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Chapter

Malnutrition in the Elderly: A Recent Update

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Abstract

Malnutrition is a common problem in the elderly. Malnutrition prevalence has been reported to be between 5 and 10% in elderly living at home and quite more in hospitalized ones. It has been observed that elderly people in need of home care services face malnutrition problems more frequently than general elderly population. Elderly people cared by home care services, especially when they have chronic, mental, or physical disease, they are inclined to be at a higher risk for malnutrition. If malnutrition is not detected and properly managed, it makes it difficult to treat other existing, clinical diseases. On the other hand, it causes increase of complications related to the patient and accordingly prone to higher morbidity and mortality risks. Therefore, all the elderly patients admitted to home care service have to be examined and evaluated for malnutritition risk and managed accordingly.

Keywords: elderly people, malnutrition, geriatric syndrome, nutrition, malnutrition treatment

1. Introduction

Although the term malnutrition has a meaning that includes the condition of being overweight, according to Early Career Faculty The European Society for Clinical Nutrition and Metabolism (ESPEN), it is defined as physical changes in body composition as a result of clinically significant malnutrition, as well as body functions and clinical outcomes [1, 2]. As a result of malnutrition mentioned here, it causes changes in body composition (decrease in fat free mass [FFM] and body cell mass [BCM]) that affect the physical and mental functions of the person and the healing process from diseases. In clinical practice, in addition to the decrease in food supply, increased catabolism in the body after trauma and inflammatory diseases also causes malnutrition. An important point here is that while malnutrition caused by inadequate food intake is easier to correct, the negative energy and nitrogen balance in the catabolic phase of diseases cannot be reversed even with large amounts of food intake. Replacing the lost tissues is only possible by controlling the inflammation [3, 4]. For these reasons, when evaluating the risk of malnutrition in individuals, static measurements such as body mass index (BMI) and anthropometry are evaluated together with simple bedside measurements of disease severity and body functions (e.g., evaluation of mood, hand-wringing dynamometer, measurement of peak expiratory flow) [5]. According to this information, the definition of malnutrition is a combination of both
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Excessive and insufficient nutrition and inflammatory activity, and it is defined as a subacute or chronic nutritional disorder that causes changes in body composition and loss of functions [6]. Both definitions can be considered valid and should probably be used together because it is important for a definition to have a therapeutic feature to guide the clinician to select patients who would benefit from nutritional therapy. The process of identifying patients with nutritional problems begins with a rapid screening and continues with a detailed evaluation of those found to be at risk [7].

To diagnose an individual as being malnourished, two or more criteria of those need to be fulfilled: i) low energy intake, ii) weight loss, iii) loss of muscle mass, iv) loss of subcutaneous fat, v) fluid accumulation, and vi) hand grip [8]. Malnutrition is reported to be related with cognitive functioning in the elderly [9]. In addition, it is used to predict morbidity and mortality rate after surgical operations in critical elderly cases [10]. Also, it was shown that malnutrition increased the risk of readmission in hospitalized elderly patients [11].

2. Malnutrition in the elderly

The phenomenon of malnutrition in the elderly is more complex than that in the young ones and is a determinant of developing morbidity and mortality. It has been associated with adverse health conditions such as prolonged hospital stay, reduced quality of life, delays in wound healing, infection, and decreased functional capacity in these individuals. The prevalence of malnutrition was reported as 5–10% in the elderly living at home, as 30–60% in elderly residents of nursing homes, and as 35–65% in the elderly that have been hospitalized [12]. Considering that the daily energy requirement of people in this age group is 30 kcal/kg on average (in the absence of any stress situation under normal conditions), 50–60% of this energy should be planned to come from carbohydrates, 30% from fat, and 20% from proteins. While the daily protein requirement of a normal adult is 0.8–1.0 g/kg, the need is 1.0–1.2 g/kg per day under normal conditions, since muscle mass loss occurs in the elderly due to various reasons (sarcopenia) [13].

In cases of clinical diseases (such as infection, sepsis, cancer, etc.) that put the person in the acute catabolic process, the need for protein increases, and it can reach up to 1.5–2.0 g/kg per day. Vegetable proteins can be preferred as a protein source, but it is important to prefer animal proteins as they are limited in terms of both content and the presence of essential amino acids. Since most of the daily energy requirement is provided by carbohydrates, when its amount in the diet is reduced, it will cause fat and protein breakdown, which will lead to weight loss and sarcopenia. The omega-3 fatty acids in the dietary fat are important because of their anti-inflammatory character and positive effects on the cardiovascular system. On the other hand, it also has appetite-stimulating properties. Foods containing omega-3 fatty acids are fish, green vegetables, nuts, and walnuts. Adequate daily water consumption is also very important in old age. When this need is not met, it causes serious problems [13].

