Institutionalized elderly people and malnutrition: research on the patients of a nursing home

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ABSTRACT

Protein-energy malnutrition (PEM) is a common finding in hospitalized or institutionalized elderly people. In the literature, PEM is not mentioned as being related to individual ability of the patient to feed him or herself correctly. This study analyzed the 56 patients of a nursing home divided into two groups: self-sufficient and non self-sufficient regarding feeding. Levels of serum albumin, transferrin, prealbumin and hemoglobin (Hb) were examined and compared to body mass index (BMI) calculated with bioelectrical impedance analysis. Fifty-three percent of patients were self-sufficient, while 47% were not self-sufficient for feeding of which 83.3% were women and 16.7% men. Levels below the average range were 49.1% for lymphocyte count, 52.9% for serum albumin, 13.7% for serum transferrin and 52.9% for serum prealbumin. No significant differences were found in terms of patient age, while the mean values of the parameters examined in the two groups, self-sufficient and not, were lower in the patients who were not self-sufficient, even if statistical significance was not reached. Serum albumin was in inverse proportion to age ($P<0.05$) and 46.1% of individuals with low levels of transferrin also showed low levels of Hb. Anemia was in direct proportion ($P<0.05$) to age. Measurement of BMI showed values below 22.5 (cut off for risk for malnutrition) in 33.4% of the subjects examined. Of the three hematochemical parameters, analysis of a possible relationship with BMI showed only a significant and directly proportional correlation with prealbumin ($P<0.05\%$). These data should be considered in the context of an epidemiological research study carried out in a conditioned and limited environment, where PEM, detected using hematochemical parameters, amounted to 50% of the patients, whereas BMI identified only approximately one-third of patients at risk of malnutrition. There were no statistically significant differences between men and women. Mean values of the surrogate hematochemical parameters were lower in patients non-self-sufficient for feeding, but the comparison does not reach significance due to the small sample size.

Introduction

Protein-energy malnutrition (PEM) is a syndrome in which there can be various low levels of protein and/or total calorie intake. This kind of malnutrition, although dramatically exemplified in children and in some developing countries, can be present in subjects of any age and nationality. It is believed that 30-60% of elderly institutionalized patients present a case of malnutrition mainly associated to several diseases, above all cancer.[1-3] Physical and mental handicaps, poor motility and frequent relapses of chronic diseases are, in non-self-sufficient and institutionalized elderly people, the major obstacles to a proper nutrition. In long-term admission hospitals or in nursing homes, in which most of the patients are women and very elderly people, PEM can reach 85%.[2,4] Guidelines[2,5] highlight early diagnosis of PEM in the elderly because of the close relationship between malnutrition and morbidity and mortality. Also the duration of hospitalization and the outcome of medical and surgical treatments are conditioned by the nutritional state.[6] Regaining at least 5% of body weight can reduce the odds of morbility and mortality in institutionalized elderly patients affected by PEM.[2,7] Unfortunately, in many cases, malnutrition is the result of a poor awareness of the problem on the part of the health operators.[8,9]

The first problem encountered when examining the nutritional status of a population concerns which parameters to choose for the study. Many different parameters are discussed in the literature.[3,10-13] Table 1 provides a summary of those most used in clinical practice.

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Each of these analytical methods has its logical validity, but they all have advantages and disadvantages depending on the population they are applied to.[3,11,13-15] For our purpose and for the type of population examined (non-self-sufficient institutionalized elderly people), we used body mass index (BMI) and lymphocyte count, together with three hematochemical parameters that are easy to repeat and compare. Our choice of parameters was based on the premise that in states of protein deficit, changes occur in the liver enzymes due to aminoacid-synthesis and a decrease in ureogenesis. Consequently, first homeostatic mechanisms are activated to maintain the plasma levels of albumin and other carrier proteins. The speed of synthesis of some proteins then drops and the plasma levels decrease at different times. This means that an evaluation of the aforementioned proteins can be used to monitor the degree of malnutrition as it develops.[16]

Albumin

Albumin is the first protein used for the assessment of malnutrition. It has a comparatively long half-life (18-20 days) and correlates PEM with the decreased proteosynthetic activity of the liver. It has the advantage of being easy to assay and is suitable for routine use. Among all the bioumoral nutritional parameters, in studies on large population samples, albumin is associated to increased morbidity and mortality in the elderly; mortality is independently predicted from albumin levels.[3] Moreover, we can classify three degrees of malnutrition according to albumin levels: mild, moderate and severe.

