ASSESSMENT OF THE NUTRITIONAL STATUS OF ELDERLY PEOPLE IN A 24-HOUR CARE INSTITUTION

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ABSTRACT

Introduction: Nutritional disorders diagnosed among elderly people staying in 24-hour care institutions lead to many irregularities. Weight loss is a strong predictor of complications and death. It is important to monitor nutritional status, detect people at risk of malnutrition early, and take appropriate interventions.

Aim of the study: Assessment of the nutritional status of patients over 65 years old based on selected indicators: the level of prealbumin, albumin, and transferrin, total lymphocyte count (TLC), body mass index (BMI), and Mini Nutritional Assessment (MNA) scale.

Material and methods: The study included 104 residents staying in a 24-hour care institution. Nutritional status was assessed using the MNA scale, BMI, levels of prealbumin, albumin, and transferrin, and the TLC. Statistical analysis was performed using IBM SPSS Statistics 24 for Windows. $P < 0.05$ was considered statistically significant.

Results: Malnutrition was diagnosed based on albumin in 57.8% of the patients, prealbumin in 74%, transferrin in 46.2%, and TLC in 26.2%. Based on BMI, 36.5% of patients were underweight. According to MNA, 51.5% were at risk of malnutrition, and malnutrition was diagnosed in 46.6%. Prealbumin and transferrin values were significantly related with each other $p < 0.001$. MNA results showed a relationship with the values of transferrin (rho = 0.22, $p = 0.023$) and prealbumin (rho = 0.20, $p = 0.043$).

Conclusions: Among the residents of care institutions, there is a significant degree of malnutrition or its risk. The MNA scale, transferrin and prealbumin levels confirm the effectiveness of the recognition of nutritional disorders and validity of its regular assessment. People with nutritional disorders should undergo nutritional intervention to prevent the consequences of malnutrition.

Key words: malnutrition, BMI, transferrin, MNA, prealbumin.

INTRODUCTION

Aging is one of the stages of everyone's life. With age, functional and morphological changes of the organism occur, which lead to a gradual deterioration of the adaptation abilities of the organism and its multiple diseases. Older people often require specialist care, which can be provided by various inpatient care institutions.

The aging process depends on genetic factors and external accelerating factors, which include diseases, injuries, an incorrect lifestyle or inhibitory factors, e.g. an active lifestyle or a balanced diet. In the case of accompanying disease states, additional organ changes appear that worsen the general condition of the body, referred to as frailty syndrome. The condition is associated with an increased risk of dependence, disability, and mortality, and is characterized by weight loss, slowness, and low exercise tolerance. This leads to disturbances in the efficiency of physiological systems and deterioration in functioning (e.g. walking, mobility, balance, cognitive functions) [1, 2]. This syndrome is accompanied by sarcopenia, which is a loss of skeletal muscle mass often caused by malnutrition [3]. Malnutrition increases the risk of the negative consequences of diseases and injuries. Malnourished people constitute 3-12% of outpatients, 17-65% of hospitalized patients, and as much as 26-89% of patients staying in nursing homes [4]. Weight loss is a strong predictor of death due to increased infection frequency and worse response to medical management. Therefore, it becomes necessary to

develop a management strategy enabling proper and systematic monitoring of the nutritional status of elderly people, early detection of people at risk of malnutrition, and taking appropriate preventive and therapeutic measures [5, 6]. Nutritional assessment is an integral part of the overall geriatric assessment. The full assessment of the nutritional level consists of conducting a medical history and physical examination, nutritional interview, anthropometric examination (e.g. body mass index – BMI), laboratory tests (e.g. prealbumin), and most often, among the elderly (over 65 years of age), the Mini Nutritional Assessment (MNA) scale is used [7-9].

In the current Polish literature, there are still few reports on the analysis of the nutritional status of elderly people staying in 24-hour care institutions and the occurrence of malnutrition indicators in the context of functional fitness and the possibilities of preventing malnutrition.

AIM OF THE STUDY

Assessment of the nutritional status of patients over 65 years of age based on selected indicators: the levels of prealbumin, albumin, and transferrin, total lymphocyte count (TLC), BMI, and the MNA scale.

MATERIAL AND METHODS

The prospective study included a group of 104 patients aged 65-97 years, staying at the Municipal Care Centre for the Elderly, Chronically Disabled, and Dependent in Wielicka Street, Krakow. Women constituted 73.1% of the respondents, and 26.9% were men. The mean age of the analysed group of patients was 80.1 years, SD = 10.8, median = 82, quartiles: Q1 = 71.25 and Q3 = 90.00.