Dehydration and secondary medical emergencies to dehydration are responsible for a significant portion of hospitalizations in the elderly (e.g., acute renal failure, falls, arrhythmias, heart failure, electrolyte imbalance, etc.). The daily water requirement in the elderly is roughly 1 ml per kcal of daily energy requirement and is 30 ml per kg with another simple calculation. Another important nutrient is fiber (pulp). The first of the physiological changes that occur in the gastrointestinal system with aging is a decrease in movements. This problem can be partially solved by increasing the amount
of fiber in the diet. On the other hand, dietary fiber plays an important role in blood sugar regulation. Therefore, the daily diet of the elderly should contain at least 25 g of fiber. 37–40% of the elderly cannot be fed at a level to meet the daily energy requirement, two out of three elderly people skip a meal, and this situation has been described as "anorexia of aging" in recent years [13]. In the old age, the mortality rate increases by 9–38% within 1–2.5 years following the onset of weight loss for any reason [14]. In addition to the decrease in oral food intake, daily growth hormone secretion decreases by 29–70% with age, which leads to sarcopenia [15]. In the frail elderly, different factors can occur at the same time and affect food intake by interacting with each other, and in the process of food intake and digestion, imbalances, weight loss, and loss of function may occur in the acute and chronic periods; in other words, malnutrition may occur. In Table 1, possible causes for inadequate food intake and malnutrition are listed under four subunits: somatic, psychological, functional, and social [7].

An increase in the incidence of depression, stool incontinence, loss of cognitive function, and physical dependence has been detected, especially in those with malnutrition [16]. There has been a significant increase in the incidence of other geriatric syndromes in the elderly with malnutrition. The risk of malnutrition was found to be associated with the levels of depression, hematocrit, fasting plasma glucose, albumin, erythrocyte sedimentation rate, instrumental activities of daily living, patient addiction, and bone mineral density [16, 17]. There has been a significant increase in the incidence of other geriatric syndromes in the elderly with malnutrition [16]. Although the effect of malnutrition on our country's economy is not fully known, it can be estimated that its negative effects are very high. It is known that such problems and costs will increase with the increase in the elderly group and chronic diseases in the aging world and in our country. The results of multicenter nutrition and health research conducted at the national level in the elderly show that there is an inadequacy in the consumption of energy, protein, vitamins A, B1 and B2, niacin and vitamin C, and minerals such as iron, calcium, and zinc, both at home and in the elderly living in nursing homes. Although the incidence of folate and vitamin B12 insufficiency in the elderly is not known in the whole population, it is known that insufficiency of these two vitamins in older ages is an important cause of cardiovascular diseases [7].

2.1 Prevalence

In a study, the malnutrition rate was found as 5.8% in the elderly living in the community, as 13.8% in those living in nursing homes, and as 38.7% in those hospitalized. There was a significant relationship between malnutrition and dementia and sarcopenia. In that study, mini-nutritional assessment (MNA) is recommended for the evaluation of the nutritional status of the geriatric age group [13]. In the ESPEN recommendations published in 2002, it is recommended that all individuals over the age of 65 should be screened routinely in terms of nutrition. Similar recommendations are included in all ESPEN guidelines published in the following years [17]. In the framework of the decision taken by the European Parliament in 2007, obesity and malnutrition were accepted as the most important public health problem, and the issue was included in the official political agenda of the European Union in 2008. The year 2009 has been declared the year of fight against malnutrition by ESPEN. Based on all these data, the nutritional status of elderly individuals living in the community and hospitalized in clinics should be screened, and a treatment plan should be developed by making detailed evaluations in risky individuals [2, 7].
2.2 Effect of malnutrition on body functions

Hunger has important effects on the function and structure of organs. Loss rates of various organs have been demonstrated in a study conducted on autopsy of patients who died from manure [18]. According to the findings of that study, the heart and liver lost about 30% of their weight, while the spleen, kidney, and pancreas were also affected. In that study, 32 healthy men who underwent partial fasting for 24 weeks each lost 25% of their baseline body weight. Fat mass decreased to 30% of baseline, and FFM to 82% of baseline. Clinical observations have shown that the loss in FFM is greatest in skeletal muscle. In response to stress, muscle proteins are both precursors of gluconeogenesis and amino acid precursors for protein synthesis required for immune response and repair. This muscle wasting may be one reason why debilitated people have a higher risk of developing complications during acute illness or after surgery [2, 7, 19].

2.2.1 Mental function

In adults, hunger causes anxiety and depression, which may be due to specific micro and macronutrient deficiencies. Several large-scale epidemiological studies have shown a relationship between diet quality and the frequency of cognitive
impairment. Subclinical deficiencies of vitamins C, E, B12, B6, and folate, and changes in calcium, magnesium, and phosphate have been identified as nutritional-related risk factors for impaired brain functions [20].

2.2.2 Muscle function

Malnutrition causes a decrease in muscle strength and endurance. With a lack of food, muscle function decreases before any change in muscle mass occurs, then worsens as the amount of cells decreases. Conversely, through its effects on cell function, function improves by 10–20% in the first few days of refeeding. Then, over a period of weeks, the muscle mass is restored and gradually returns to normal. In addition to muscle wasting, inflammatory activity all reduces muscle strength, endurance, and mobility. Muscle strength is a combined measure of muscle mass and inflammatory activity and is therefore a useful risk factor for quality of life and ability to cope with trauma and disease. The hand-grip dynamometer, which measures voluntary muscle strength, is a useful clinical tool for nutritional assessment and has been found to be correlated with surgical outcomes and clinical improvement [6].