Transferrin

Transferrin has a half-life of 8-10 days. It transports the iron derived from the breakup of the hemoglobin from the bowel and sites of iron storage to the cells that synthesize hemoglobin, myoglobin and iron enzymes. Transferrin is a glycoprotein made of a single polypeptide chain. Normally, in the blood, 5 parts out of 9 are saturated, the remaining four parts have unsaturated sites. Unsaturated transferrin is essential for binding free iron and in conditions of infection.

Prealbumin

Prealbumin has a 48-h half-life. Its plasmatic concentration decreases significantly after only three days of improper proteic support and it increases 1 mg/dL per day with appropriate nutritional support. Its serum concentrations are not affected by the patient's hydration status and this is very useful in a study on the elderly. Prealbumin has a high rate of tryptophan, a basic aminoacid in the first steps of proteic synthesis. A recent study on malnutrition related to heart failure[14] showed that prealbumin is the only nutritional marker independently associated with cardiac cachexy.

Therefore, the aims of this study were: i) to look for signs of malnutrition and/or risk of malnutrition in patients in a nursing home using evaluation of BMI, lymphocyte count, serum albumin, transferrin and prealbumin; ii) to use these parameters to compare the nutritional status of two groups of patients: self-sufficient for feeding and non-self-sufficient and needing assistance during meals from a health operator.

Materials and Methods

The study design was developed after finding that a high percentage of patients at the *Andrea Rossi* Nursing Home, Assisi, central Italy, had problems in maintaining correct nutrition levels due to various levels of difficulty in feeding themselves. The study group was made up of 56 patients who were divided into three groups on the basis of their ability to feed themselves: self-sufficient, non-self-sufficient needing assistance from a health operator, and non-self-sufficient force-fed through nasogastric tube or percutaneous endoscopic gastrostomy. Data refer to 51 patients. Only 5 were excluded from the study: 2 with chronic leukemia, 3 force-fed by nasogastric tube given the complexity of intervention by the Nutritional Service of the Hospital.

Table 2 shows the degree of autonomy in feeding. The meals (composition, quantity and timing) were given according to recommendations established with the Nutritional Service of the Assisi Public Hospital. For each patient, independently of their degree of autonomy, meals were given out from a trolley, even for patients

Table 1. Assessment of malnutrition.

Clinical assessment
Laboratory examinations
Anthropometry
Body composition
Assessment of calorie intake and consumption
Questionnaires

Table 2. Autonomy levels for feeding.

	No.	Males	Females
Completely self-sufficient	27	9	18
Needing assistance from an operator	24	5	19
Force-fed	3	-	3

who had trouble with chewing and who needed a semi-solid diet. The calorie intake, divided into five meals, was 1800-2000 kilocalories per day; protein percentage was 15-20%. Given that there is still no conclusive agreement among nutritionists about protein needs in elderly people, and those studies on nitrogen balance show values range from 0.5 to 1.4 g/kg/day, the individual protein percentage was calculated as approximately 1 g/kg/day. To assess the degree of malnutrition, we decided to calculate three serum proteins that reflect adequacy of amino-acid intake: albumin, transferrin and prealbumin, in addition to BMI and lymphocyte count.

Between the two short half-lived and lower molecular weight proteins, in accordance with the experience of others,[14,15] we used prealbumin as a marker over the retinol-binding protein, after consideration of some intrinsic characteristics of the two and of the population examined. The values of the parameters assessed for which we diagnosed PEM or risk of PEM have been taken from established guidelines.[5] We also examined the hemoglobin values and the lymphocyte count because some Authors[17-19] believe that also a low hemoglobin level and a low lymphocyte count can be markers for PEM. [Some of our results have already been presented at the 2012 National Congress of the Federation of Associations of Hospital Doctors on Internal Medicine (FADOI)]. In April 2011, as requested by the General Practitioner in charge, each patient underwent the following blood tests: blood count, leukocyte formula, serum electrolytes (potassium, sodium, magnesium, calcium), protidemia, proteic electrophoresis, transferrin, prealbumin, blood urea nitrogen, creatinine, creatinine clearance assessed by modification of diet in renal disease formula. The parameters studied, therefore, did not require a specific blood sample as they were obtained from that periodically requested by the General Practitioner in charge, for which consent was not required. Samples were collected in such a way as to ensure availability of all the parameters at the same time. Blood tests were carried out at the laboratory of the Hospital of Perugia according to standard institutional reference values. PEM markers[20-29] and the degree of relative risk are listed in Table 3.