The selection criteria for the study group were as follows: age over 65 years, no cancer, no objective or subjective symptoms of infection, C reactive protein (CRP) < 10 mg/l, patient's consent to participate in the study, and no prior nutritional intervention in the form of food products for special medical purposes. The exclusion criteria from the study were as follows: diagnosed cancer, presence of any objective and subjective symptoms of infection, CRP > 10 mg/l, any nutritional intervention, age below 65 years, and refusal to participate in the study.

The research was carried out according to the established scheme:

- measurement of height, weight, and BMI calculation,
- collecting data on the basis of the MNA scale,
- taking blood samples to determine the level of prealbumin, albumin, transferrin, and blood counts to determine the total number of lymphocytes,
- analysis of the results of BMI, MNA, and laboratory tests,
- assessment of nutritional status and qualification of patients to specific groups.

In qualifying patients to the nutritional status groups, the values of individual parameters were taken into account [7]. According to the MNA scale: > 24 points – good nutritional status, 17-23.5 points – risk of malnutrition, and < 17 points – malnutrition. BMI according to the basic World Health Organization (WHO) classification was as follows: < 18.5 – underweight, 18.5-24.99 – normal value, and ≥ 25.0 – overweight. Laboratory values of the nutritional status indicators are presented in Table 1 [7]. Total lymphocyte count (TLC) was calculated from the formula below.

$$\text{TLC} = \%\ \text{of lymphocytes} \times \frac{\text{leukocyte count}}{100}$$

In the statistical analysis, various comparisons and correlations of individual nutritional status indicators were made to demonstrate different types of sensitivity and thus the usefulness of the indicators in the assessment of nutritional disorders. The assumption of the analysis of the results was to distinguish patients with malnutrition based on each nutritional status indicator (BMI, transferrin, prealbumin, TLC albumin, MNA). Patients were also included in the malnutrition group if, taking into account all 4 selected indicators (transferrin, prealbumin, albumin, TLC), at least 2 of them indicated malnutrition. To estimate the frequency of malnutrition, the simultaneous indication of malnutrition from 3 indicators (MNA, transferrin, and prealbumin) was also used. Detailed information can be found in the text preceding the individual tables with results.

The calculations were made with the use of IBM SPSS Statistics 24 for Windows. The distributions of qualitative variables were described by the absolute number of individual categories (*n*) and their percent-

Table 1. Laboratory indicators of nutritional status

Nutritional status	Transferrin [mg/dl]	Prealbumin [g/l]	Albumin [g/l]	TLC in 1 mm^3
Good	> 200	> 0.15	> 35	> 1500
Mild malnutrition	150-199	0.1-0.15	31-35	1200-1500
Moderate malnutrition	100-149	0.05-0.099	25-30.99	800-1199
Severe malnutrition	< 100	< 0.05	< 25	< 800

TLC – total lymphocyte count

age share in the distribution of the variable (%). Average values of normally distributed variables were described using the mean and standard deviation (SD), and in the case of variables with distributions significantly different from the normal – using the median and first and third quartiles. The relationships between the categorical variables are presented in the form of cross tables. Statistical significance was analysed using the chi-square test (χ^2), or the Fisher test and the likelihood-ratio test. The strength of the relationship was assessed using the Cramer V coefficient, Spearman's rho coefficient, and the Eta coefficient. Graphical presentation of the relationship between the analysed variables was made by means of a scatter plot with a plotted loess regression curve, showing the average values of the variable presented on the y-axis corresponding to the values of the variable presented on the x-axis. The p value < 0.05 was considered statistically significant.

The study was approved by the Bioethics Committee of the Jagiellonian University, No. KBET/59/B/2014.

RESULTS

The range of BMI values was from 12.37 to 27.6. There were 59.6% (62) properly nourished patients, underweight was diagnosed in 36.5% (38), and overweight in 3.8% (4) of patients.

The level of transferrin in the blood serum ranged from 84.0 to 381.0 mg/dl (mean = 209.1, SD = 55.4). Based on the results of transferrin, 53.8% (56) of patients were properly nourished, mild malnutrition occurred in 29.8% (31), moderate malnutrition in 14.4% (15), and severe malnutrition was diagnosed in 1.9% of patients.

The level of prealbumin in the blood serum ranged from 0.03 to 0.32 g/l (mean = 0.16, SD = 0.06). On the basis of prealbumin, 26.0% were properly nourished (27), mild malnutrition occurred in 56.7% (59), moderate in 14.4% (15), and severe malnutrition was diagnosed in 2.9%.