2.2.3 Cardiovascular function

Prolonged and severe malnutrition causes cardiac muscle wasting with decreased cardiac output, bradycardia, and hypotension. The reduction in heart volume, 40% of which is due to the reduction in heart muscle, is proportional to body weight loss. Decreased ventricular volume may explain the remaining 60%. In severely depleted patients, exercise tolerance is impaired and peripheral circulatory failure may also develop. Specific deficiencies such as vitamin B1 may lead to heart failure (wet beriberi), and mineral and electrolyte disturbances may lead to cardiac arrhythmias [21].

2.2.4 Renal functions

It has been reported that malnutrition causes significant changes in renal hemodynamics with a decrease in renal plasma flow and glomerular filtration rate, as well as a decrease in the capacity of concentrating urine and removing acid load. The capacity to remove excess water and salt load is also reduced, and the extravascular fluid volume makes up a larger-than-normal body part. Together with other malnutrition-related changes, these cause “hunger edema” [5].

2.2.5 Respiratory function

Protein loss of more than 20% affects the structure and function of respiratory muscles. This is accompanied by a decrease in diaphragmatic muscle mass, maximal voluntary ventilation, and respiratory muscle strength. Impaired neural respiratory power also affects ventilation. Exhausted individuals have impaired response to hypoxia and hypercapnia, altered respiratory pattern, and morphological changes in the pulmonary parenchyma. It is quite difficult to separate the patients from the ventilator. Bronchopneumonia is common in such patients, resulting in hypoventilation, inability to cough effectively, and impaired resistance to spreading microbes [5].
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2.2.6 Gastrointestinal system

The most prominent effect of acute and chronic food starvation in the small intestine is a decrease in the absorption surface area. Impaired absorption of lipids, disaccharides, and glucose has been demonstrated in severely depleted patients. There is also a decrease in the production of gastric, pancreatic, and biliary secretions, which also contribute to malabsorption. As a result of these changes, severely malnourished patients often suffer diarrhea that is added to the malnutrition, and a vicious cycle begins. Changes in the bacterial flora or significant intestinal infections add to malabsorption and diarrhea. All gastrointestinal changes associated with malnutrition lead to inflammation and impaired intestinal barrier function. In chronic cases, this leads to liver steatosis or worse, steatohepatitis [5].

2.2.7 Thermoregulation

Severe weight loss impairs the thermogenic response to fasting and cold, and fasting for more than 48 hours reduces vasoconstrictive responses. These changes predispose to mild hypothermia with important clinical consequences. A decrease of only 1–2°C in core body temperature leads to impaired cognitive functions, incoordination, confusion, and muscle weakness, which tends to decline, especially in the elderly. In cases of severe famine, the fever response is lost, and there may be no fever even in the presence of life-threatening infection. Loss of thermoregulation returns after refeeding [5].

2.2.8 Immune system

Malnutrition itself affects nearly all immune response systems, but particularly impairs cellular immunity and resistance to infection. As a result of decreased immunity, susceptibility to infections increases, and the ability to cope with trauma and infection decreases. Annually, people with a BMI below 18.5 kg/m² tend to be sick more days than most people with a BMI above 18.5 kg/m² [21].

2.2.9 Wound healing

Malnutrition, and especially in the last period, low food intake, delays wound healing in surgical patients. Low body mass index, low body weight, and decreased food intake have been shown as independent risk factors for the development of pressure ulcers. An adequate diet improves wound healing in a week. There is evidence that nutritional support reduces the incidence of pressure ulcer development and that patients receiving high protein supplementation tend to have better healing of pressure ulcers [22].

2.2.10 Quality of life

Good nutrition improves quality of life, food itself not only provides sensory and psychological satisfaction, but also depends on it for mental and physical well-being. The consequences of malnutrition include progressive physical, mental, and social disability, and an increased propensity for diseases and their worsening [5].
2.3 Diagnosis in malnutrition

Before making a diagnosis of malnutrition, risk groups should be screened. Screening tests are used for this. With these tests, people to be investigated for the diagnosis of malnutrition are determined [5].

2.3.1 Screening

A good screening method should be simple to implement quickly and easily by practitioners, as well as have criteria such as predictive validity, content validity, and reliability, and should provide a correct orientation for diagnosis. For this purpose, many malnutrition screening methods have been developed recently. These methods include questions about weight, recent weight loss, if any, and food intake. At the same time, weight, height, net measurements, and BMI calculation are used in these methods [23, 24].

2.3.2 Screening methods

Malnutrition Screening Tool (MST) and Short Nutritional Assessment Questionnaire (SNAQ) can be given as examples of short, easily applicable screening methods that can be used in malnutrition screening. Some screening methods, on the other hand, are considered as an evaluation method, not a screening method, since they include inquiries such as clinical status, physical examination, disease severity, and food amount. Subjective Global Assessment (SGA) is one of these assessment methods. SGA has been used as a screening method for more than 20 years and is used as a reference in the development of new methods. Nutritional Risk Screening (NRS2002) supported by ESPEN and Malnutrition Universal Screening Tool (MUST) developed by British Association for Parenteral and Enteral Nutrition (BAPEN) are other screening methods widely used in Europe. Simple training is needed for the use of SGA, NRS-2002, and MUST [23, 24]. Some of these screening methods are more suitable for different patient categories. For example, NRS-2002 or MUST, SNAQ, or MST is more suitable methods for hospitalized adult patients. For community surveys, it has proven its MUST value. For the elderly in the hospital or community, MNA and its short form MNA-SF are suitable [25]. The patients whose malnutrition will be evaluated with screening tests are determined and the evaluation phase is started.