Results

Average age of the patients was 85.1±7.4 years. All patients presented some degree of mental and physical or motor problems. The comparison between the average age of self-sufficient and non-self-sufficient patients, as well as between males and females did not prove significant. Of the patients examined, 52.9% were completely self-sufficient for feeding. The percentage of patients in need of constant assistance from a health worker during meals was 83.3% for women and 16.7% for men; also in this case, differences in percentages did not reach statistical significance.

Tables 4 and 5 show the study subjects divided into self-sufficient and non-self-sufficient patients and their blood test results. The lymphocytes/μL number showed normal values in 51.0% of the patients, while among the remaining 49.0%, 7.8% had a mild, 39.2% had a moderate, and just 2.0% had a severe deficit. The values for self-sufficient and non-self-sufficient patients and for men and women are presented in Table 6.

In the 51 patients examined, values below the normal range were found for serum albumin in 52.9%, for serum transferrin in 13.7%, and for serum prealbumin in 52.9% (Tables 7-9). Analysis of albumin values (Table 7) showed that in 47.1% of patients studied values were normal in 47.1%, a mild deficit was found in 47.1%, and a moderate deficit was found in 5.8%.

In the two groups of self-sufficient and non-self-sufficient patients regarding feeding, albumin values were within the normal range in 51.9% and 41.7%, respectively. Mild hypoalbuminemia was observed in 48.1% of the self-sufficient and 45.8% of the non-self-sufficient patients; a moderate hypoalbuminemia was present in 12.5% of the non-self-sufficient patients. There was no statistically significant difference between groups. In contrast, the correlation between age and serum albumin was statistically significant ($P<0.05$) (Figure 1).

Analysis of serum transferrin values showed that 13.7% of patients had slightly lower values but none had moderate or severely reduced values. A moderate reduction in serum transferrin was observed in 7.4% of self-sufficient and 20.8% of non-self-sufficient patients (Table 8).

Table 3. Main markers for malnutrition and its relative risk.

	Normal	Mild	Moderate	Severe
Albumin (g/dL)	3.5-4.5	2.8-3.4	2.1-2.7	<2.1
Prealbumin (mg/dL)	22-50	-	10-21	<10
Transferrin (mg/dL)	220-350	150-200	100-149	<100
Lymphocytes/μL	>1800	1500-1800	900-1500	<900
BMI (kg/m^2)	>22.5	21-22.5	19-21	<19

BMI, body mass index. *Adapted from Kondrup* et al., *2003*.[2]

Transferrin values were below average in 35.7% of male and 5.4% of female patients. There was no statistically significant difference between the two groups. Together with the drop in the values studied, a reduction in hemoglobin was also observed. Cross-checking the transferrin values below average with each patient's hemoglobin values, we noticed that of the 13.7% patients with low transferrin levels, 46.1% also had low hemoglobin levels. Approximately 45% of patients were anemic, especially (P<0.05) the oldest members of the study groups (Figure 2), independently of the degree of feeding autonomy.[30] The slight differences observed between self-sufficient and non-self-sufficient patients and between men and women did not reach statistical significance.

Data concerning prealbumin (Table 9) show that 47.1% of the patients had normal values, whereas among those who had values below average, 45.1% had a moderate deficit.

The most severe cases of deficit (7.8%) were lim-

Table 4. Blood test results for self-sufficient patients.

