong>Transthyretin, g/L</strong></td>
<td>0.21±0.05</td>
<td>0.23±0.05</td>
</tr>
<tr>
<td><strong>Antitrypsin, g/L</strong></td>
<td>1.38±0.27</td>
<td>1.26±0.20</td>
</tr>
<tr>
<td><strong>Anergy, No. of patients</strong></td>
<td>13/18</td>
<td>8/31†</td>
</tr>
<tr>
<td><strong>Body composition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body fat, kg</td>
<td>20.5±7.5</td>
<td>20.5±5.8</td>
</tr>
<tr>
<td>Lean body mass, kg</td>
<td>43.7±7.2</td>
<td>48.1±8.3</td>
</tr>
<tr>
<td>Body water, kg</td>
<td>31.8±5.1</td>
<td>35.8±5.8*</td>
</tr>
<tr>
<td>Body cell mass, kg</td>
<td>14.3±5.0</td>
<td>18.4±3.8†</td>
</tr>
</tbody>
</table>

Values are mean±SD. TSF indicates triceps skinfold thickness; AMC, arm muscle circumference. *P<.05, †P<.01 by Student's t test.

At the 9-week follow-up the dependent patients had lower concentrations of serum albumin and lower body cell mass compared with the independent patients (Table 5). The change of body cell mass between admission and 9 weeks later was significantly greater in the dependent group (Table 6). Multiple regression analysis showed a varying pattern of significant relations between the change of body cell mass and the patients' activity and feeding dependence. This latter related significantly to the change of body cell mass both in combination and singly (R² between 40.1% and 44.5%,...
TABLE 6. Changes of Anthropometry, Serum Proteins, and Body Composition Between Admission and After 9 Weeks in Dependent and Independent Patients

<table>
<thead>
<tr>
<th></th>
<th>Dependent Feeding (n=10)</th>
<th>Independent Feeding (n=28)</th>
<th>P (mean change between the two groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight, kg</td>
<td>-0.47±3.9</td>
<td>-0.42±2.7</td>
<td>.97</td>
</tr>
<tr>
<td>TSF, mm</td>
<td>-0.69±2.2</td>
<td>-0.34±1.51</td>
<td>.59</td>
</tr>
<tr>
<td>AMC, cm</td>
<td>0.06±1.9</td>
<td>-0.48±1.01*</td>
<td>.26</td>
</tr>
<tr>
<td>Albumin, g/L</td>
<td>-0.88±5.1</td>
<td>0.28±3.21</td>
<td>.40</td>
</tr>
<tr>
<td>Transthyretin, g/L</td>
<td>0.00±0.08</td>
<td>0.03±0.04†</td>
<td>.22</td>
</tr>
<tr>
<td>Body composition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body fat, kg</td>
<td>-1.06±2.65</td>
<td>-2.11±2.42†</td>
<td>.32</td>
</tr>
<tr>
<td>Lean body mass, kg</td>
<td>0.13±3.16</td>
<td>1.37±4.7</td>
<td>.50</td>
</tr>
<tr>
<td>Body water, kg</td>
<td>0.13±2.04</td>
<td>0.91±2.91</td>
<td>.49</td>
</tr>
<tr>
<td>Body cell mass, kg</td>
<td>-2.58±4.46</td>
<td>0.82±3.1</td>
<td>.031</td>
</tr>
</tbody>
</table>

Values are mean±SD change. TSF indicates triceps skinfold thickness; AMC, arm muscle circumference.
*P<.05, †P<.001 by Mann-Whitney U test.

Discussion

The major findings of the present investigation were that a high proportion of acute stroke patients admitted from their own home had a low concentration of serum proteins on admission, 8% were considered to be protein-energy malnourished, and approximately one third were dependent on assisted feeding. The dependent group had a lower serum albumin concentration and lower body cell mass on admission and after 2 and 9 weeks compared with the independent group. The loss of body fat during the observation period was not related to the patients' dependence, in contrast to the loss of body cell mass, which was greater in those who were dependent.

According to the 1976 study of Katz and Akpom,17 patients who need help to prepare food should be classified as independent. However, we chose to place those patients in the dependent group for the statistical analysis, because stroke patients who need help to prepare food usually do so because of paresis in the upper extremity.