2.4 Evaluation of malnutrition

Nutritional evaluation is a more detailed and time-consuming evaluation process by dietitians, nurses, or doctors experienced in clinical nutrition of patients who are determined to be in the risk group in nutritional screening. Thus, an approach plan can be created that includes continuous monitoring and an appropriate treatment approach. Malnutrition assessment should include the following principles:

- Nutrient balance measurement
- Body composition measurement
- Inflammatory activity measurement
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• Body functions measurement

• Laboratory tests [23–25].

2.4.1 Nutrient balance measurement

All potential factors that may cause malnutrition should be identified, and the course of the patient's condition should be predicted. Weight loss, food intake, appetite status, fluid balance, gastrointestinal symptoms, fever, various food losses, medical and drug use history should be evaluated. Detailed and accurate information about food intake is critical for the assessment of nutritional status. A dietary history should include qualitative as well as quantitative aspects to assess energy, protein, and micronutrient intake, as well as to estimate whether there is improvement or deterioration in the patient's nutritional status by comparison with predicted requirements. Making a good quality assessment is time-consuming and requires the specific experience of trained personnel. Evaluation of the diet in the last 24 hours reveals the current situation, while questioning the dietary history gives an idea for longer periods. Food diaries are indicative of individual intake, but to be fully reliable the questioner must ask additional questions. This type of query is only meaningful when used for the target population. Fluid balance is an intrinsic part of nutritional assessment. Physical examination should be performed to detect dehydration and edema. For this purpose, fluid balance records should be kept and blood creatinine, urea, and electrolyte levels should be measured when clinical indications are available [5]. Although it is not very common in daily practice, the energy requirement can best be determined by indirect calorimetry. There are many equations for estimating the energy requirement, but most of them deviate significantly from the actual values determined by indirect calorimetry. Isolated deficiencies can be determined by laboratory tests. Examples of these are minerals (i.e., K, Ca, Mg, Zn, Fe), vitamins, and trace elements [26].

2.4.2 Body composition measurement

Body weight, height, and calculated BMI are key measurements that should always be determined. Other anthropometric measurements, although easy, have not been popular. Anthropometric techniques measuring body compartments (fat free mass [FFM], fat mass [FM], skinfold thickness [TSFT], mid-arm muscle circumference [MAMC]) have been used in many studies. They may be useful in conditions where weight is difficult (i.e., elderly people with a fractured femur) [26].

2.4.3 Inflammatory activity measurement

The status of malnutrition should be determined not only by anamnesis, physical examination, and bedside measurements such as fever, pulse, and blood pressure, but also by laboratory tests such as hemoglobin, complete blood count, serum albumin, and c-reactive protein, which show the severity of inflammation [22].

2.4.4 Body functions measurement

Physical dysfunction related to malnutrition can be measured at the bedside with simple measurements that can identify the initial condition and allow monitoring. Evaluation of skeletal muscle function is important as it is sensitive to changes in
muscle mass and food intake. Improvements in muscle strength occur within 2–3 days of starting nutritional support, but are not accompanied by an increase in muscle mass. Conversely, with total starvation, decreases in muscle strength begin within a few days. Muscle functions can be evaluated qualitatively by anamnesis and examination, as well as reductions in daily living activities and strength of handshake. The simplest quantitative measurement is with a handheld dynamometer, which correlates very well with clinical outcomes in surgical patients. Changes in respiratory muscle strength can be assessed by serial FEV1 measurements, bearing in mind that of course this also reflects changes in airway resistance. Evaluation of cognitive functions is not common. Malnourished patients exhibit a reversible deterioration in cognitive functions and mood. Using a valid mental scoring technique such as profile of mood states (POMS) or Mini-Mental State Examination (MMSE), mood swings should be scored and changes with treatment should be recorded [27, 28].

2.4.5 Methods used in nutritional evaluation

2.4.5.1 Anthropometric measurement

This measurement shows anatomical changes related to changes in body malnutrition status.

2.4.5.2 Body weight measurement

Changes in body weight in the short term reflect fluid balance and are the most important measure of fluid balance. Long-term changes in body weight, on the other hand, may reflect net changes in true tissue mass, but do not provide information about compositional changes. Involuntary weight loss in the last 3–6 months is considered mild if it is less than 5%, and if it is more than 10–15%, it is considered as an indicator of a severe nutritional change. Even if significant body weight has been lost in the past year, this does not reflect malnutrition if the lost body weight has recently been regained. However, if the loss of body weight continues, the clinician should investigate the reasons for this. Measured body weight is an important variable in calculating metabolic rate, nutritional requirement, and drug doses. Compared with indirect calorimetry, it is more accurate to use ideal body weight for calculations in overweight or underweight individuals, even though the metabolic rate estimates obtained with the equations may show deviations of up to 28%. Weight divided by ideal weight gives “percent of ideal body weight.” Reference tables are available for individuals of the same age and sex, giving the ideal weight specific to the North American population. Ideal weights are determined by American health insurance companies on the basis of minimum health expenses [5, 18].