Self-sufficient patient	Age	Lymphocytes ($\times 10^3/\mu L$)	Albumin (g/dL)	Prealbumin (mg/dL)	Transferrin (mg/dL)	BMI (kg/m^2)
1	70.9	2.06	3.69	27.3	222	25.6
2	95.8	2.389	3.33	17.5	260	31.6
3	83.1	1.980	3.94	22.2	248	25.6
4	83.8	3.176	3.68	19.1	350	31.7
5	83.3	1.231	2.87	9	260	20.5
6	78	1.939	3.74	19.6	300	40.23
7	83.8	1.970	3.58	16.8	324	27.8
8	77	1.708	3.46	18.5	236	31.5
9	83.4	2.038	3.75	22.8	236	36.1
10	87.8	1.382	3.63	18.5	241	19.9
11	89.9	1.319	3	11.8	225	27
12	89.2	2.773	3.5	26.9	270	32.3
13	81.6	1.288	3.55	17.8	295	31.8
14	83.2	2.047	3.38	28.1	252	32
15	77.1	2.490	3.78	29.3	304	34.1
16	89.3	2.347	3.34	18.6	268	29.3
17	81.7	1.014	3.81	20.7	255	26.8
18	83	2.193	2.98	30.5	235	40.4
19	87.5	1.871	2.91	12	255	27.2
20	92.9	2.200	3.31	16.7	297	28.5
21	86.5	1.939	3.46	17.7	252	24.9
22	91.8	2.061	3.62	19	246	38.3
23	75.1	0.870	3.37	17.2	248	25.9
24	73.1	1.260	3.71	17.6	159	28.3
25	82.7	3.865	3.53	20.6	216	27.2
26	80.1	2.238	3.35	21.7	340	27.9
27	85.7	2.552	3.31	12.2	273	23.5
Mean	83.60	2.01	3.47	19.62	261.74	29.48
Minimum	70.9	0.87	2.87	9.00	159.00	19.90
Maximum	95.8	3.86	3.94	30.50	350.00	40.40
SD	5.99	0.66	0.28	5.36	40.47	5.24

BMI, body mass index; SD, standard deviation.

ited to 3 subjects of advanced age affected by multiple pathologies and who had been bedridden for a long period of time. There was only a moderate difference in values between self-sufficient and non-self-sufficient patients and between men and women, and these differences did not reach statistical significance. Lymphocyte counts and BMI values were cross-checked with those for serum prealbumin, transferrin and albumin. The correlation was positive in both the self-sufficient and non-self-sufficient patients, but statistical significance was not reached, probably due to the small sample size.

The lean body mass values obtained via bioelectrical impedance analysis were thought to be conditioned by changes in the hydration status of the patients, typical of the elderly, and were excluded from the analysis. BMI values were included since they were considered to be reliable.[2,20,29,31-35]

Analysis of BMI (Table 10) showed values below 22.5 in 33.4% of the patients; this is considered the

Table 5. Blood test results for non-self-sufficient patients.

Non-self-sufficient patients	Age	Lymphocytes ($\times 10^3/\mu L$)	Albumin (g/dL)	Prealbumin (mg/dL)	Transferrin (mg/dL)	BMI (kg/m^2)
1	83.9	1.509	3.8	18.8	220	19.7
2	91.4	1.637	3.21	16.6	240	23.8
3	95.8	2.477	3.32	15.3	225	19.4
4	82	1.152	2.64	16.5	205	36.73
5	62.8	2.431	3.8	19.6	225	27.8
6	87.4	1.553	3.6	22.4	222	21.5
7	95.7	0.978	2.95	11.9	220	14.7
8	84	1.299	2.22	6.7	210	18.1
9	70	1.408	3.68	18	240	16.8
10	92.1	1.948	3.51	8.4	220	18
11	89	0.920	2.77	8.6	188	20.43
12	69.7	1.102	4.19	28.5	265	15.5
13	85.8	2.351	3.31	17.2	251	18.1
14	91.4	1.370	4.03	17.2	310	23.3
15	79.9	1.332	3.34	17.6	180	25.9
16	86.9	1.252	2.98	27.5	236	24.8
17	99.2	1.327	3.47	16	234	22.2
18	91.7	1.478	3.43	17.4	235	19.3
19	83.6	2.118	3.59	17.1	210	23.7
20	96.2	2.531	3.46	14.9	328	21.2
21	84	0.960	3.22	20.1	245	19.6
22	92.7	1.340	3.13	14.5	258	28
23	80.2	2.380	4.04	19	260	35.3
24	92.4	1.407	3.6	10.8	235	20.4
Mean	86.16	1.59	3.39	16.69	235.92	22.26
Minimum	62.8	0.92	2.22	6.70	180.00	14.70
Maximum	99.2	2.53	4.19	28.50	328.00	36.73
SD	8.99	0.52	0.46	5.21	33.06	5.49

BMI, body mass index; SD, standard deviation.