The serum albumin level ranged from 16.3 to 44.9 g/dl (mean = 35.2, SD = 5.4). On the basis of albumin, 42.2% (35) of patients were properly nourished, mild malnutrition occurred in 42.2% (35), moderate malnutrition in 12.0% (10), and severe malnutrition was diagnosed in 3.6%.

The TLC in mm^3 ranged from 832 to 13348 (Me = 1908, Q1 = 1448.25, Q3 = 2510.00). On the basis of TLC, 73.8% (76) of patients were properly nourished, mild malnutrition occurred in 15.5% (16), moderate malnutrition in 10.7% (11), and severe malnutrition was not diagnosed.

The MNA scale values ranged from 7.0 to 24.5 (mean = 17.4, SD = 3.4). There were 1.9% (2) of properly nourished patients, 51.5% (53) were at risk of malnutrition, and malnutrition was diagnosed in 46.6% (48) of patients.

On the basis of 4 selected indicators of the nutritional status: transferrin, prealbumin, albumin, and TLC, with the condition that at least 2 of them indicate malnutrition, the state of malnutrition was established in as many as 68.3% of patients (Table 2).

Due to the similar results of the nutritional status according to transferrin and prealbumin concerning severe and moderate malnutrition, the relationship between the nutritional status of the subjects between transferrin and prealbumin indices was determined. The results show that the values of prealbumin and transferrin are significantly related to each other (p < 0.001); along with the increase in nutritional status according to transferrin, the nutritional status according to prealbumin also increases (Fig. 1 and Table 3).

Because the results of nutritional status according to transferrin and prealbumin were significantly related, the correlation between transferrin and prealbumin was determined in the group of patients with malnutrition, regardless of the degree of malnutrition. On the basis of the transferrin level, 46.2% (48) of the patients were diagnosed as malnourished, and 74.0% (77) of the patients were diagnosed as malnourished on the basis of prealbumin level (Table 4).

The values of prealbumin increase with the increase in the value of transferrin (Fig. 1). In the lower range of transferrin values, and in the higher range of transferrin values, there is a slight decrease in the value of prealbumin (rho = 0.38, p < 0.001). These results confirm that both transferrin and prealbumin are effective markers in the diagnosis of malnutrition.

Regarding the results of nutritional status using the MNA scale, transferrin, and prealbumin, a group

Table 2. Malnutrition status according to MNA, transferrin, and prealbumin

		Count	Percentage	Percentage of valid	Cumulative percentage
Valid	No	26	25.0	31.7	31.7
	Yes	56	53.8	68.3	100.0
	Total	82	78.8	100.0	
Missing data	System data gaps	22	21.2		
Total		104	100.0		

of malnourished patients was selected based on the above indicators, with the exclusion of patients at risk of malnutrition assessed with the MNA index. The group of patients with malnutrition included 25 patients (24.0%) (Table 5).

The use of concurrent malnutrition indication of 3 indicators to estimate the incidence of malnutrition causes a significant decrease (from 53.8% to 24.0%) in the number of people with malnutrition compared to the assessment based on 4 indicators.

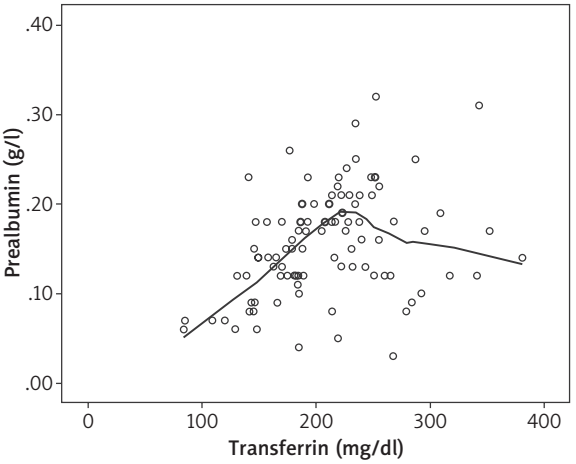

Figure 1. The relationship between the levels of transferrin and prealbumin

In the selected group of malnourished patients, with the exclusion of patients at risk of malnutrition assessed with the MNA index, the relationship between the indicators was determined: MNA and transferrin (Fig. 2) and MNA and prealbumin (Fig. 3). In both correlations of nutritional status indicators, similar results were obtained.

The MNA results show a rapid increase as the transferrin values increase from 100 to about 200, followed by the stabilization of the MNA values, as reflected in the statistically significant value of rho = 0.22, $p = 0.023$.

The MNA values increase with the increase of the prealbumin value, which is reflected in the significant value of the coefficient rho = 0.20, $p = 0.043$.