2.4.5.3 Body mass index

It is another measure to evaluate malnutrition. It is expressed according to the formula below. Although it has a narrow normal range, it offers a wide range that allows comparison in both sexes and age groups.

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height X Height} \ (\text{mxm})}$$

The result obtained is interpreted according to the following values:
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- 30< obese
- 25–30 overweight
- 20–25 normal
- 18–20 possible malnutrition
- 23.5< indicates adequate nutritional status.

If the BMI is less than 12 in men and 10 in women, survival is rare. If the body mass index is below 20, mortality increases. As a result of osteoporosis in the elderly, this range is increased with a decrease in height, and a BMI lower than 22 indicates malnutrition. If the patient has recently complained of involuntary weight loss, this is associated with malnutrition, even if the BMI is obese or even within the normal range. Estimated height can be calculated by adjusting age and knee height measurements according to gender in patients, elderly and frail people, or in cases of scoliosis or kyphosis and when height measurement cannot be performed [5].

2.4.5.4 Mid-upper arm circumference (MUAC), triceps skinfold thickness (TSF)

Mid-upper arm circumference (MUAC) is measured from the midpoint of the acromion and olecranon prominence using a tape measure. This measurement process is very easy and the margin of error is very small. It is a useful measurement method that replaces weight measurement in situations where weight measurement is impossible. Low measurement values correlate well with mortality, morbidity, and response to nutritional support. It has been determined that MUAC is a better predictor of mortality than BMI in the elderly population. The value obtained as a result of the upper middle arm circumference measurement; it reflects the sum of tissue, bone, muscle, fluid, and fat mass. However, useful correlations of muscle and fat mass can be obtained when triceps is used together with the measurement of skinfold thickness [5].

2.4.6 Advanced functional tests

2.4.6.1 Direct muscle stimulation

It provides the drawing of force frequency curves as a result of direct measurement of contraction, relaxation, and force by electrical stimulation of the adductor pollicis muscle. It can detect early changes with starvation and refeeding [5].

2.4.6.2 Respiratory function

Besides measuring airway resistance, FEV1 reflects the strength of respiratory muscles. Expiratory and inspiratory force against resistance can also be measured. Hill demonstrated a strong correlation between respiratory function and total body proteins after a rapid loss of 20% in body proteins [5].

2.4.6.3 Immune function

Severe protein energy malnutrition results in impairment of all factors such as cellular immunity, phagocyte function, complement system, secretory IgA, antibody
concentrations, and cytokine production. Deficiency of some nutrients (e.g., zinc, selenium, iron, and vitamins A, C, E, B6) also alters the immune response. In the presence of malnutrition, leukocyte functions, antibody secretion, and complement levels may also be impaired [7, 29].

2.4.7 Laboratory tests

2.4.7.1 Serum albumin level

Although a good indicator of surgical risk and a good reflection of disease severity, it does not reflect malnutrition, contrary to popular belief. Delays in normalization of serum albumin during acute illness may be affected by energy and protein intake. Serum albumin is mainly affected by distribution and dilution. This is due to the increased rate of albumin escape from the circulation in relation to the cytokine response to injury and the dilution resulting from the increase in extravascular volume. Albumin has a long metabolic half-life of 18 days, the metabolic effects on its concentration take time to appear. In fact, the normal outflow of albumin from the circulation and its return through the lymphatics is approximately 10 times the synthesis rate [5, 7].

Proteins with shorter half-lives are affected by distribution and dilution, such as transthyretin (2 days) and transferrin (7 days) albumin. Transthyretin more accurately reflects recent food intake, but is not a good indicator of nutritional status. Therefore, these parameters are rarely included in a complete nutritional assessment [5, 7].

2.4.7.2 Other tests

Liver enzyme tests, creatinine, urea and electrolyte levels, calcium, phosphate, and magnesium levels should be measured routinely and recorded regularly. It is useful to know the zinc, selenium, and iron levels in the diagnosis of gastrointestinal diseases. C-reactive protein is useful for assessing acute inflammatory activity, but is not reliable for chronic inflammation or recovery from acute inflammation [5, 7].

2.4.7.3 Creatinine

Urinary excretion of creatinine reflects muscle mass. Urinary excretion of creatinine is high in weight lifters with a large muscle mass and low in malnourished patients. The creatinine excretion in 24 hours is used to calculate the creatinine height index (CHI).

\[
\text{CHI}(%)= \left( \frac{\text{24 - hour persistence creatinine}}{\text{height}} \right) \times 100
\]

This formula is used to reflect muscle mass. If the deficit in muscle mass is 5–15%, it is mild, if it is between 15 and 30%, it is moderate, and if it is more than 30%, it indicates a severe nutritional deterioration.

Nitrogen balance is one of the most frequently used research methods in clinical practice, which always overestimates the intake and underestimates the losses from urine, faeces, and wounds. For total nitrogen, the Kjeldahl technique is better than inferring from urine urea. Under normal conditions, urea contains 80% of urinary
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nitrogen, but this ratio varies with malnutrition and disease. Nevertheless, large changes in urinary urea excretion are useful in demonstrating changes in net protein catabolism and are a simple method to apply in intensive care. Decreased protein turnover with fasting is characterized by low serum urea concentration if patients are well hydrated [5, 7].