Table 6. Risk stratification, lymphocyte counts, degree of autonomy and gender.

	Total (%)	Self-sufficient (%)	Non-self-sufficient (%)	Males (%)	Females (%)
Normal	51.0	70.4	29.2	57.2	48.7
Mild	7.8	3.7	12.5	0.0	10.8
Moderate	39.2	22.2	58.3	35.7	40.5
Severe	2.0	3.7	0.0	7.1	0.0

Table 7. Risk stratification, serum albumin, degree of autonomy and gender.

	Total (%)	Self-sufficient (%)	Non-self-sufficient (%)	Males (%)	Females (%)
Normal	47.1	51.9	41.7	50.0	45.9
Mild	47.1	48.1	45.8	42.8	48.6
Moderate	5.8	0.0	12.5	7.2	5.5
Severe	0.0	0.0	0.0	0.0	0.0

Table 8. Risk stratification, serum transferrin, degree of autonomy and gender.

	Total (%)	Self-sufficient (%)	Non-self-sufficient (%)	Males (%)	Females (%)
Normal	47.1	51.9	41.7	50.0	45.9
Mild	47.1	48.1	45.8	42.8	48.6
Moderate	5.8	0.0	12.5	7.2	5.5
Severe	0.0	0.0	0.0	0.0	0.0

Table 9. Risk stratification, serum prealbumin, degree of autonomy and gender.

	Total (%)	Self-sufficient (%)	Non-self-sufficient (%)	Males (%)	Females (%)
Normal	47.1	59.3	33.3	50.0	45.9
Moderate	45.1	37.0	54.2	42.9	45.9
Severe	7.8	3.7	12.5	7.1	8.2

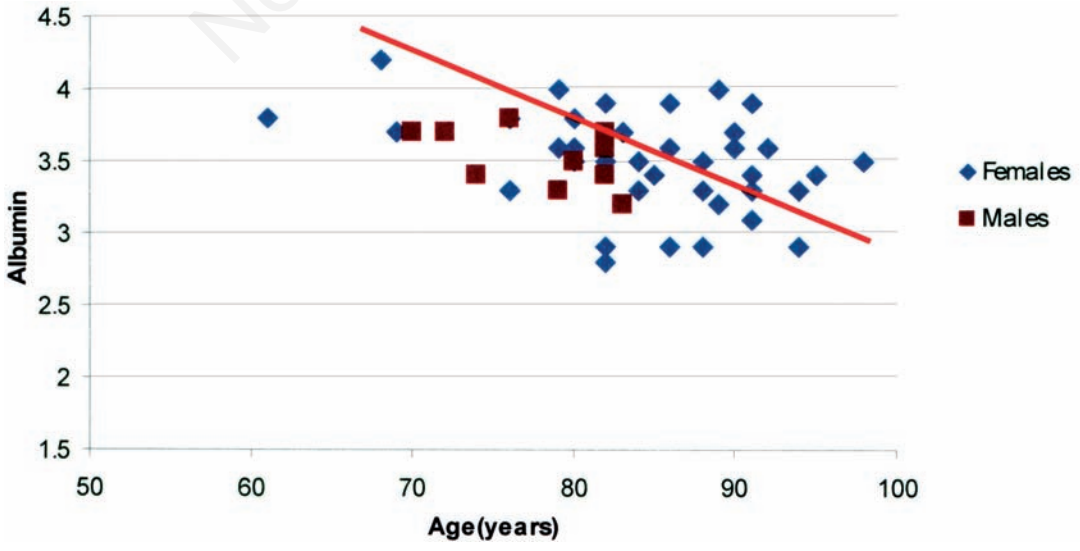

Figure 1. Correlation age/albumin.

cut-off value for malnutrition risk.[32] Correlations between lymphocyte count and BMI with the three serum proteins showed the following:

- Lymphocyte count and albumin: r not significant
- Lymphocyte count and transferrin: r not significant
- Lymphocyte count and prealbumin: r not significant
- Lymphocyte count and BMI: r not significant
- BMI and albumin: r not significant
- BMI and transferrin: r not significant
- BMI and prealbumin: significant ($P<0.05$) for direct correlation.