DISCUSSION

Nutritional disorders diagnosed among elderly people staying in 24-hour care institutions lead to many irregularities in the functioning of individual systems. The most common symptoms are immunological disorders, anaemia, muscle weakness, bone fragility, cognitive dysfunction, difficult treatment

Table 3. Cross table: nutritional status by transferrin, nutritional status by prealbumin

Likelihood ratio test $p < 0.001$, Cramer V = 0.43, $p < 0.001$			Nutritional status by prealbumin			Total
			Severe or moderate malnutrition	Mild malnutrition	Normal nutrition	
Nutritional status by transferrin	Severe or moderate malnutrition	Count	11	5	1	17
		Percentage of nutritional status by transferrin	64.7	29.4	5.9	100.0
	Mild malnutrition	Count	2	24	5	31
		Percentage of nutritional status by transferrin	6.5	77.4	16.1	100.0
	Normal nutrition	Count	5	30	21	56
		Percentage of nutritional status by transferrin	8.9	53.6	37.5	100.0
Total		Count	18	59	27	104
		percentage of nutritional status by transferrin	17.3	56.7	26.0	100.0

Table 4. Malnutrition status by transferrin, malnutrition status by prealbumin – cross table

			Malnutrition status by prealbumin		Total
			No	Yes	
Malnutrition status by transferrin	No	Count	21	35	56
		Percentage of total count	20.2	33.7	53.8
	Yes	Count	6	42	48
		Percentage of total count	5.8	40.4	46.2
Total		Count	27	77	104
		Percentage of total count	26.0	74.0	100.0

of the underlying disease, and an increase in the incidence of comorbidities [10]. In view of so many disorders related to the nutritional status in the elderly, it is important to recognize malnutrition early and implement nutritional interventions to improve the health situation [11, 12]. Various indicators and scales are used to assess the nutritional status. In our own study, the MNA scale was used to assess the nutritional status of people over 65 years of age. The level of transferrin, prealbumin, albumin, and total lymphocyte count were analysed as laboratory indicators of nutritional status. The anthropometric index (BMI) was also used. According to MNA, there were 51.5% of patients at risk of malnutrition, and malnutrition was diagnosed in 46.6%. Similar results were obtained in studies conducted in patients over 65 years of age living in a nursing home – 18.6% of residents were at risk of malnutrition, and malnutrition was diagnosed in 38.2% [13]. Subsequent studies conducted among people staying in a home for the elderly also show malnutrition in 40.4% of respondents [14]. Many studies confirm the occurrence of malnutrition in this age group, which is also associated with increased mortality [15, 16]. In subsequent studies, a higher percentage of malnourished patients was observed among hospitalized patients with cognitive impairment [17]. In the studies of Polish authors, among the elderly staying in 24-hour care centres, it was found that 58-61% of people were at risk of malnutrition [18, 19], and 16% of those were malnourished [18]. In other studies, the risk of malnutrition was diagnosed in 43.9% and malnutrition in 33.7% of the respondents [20]. In the geriatric ward, studies showed malnutrition among 33% of patients and the risk of malnutrition in 52% [6], and in the internal medicine ward, the risk of malnutrition was reported in 56% of patients [19]. The above results indicate that the largest group of respondents are people at risk of malnutrition.

Serum albumin and prealbumin are visceral proteins that are considered useful biochemical laboratory values in assessing nutritional status, but also characterize inflammation in the body. Prealbumin is often preferred over albumin because of its shorter half-life, which can be easily tested and used as a prognostic factor for rapid changes in nutritional status. In our study, albumin was used to diagnose malnutrition in 57.8% of the patients, and in 74% based on prealbumin. In the studies of other authors, similar results were obtained for albumin – patients with malnutrition 52.9%, and the level of malnourished patients according to prealbumin was much lower – also 52.9% [21]. In the meta-analysis of over 100 observational and cohort studies, the MNA scale and laboratory indicators were used, such as albumin and prealbumin. It has been shown that the level of prealbumin and albumin among people at high risk

Table 5. Malnutrition status according to MNA, transferrin, and prealbumin

Valid	Count	Percent	Percentage of valid	Cumulative percentage
No	79	76.0	76.0	76.0
Yes	25	24.0	24.0	100.0
Total	104	100.0	100.0	