2.5 Saving data

It is absolutely essential that the data obtained by monitoring at the beginning and maintenance of nutritional support be recorded in a digital environment or on paper and be easily accessible for control when necessary. Thus, absolute values or trends can be easily monitored and decisions can be made quickly when necessary. In order to better reflect the clinical situation, the correlation or combination of various parameters paves the way for more effective predictions [5].

2.6 Evaluation of results and diagnosis

Today, there are many tools available for screening and diagnosing malnutrition. To prevent misuse, it is important to know how they were developed and for which specific patient population and department of care they were evaluated. The methods used in screening and diagnosis are important in recognizing the disease with malnutrition, finding the underlying causes of malnutrition, and evaluating the consequences of malnutrition [30, 31]. Screening instruments are short, time-consuming, easy for the patient, and often do not require the expertise of the personnel performing these tasks. Screening tools often indicate only malnutrition. For patients at risk, it is necessary to learn more about the cause, severity, and pattern of malnutrition (such as protein-energy malnutrition, vitamins, and minerals) [32, 33].

The tests used in the diagnosis of malnutrition give an opinion about the severity and type of malnutrition and the underlying factors. Diagnostic tools are more complex in shape than screening tools, take more time, and require more experienced personnel. The results of the laboratory and/or clinical research may form part of this evaluation [33, 34].

The most commonly used assessment tool specifically for malnutrition in the elderly is the Mini Nutritional Assessment test (MNA) [1, 32]. Subjective global assessment is another test that is accepted as a basis by the social security institution and is frequently and widely used in the screening and diagnosis of malnutrition. Comprehensive geriatric assessment is a method that ensures that many problems of an elderly person are evaluated and followed up as effectively as possible. Comprehensive Geriatric Evaluation is put into practice in order to obtain a full-fledged result in terms of the geriatric patient’s condition. Thus, the patient is evaluated in terms of somatic, psychological, social, and functional aspects, and an integral treatment plan is created for the patient to manage himself and improve his quality of life [35, 36]. Malnutrition is a geriatric syndrome and must be included in a comprehensive geriatric evaluation. Comprehensive geriatric evaluation also evaluates the relationship of malnutrition with other somatic, psychological, social, and functional conditions. MNA is recommended in the evaluation of malnutrition in the elderly. MNA is a valid method for detecting malnutrition in clinical as well as outpatients. The MNA is also a valid tool for evaluating the results of nutritional support treatments. MNA is accepted as a valid measurement tool for detecting malnutrition
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in geriatric patients, as well as a valid tool for predetermining the risk of malnutrition. ESPEN recommends MNA as an examination tool for the elderly [32, 37]. It is a tool that must be used in SGA and has practical benefits.

2.6.1 MNA form

The MNA begins with six screening questions (questions A-F1/F2), which are MNA-Short form (MNA-SF) with a maximum of 14 points. These questions relate to the patient's food intake, weight loss, mobility, psychological stress or acute illness, depression or memory problems, and determination of BMI. If BMI cannot be measured, it has been proven that the use of calf circumference may be appropriate [38]. If a score of less than 12 points is obtained as a result of this questioning, it is recommended to continue with the other questions (questions G-S). These questions are related to residence status, medication use, presence of pressure sores or skin inflammation, eating meals and protein and fluid intake, patient's own opinion according to nutrition and health status, and some extra anthropometric measurements [32, 37]. This will be the final MNA-score: <17 means malnutrition, 17–23.5 means malnutrition risk, and >23.5 indicates adequate nutritional status. Fill in the “Examination” section of the form. If the total score is 11 or less, proceed to the questions under the “Research” section to determine the score for the Nutritional Malnutrition Indicator. The administration of MNA-SF takes less than 5 minutes, while the administration of full MNA requires 10–15 minutes. SGA is also a very useful and frequently applied test. In the current situation, it is frequently used in diagnosis. However, it includes subjectivity in practice. SGA is one of the easy and practical methods in determining the nutritional status of individuals. It is one of the tests required to be specified when a report is issued for the reimbursement of malnutrition products. It includes evaluation criteria such as the patient's history (weight loss, change in food intake, gastrointestinal symptoms, and functional status), physical tests (muscle mass, subcutaneous fat, sacral and foot edema, ascites). Does not include SGA lab data. It is thought that adding this information to the test will not affect the performance of the test in detecting malnutrition. It has been reported that the weight index is the main factor affecting the subjective evaluation. The feature of this screening test is that it can be used in the elderly population. In long-term care, it has been found to be a useful assessment tool in identifying the elderly at high risk for complications associated with changes in nutritional levels (major infections, pressure sores, and mortality) [38–41].

2.6.2 Tests used for inpatients

Malnutrition Universal Screening Tool (MUST) [20], Short Nutritional Assessment Questionnaire (SNAQ) [42], Nutritional Risk Screening (NRS2002) [19]

2.6.3 Tests used for outpatients

Mini Nutritional Assessment Test Short Form (MNA-SF) [25, 32], Subjective Global Assessment (SGA).