Discussion

From the literature we learn that PEM in elderly people, far from being rare, is a common denominator both for hospitalized and for institutionalized patients, and that it is closely related to the seriousness of the pathologies presented.[1,36-38] However, there are few references to the relationship between PEM and autonomy in feeding for a proper nutrition. Therefore, we have tried to recognize beforehand the cases in which PEM or risk of PEM were present in the elderly patients of a Nursing Home using parameters that are sufficiently significant and useful to enable action to be taken to remedy any deficit. Using a few simple parameters to recognize PEM in advance allows staff to intervene quickly and facilitates follow up. In addition, through these parameters and BMI we compared the nutritional status of the non-self-sufficient patients who needed assistance from a health worker during meals, and of those self-suffi-

Table 10. Risk stratification, body mass index, degree of autonomy and gender.

	Total (%)	Self-sufficient (%)	Non-self-sufficient (%)	Males (%)	Females (%)
Normal	66.6	92.6	37.5	78.6	62.2
Mild	5.9	0.0	12.5	0.0	8.1
Moderate	15.7	7.4	25.0	14.3	16.2
Severe	11.8	0.0	25.0	7.1	13.5

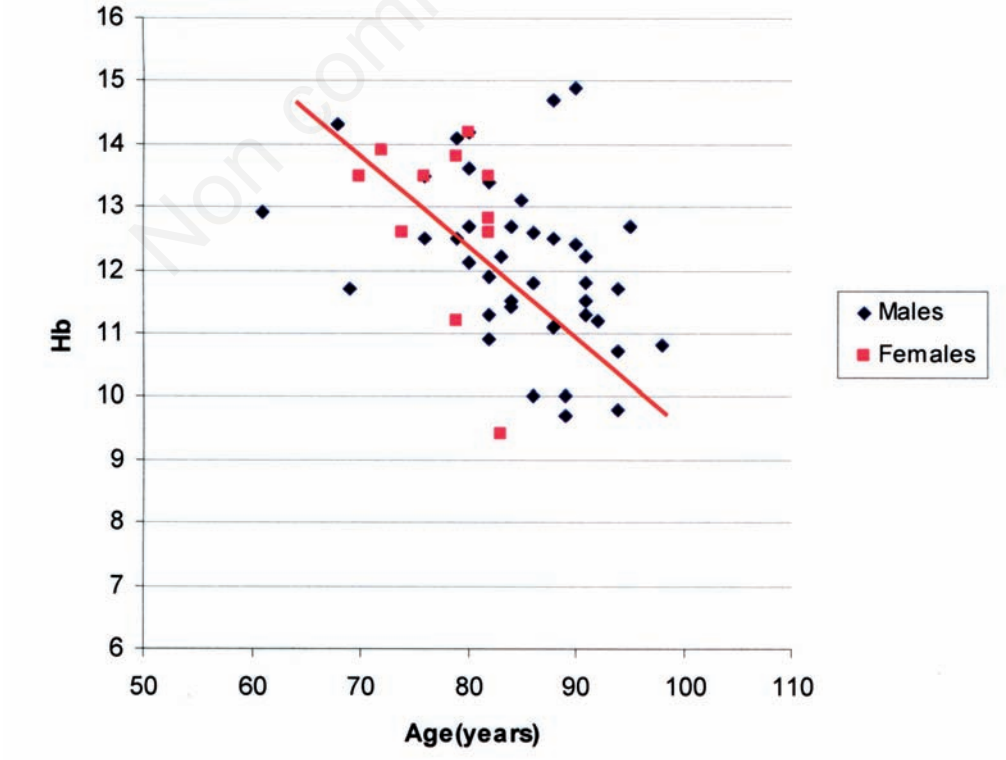

Figure 2. Correlation age/anemia.

cient subjects. In agreement with other studies,[4,5] the study population was mainly female (72.5%). In fact, problems in being able to feed oneself properly mainly concerns female patients (83.3%). Male patients are generally more self-sufficient, even if the data do not reach statistical significance. Only one of 3 men needs assistance during meals. This lack of nutritional autonomy in the two genders is not related to age but to the individual pathologies presented.