Although there are many methods available to estimate body composition, there are also several limitations.20 Anthropometric measurements and bioelectric impedance analysis were the methods used in this study. The reference values for our anthropometric measurements were obtained from a Swedish population and are adjusted for age and sex.13,14 There is no ideal method for assessing nutritional status in elderly patients. We used a combination of anthropometric measurements, serum proteins, and skin tests to define protein-energy malnutrition.

TABLE 7. Number of Patients With Low Modified Norton Score (≤3) Before the Onset of Stroke Symptoms and After 2 and 9 Weeks Comparing Dependent and Independent Patients

<table>
<thead>
<tr>
<th>Low Modified Norton Score (≤3)</th>
<th>Dependent Feeding</th>
<th>Independent Feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before (n=18)</td>
<td>Week 2 (n=15)</td>
</tr>
<tr>
<td>Mental condition</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Activity</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Mobility</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Food intake</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Fluid intake</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Incontinence</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>General physical condition</td>
<td>3</td>
<td>11</td>
</tr>
</tbody>
</table>

*P<.01, †P<.001 by Mann-Whitney U test.
of age on body cell mass in this study because the age
in men. It is difficult to ascertain the actual influence
of protein is insufficient despite adequate energy con-
sumption over a long time. We did not investigate food
intake being only a little less than that of the indepen-
dent patients. Food records with regard to amount were
kept only for those patients who consumed solid foods.
The nutritional content could not be measured because
the records did not show whether the patients had
selective reduction of foodstuffs.

The difference in serum albumin concentration be-
 tween the dependent and independent groups on ad-
mission (Table 3) is probably due to significant prob-
lems before the onset of the stroke. A gradual fall in
albumin concentration develops when the consumption
of protein is insufficient despite adequate energy con-
sumption over a long time. We did not investigate food
habits before admission. In addition to lower serum
albumin on admission, the dependent patients were also
significantly more anergic and had lower body cell mass
than the independent patients, while there were no
significant differences in the anthropometric variables.
Those differences might be related to the patients' lifestyle before admission. Low physical activity and
high caloric intakes may have affected the body composi-
tion in the dependent group. However, the dependent
patients were older than those who were independent,
and there were more women. Longitudinal studies of
body composition in the elderly have shown that body
cell mass decreases with age and is lower in women than
in men. It is difficult to ascertain the actual influence
of age on body cell mass in this study because the age
difference between the two groups is not very large. At
the follow-up, the high concentration of antitrypsin and
the low concentration of serum albumin and transthyre-
tin indicate acute phase reaction, ie, an active disease
process.

Nine weeks after admission there was a decline in
body fat in both the dependent and independent
groups, indicating consumption of energy stores. In
contrast, the change of body cell mass between ad-
mision and after 9 weeks was significantly greater in the
dependent patients compared with the independent
(Table 6). Malnutrition is characterized by loss of body
cell mass, while lean body mass changes minimally. Im-
mobilized individuals lose muscle mass irrespective
of nutritional intake because of reduced synthesis of
proteins, while the rate of breakdown of proteins is
unchanged. The dependent patients in this study were
more immobilized (Table 7).

Keeping this in mind, we used regression analysis to
test the hypothesis of whether the change of body cell
mass was more related to the patients' functional con-
tion than to food intake. Our results showed signifi-
cant relations between patients' activity and feeding
dependence. According to Katz and Akpom, there is a
pattern of cumulative order among personal activities of
daily living. If the patient loses the ability to feed, he or
she has also lost all other abilities in the activities of
daily living scale. Therefore, early rehabilitation is im-
portant not only to help the patient gain independence
and function but also preserve body cell mass. Even in
severely impaired patients after stroke, mobility im-
proves continuously for up to 3 months afterward. The
sample size in our study was small, however, and there
is need for further studies.

In summary, hypoalbuminemia and anergy were com-
mon on admission in elderly patients with acute stroke,
and this seemed to be more obvious in the dependent
group. During the recovery period the stroke patients
seemed to break down body fat to compensate for
energy needs, independent of their functional condi-
tion. However, change of body cell mass appeared to
relate to the patients' functional condition after stroke.
These are relevant data that draw attention to the need
for both nutritional intake and intensive rehabilitation
measures during the recovery period. There is also a
need for more prospective controlled studies.

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