In addition, using anthropometric measurements other than BMI will provide additional contributions in detecting malnutrition and the underlying causes of malnutrition [43].
2.6.4 Practical meaning

Comprehensive geriatric assessment consists of the following sections:

- Medical history
- Family interview
- Functional anamnesis
- Social history
- Physical examination
- Clinical measuring instruments
- Laboratory research

History is a standard part of Comprehensive Geriatric Evaluation. In anamnesis; decreased appetite, decreased sense of smell or taste, weight loss, nausea, vomiting, diarrhea, chewing and swallowing problems should be questioned. However, indicators of malnutrition can be found in all parts of the comprehensive geriatric assessment. Being in need of care in the functional history is a risk factor for malnutrition. In the social anamnesis, living alone or not having a caregiver who takes care of the needs of the elderly is known as a risk for malnutrition. In the physical examination, information about the nutritional status can be obtained by determining the clinical evaluation of the patient's nutrition and hydration status (weak, cachectic, dry axilla and mouth), height, weight, and BMI. By looking at muscle mass (atrophy, sarcopenia) and muscle strength, information about the symptoms and possible consequences of malnutrition can be obtained. Based on the results of the comprehensive geriatric assessment and MNA, the patient's problem list should include data on malnutrition problem or risk in malnutrition. At the same time, the most important factors that reveal the problem of malnutrition from both results will be seen. These factors may be, for example, reduced self-care and malnutrition due to moderate to severe dementia. In such a case, a nutrition plan should be drawn and followed during the patient's hospitalization or discharge. The treatment plan is aimed at adequate food intake on the one hand and treating the factors that cause it, on the other. For example, when such a patient goes home after being discharged from the hospital, he should be kept under control while taking his meals, and the meals given to him should be enriched with energy and nutrients, and he should be weighed and checked on a weekly basis during the home care period. However, many of the elderly patients do not know exactly how much weight loss occurs, it is not always possible to measure weight in polyclinic conditions, or it is not possible to measure the weight of bedridden patients. In such cases, the use of other acceptable anthropometric measurements such as calf measurement, skinfold thickness measurement instead of weight and body mass index will facilitate the work of doctors, patients, and patient relatives, especially in order to provide easier nutrition products for patients. It would be appropriate to define these measurements in the national health network system and include them in the scope of reimbursement [30, 43].
2.7 Treatment

Nutritional support treatment should be planned for patients with malnutrition or risk of malnutrition as a result of screening and evaluation. This can be done in two ways:

- First of all, in those who can take oral food, a diet is arranged in line with the daily calorie needs by consulting the diet unit of the clinic. Considering the patient's preferences is the determinant of success; but unfortunately, since a rich diet kitchen is not possible in our hospitals today, adequate support cannot be provided in this way.

- The second way is supportive treatment with enteral and/or parenteral nutrition products.

Enteral nutrition is essential in this treatment modality, but this is not always sufficient or possible, so it is sometimes supplemented with parenteral nutrition therapy. Enteral nutrition routes are oral enteral, nasoenteral, and enterocutaneous routes. Nasogastric or nasointestinal feeding tube can be used for the nasoenteral route. Silicone or polyurethane tubes should be preferred. Enterocutaneous routes are percutaneous endoscopic gastrostomy (PEG) and percutaneous endoscopic jejunostomy (PEJ). Sometimes the jejunum can be reached through a tube extended from the PEG (PEG-J). In the geriatric part of the enteral nutrition guide published by ESPEN in 2006, it is emphasized that oral nutritional support should be provided as much as possible in the frail elderly during the selection of the nutrition route. In the presence of neurological dysphagia, it is recommended to choose one of the enteral nutrition routes, choose products with fiber content, and give products with high protein content in the presence of pressure sores. It was emphasized that oral or tube feeding therapy should be given in patients with early and moderate dementia, and tube feeding should not be preferred in patients with advanced dementia. It is also recommended not to apply tube feeding in terminal stage cancer patients. PEG is recommended for patients who require long-term tube feeding (>4 weeks) [30]. After choosing the nutritional route, the daily energy requirement should be calculated, and then the amount of support to be given daily should be calculated by considering the oral food intake. The daily energy requirement can be found by adding the basal energy requirement, the activity factor, and the stress factor. We use practical formulas to calculate basal energy requirement. The most accurate way is to measure with an indirect calorimeter. The use of formulas saves time and is cost-effective and must be within ±10% standard deviation from actual measurements. The most commonly used formula is the Harris-Benedict formula. Calculation is made using weight, height, and age. After the basal energy requirement is found, the stress factor is determined by looking at the clinical disease and clinical findings and added to the basal energy requirement [44].

After calculating the daily energy requirement, two ways can be used to calculate the current deficit:

- In the first, the patient is advised to list what they eat and the daily calorie intake is calculated from this list.