Results of the present study and those of others[14,21,22] show that both BMI and lymphocyte count, serum albumin and prealbumin are reliable surrogate markers to evaluate the adequacy of nutrients and to stratify malnutrition in the elderly. Based on these parameters, approximately 50% of the patients needed a greater protein intake. Analysis shows the differences between the two groups of self-sufficient and non-self-sufficient patients; the extent of the difference between the two groups (%) varies. However, statistical significance was not reached and this was probably due to the small sample size. Anemia was evaluated as defined by the World Health Organization:[17] hemoglobin below 12 g/dL in women and 13 g/dL in men. In the elderly, prevalence and incidence of anemia increases progressively with age. The data presented at the 2012 National Congress of FADOI[30] reveal that level of anemia and reduction in lean body mass also progress with age. Almost half of the patients (46.1%) with below average transferrin values also had low hemoglobin levels. We suggest that also anemia and low serum transferrin can be surrogate markers of protein deficit and should be considered when evaluating the general nutritional status of the institutionalized elderly patient. Prealbumin is a useful parameter to indicate current nutritional status; values were below average in 52.9% of the patients, but in almost all cases this was only a moderate deficit. Severe deficit was observed in only 7.8% of patients.

The results of our research highlight three essential aspects.

- Approximately 50% of the patients examined in the present study were malnourished or at risk of malnutrition and, therefore, need a specific protein supplement and follow up. Even though this is a high percentage of patients, it is lower than the 85% expressed by other Authors.[2,4]
- Statistical analysis showed no significant difference in any of the parameters between male and female patients. The comparison between self-sufficient and non-self-sufficient patients regarding their ability to appropriately feed themselves (Tables 4 and 5) highlights the fact that the average values of each parameter do differ, being higher in the self-sufficient patients compared with the non-self-sufficient, respectively: lymphocyte count/μL 2010 *vs* 1590; albumin g/dL 3.47 *vs* 3.39; prealbumin mg/dL 19.62 *vs* 16.69; transferrin mg/dL 261.74 *vs* 235.92; BMI kg/m^2 29.48 *vs* 22.26.

These data, although not reaching statistical significance due to the small sample size, still indicate that the patient who is not self-sufficient regarding feeding is at greater risk for PEM.

Calculation of BMI highlighted the fact that 33.4% of the patients were at risk for malnutrition. From the comparison between BMI and the blood test results, a statistically significant direct difference ($P<0.05$) was only seen for prealbumin (Table 8), whereas results for the other parameters did not reach significance. However, there was a positive correlation with BMI for the other parameters. Statistical significance was not reached probably due to the small sample size but the surrogate hematochemical parameters integrated with BMI take the percentage of patients with PEM from 33.4% to approximately 50%.

Conclusions

These data must be placed in the context of an epidemiological research study in a conditioned and limited environment. However, there are at least two aspects that legitimize research into PEM.[38-40]

The possible consequences of an improper or insufficient nutrition are:

- compromized gastrointestinal function
- reduced immune system function
- more and slower healing bedsores
- more complications
- prolonged hospitalization
- more drugs prescribed
- compromized psychic health and Quality of Life
- increased costs (30-35%)

Research into the nutritional status of a population of elderly people[35] allows us to:

- identify in advance subjects at risk for malnutrition (screening)
- confirm their malnutrition status (diagnosis)
- analyze the risk of complications to malnutrition (prognosis)
- identify subjects needing nutritional supplement (prognosis)
- choose type and modality of intervention (therapy)
- evaluate the effectiveness of the proposed treatment (monitoring)

This study was carried out on a restricted and selected population. Given the study results, we suggest that the routine monitoring of surrogate parameters and their correct interpretation can be a useful instru-

ment to evaluate and supervise the nutritional status of the institutionalized elderly patient. Research into larger study populations could evidence the statistical significance of findings.

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