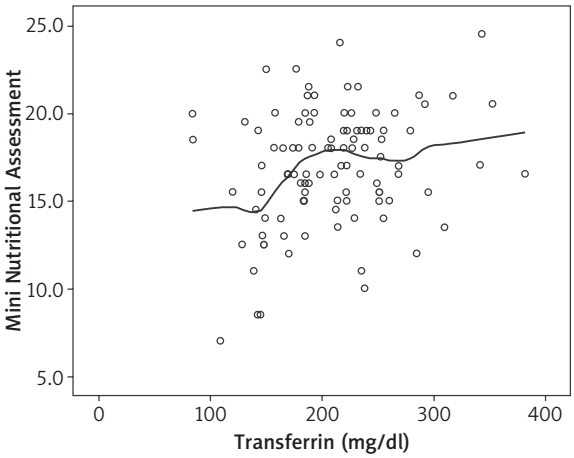

Figure 2. The relationship between transferrin level and the MNA scale

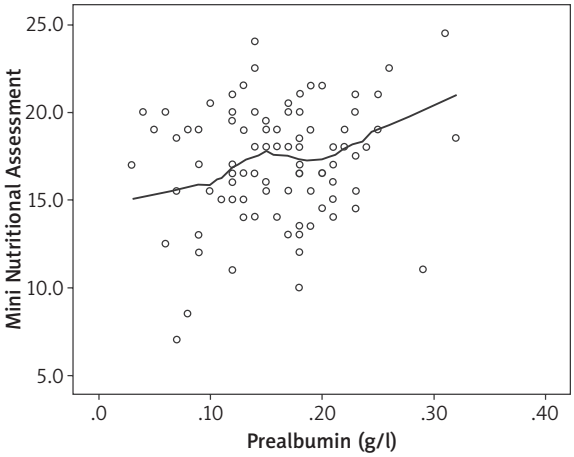

Figure 3. The relationship between prealbumin level and the MNA scale

of malnutrition according to MNA was significantly lower than in people at low risk of malnutrition. Similar results were observed in the case of diagnosed malnutrition based on SGA and NRS 2002 [22]. In this study, after attempting to include patients with acute diseases, the predictive value of albumin and prealbumin were lowered, confirming that they are also markers of inflammation. Nevertheless, the authors of the meta-analysis state that biomarkers of malnutrition, such as prealbumin and albumin, are easy to measure and may be useful as prognostic factors for further prognosis [23].

Transferrin is not only a nutritional biomarker clinically used to assess overall nutritional status, but is also a sensitive and specific marker of early iron deficiency [24]. In our study, based on the results of transferrin, malnutrition occurred in 46.2% of the examined people. Other studies showed a significantly lower number of malnourished people, at 13.7% [21] and 20.1% [25].

In our own research, based on TLC, 26.2% were diagnosed as improperly nourished people. A study conducted in an Italian nursing home showed 49% of people with low TLC levels, which indicates the occurrence of various degrees of malnutrition [21].

Another parameter that was taken into account in our study when assessing the nutritional status was BMI. Underweight was diagnosed in 36.5% of people staying in 24/7 institutions. Similar studies conducted among people living in a 24-hour care home showed 33.4% to be underweight [21]. In studies by other authors, underweight was found in 54.7% [14]. The results of these authors show that both BMI and TLC, albumin and prealbumin are reliable markers used interchangeably with other indicators of nutritional status [14, 21].

In our own study, an attempt was made to analyse 4 indicators: albumin, prealbumin, transferrin, and TLC. Similar results of transferrin and prealbumin were obtained only in severe and moderate malnutrition. After selecting the group of patients with malnutrition (regardless of the degree of malnutrition), the values of prealbumin largely coincided with the level of transferrin. Attempts were also made to compare transferrin and prealbumin with the MNA scale. Similar results were obtained in the correlations of these indicators. Thus, the results confirm that these parameters are effective indicators in the diagnosis of malnutrition, which is also reflected in the studies of other authors [23, 25].

Nutritional disorders associated to the greatest extent with the risk of malnutrition and malnutrition lead to various types of health disorders among the elderly. The immune system is impaired, there is limited physical and mental activity, the quality of life is reduced, and there is increased susceptibility to multi-disease and the related costs of treatment. It is important to undertake a nutritional survey in the elderly population to identify people at risk of malnutrition. This will allow the identification of people who require nutritional intervention, which may prevent the risk of complications resulting from malnutrition and help to assess the effectiveness of the proposed treatment. Our own study was conducted on a selected population, and the results of the research suggest that routine monitoring of parameters and their interpretation may be a useful tool for the assessment and supervision of nutritional status.

CONCLUSIONS

There is a high degree of malnutrition or the risk of malnutrition among the residents of inpatient care. The MNA scale, transferrin, and prealbumin confirm the effectiveness in the diagnosis of disorders in the nutritional status and the correctness of regular assessment of the nutritional status. People with diagnosed nutritional disorders should undergo nutritional intervention to prevent the consequences of malnutrition.

Disclosure

The authors declare no conflict of interest.

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