- The other way is to question the ratio of the amount of food consumed today compared with the past. It is asked whether it consumes half of it compared with
before, and then it is not satisfied with it, and it is questioned in more detail whether it is less or more. A ratio that can be obtained from here will approximately show the amount of energy it receives over the daily energy requirement. After calculating the daily calorie deficit, daily protein needs and water needs should be calculated. In addition, in the presence of special conditions (diabetes, cancer, sepsis, chronic kidney failure, congestive heart failure, etc.), appropriate nutrient ratios should be determined. Fibers gain importance in the maintenance of gastrointestinal system motility in elderly patients, and fiber should be added to the diet. During enteral nutrition, it is important to choose the appropriate product according to the clinical situation. Under normal conditions, standard products with different flavors are preferred, and special products are used in unusual cases. Standard products usually contain 1 kcal per 1 ml. They have moderate osmolarity and good tolerability. Nutrient ratios are at the levels of carbohydrate 50%, fat 30%, and protein 20%. They contain essential nutrients as well as vitamins and trace elements. Diabetic products contain less carbohydrate and molecules with lower glycemic indexes such as fructose, isomaltose, and maltodextrin are chosen. High-energy products are preferred in patients who need fluid restriction (1 ml=1.5–2 kcal). For this reason, their osmolarity is also high, tolerability is more difficult. Protein content is higher in protein-rich products. There are various soluble or insoluble fibers in fiber-rich products. While these fibers contribute to motility on the one hand, they also create a prebiotic effect. When tolerance cannot be achieved in others, products with low osmolarity may be preferred. Their osmolarity varies between 240 and 300 mosm/l. There are products developed for use in cancer cachexia and inflammatory diseases and containing various immunonutrition products (glutamine, arginine, RNA, eicosapentaenoic acid (EPA)). There are data showing that they are especially beneficial in cancer cachexia, they are appetizing. While glutamine stands out in terms of gastrointestinal system tolerability, antioxidant properties and anti-inflammatory contribution on the immune system, arginine in wound healing and EPA in increasing appetite gain importance. In various diseases in which intestinal absorption is affected, products containing semi-elementary and elementary molecules can be preferred. For example, medium-chain fatty acids (MCTs) are absorbed from the intestine, while they do not need lipoprotein lipase and are absorbed directly from the mucosa without the need for micelles and reach the liver by mixing directly with the portal system. It can be especially useful in conditions such as short bowel syndrome, inflammatory bowel disease, and cholestasis. Recently, support products consisting of combinations of arginine, glutamine, leucine, and its 52 metabolite hydroxy methyl butyrate (HMB), which are known to be effective in the healing of pressure sores, have taken their place in the market. In particular, HMB not only triggers collagen synthesis and protein synthesis, but also stops protein degradation, and is 200 times more potent than leucine, of which it is a metabolite. After calculating the daily energy deficit and choosing the appropriate enteral nutrition product, the first thing to do is how quickly this product should be given or how long it takes to reach the target volume. Because reaching the target quickly may cause complications such as tolerance disorders, vomiting, diarrhea, and aspiration. Generally, the recommended target amount is to be reached in 7–10 days. The preference of oral enteral products in low-volume boxes is positive in terms of patient compliance. Aroma differences arise between societies. While fruity flavors are preferred more in Turkish society, vanilla and coffee can be tolerated better in Western
societies. Products produced for tube support therapy should not be given orally. Nausea, vomiting, and diarrhea are the most common symptoms during treat-
ment. For nausea and vomiting, treatment should not be stopped immediately, products that accelerate gastric emptying time and increase intestinal motility can be used. On the other hand, the amount of product may be reduced for a while or a different product may be tried. When diarrhea occurs, first of all, the presence of infection should be investigated by stool analysis. In some cases, treatments that suppress bowel movements can be given (such as loperamide in short bowel syndrome). Since the risk of aspiration will increase in the elderly and those with neurological diseases, gastric residual determination should be made, especially in tube feds. In the presence of 200 cc or more residue, the amount or speed of outgoing product should be reduced, or the product should be changed in the same way or supportive treatments should be added. During bolus applications during tube feeding, 25–50 cc of water should be given in front of and behind the product, and during infusion therapy, the outgoing product should be stopped at regular intervals and water should be given again. The same is true with PEG. In patients fed from the jejunum, hypo-osmolar products or water should not be given directly. Bolus administration should not be done. Only infusion therapy can be given. In all cases, the patient's head should be kept at a height of 30–400 meters. In cases where enteral nutrition is not possible or insufficient, parenteral therapy should be applied. There are two types; peripherally administered and centrally administered. The main difference between the products applied in both ways is the calories and fat they contain in unit volume. While there is 0.6–0.7 kcal in ml of products administered centrally, there is 1 kcal in ml of products administered via central route. Fats are molecules suitable for central administration. They are found in peripherally applied products at low rates. The standard oil used in parenteral products is soybean oil. Over time, olive-oil-based products, mixtures containing medium-
chain fatty acids, and mixtures containing fish oil have been introduced to the market. Mixtures containing fish oil stand out with their high EPA content and their anti-inflammatory effects are known. Again, while an anti-inflammatory effect is observed in products containing olive oil, it has been reported in some articles that it can prevent fatty liver [44].

3. Cancer patients and malnutrition

Cancer usually occurs with advanced age. One of the most important reasons for weight loss in cancer patients is a decrease in food intake. Many factors cause this: Loss of appetite (tumor burden, treatment, depression), early satiety (gastrointestinal tract), other GI symptoms (nausea, vomiting), odynophagia (mucositis, fungal/viral esophagitis), dry mouth, dysphagia, chewing difficulty in reaching food as a result of a decrease in daily life activities, pain, and deterioration in quality of life. Poor oral hygiene, loss of teeth, space-occupying lesion, especially in tumors related to the gastrointestinal system, and due to the treatment that occurs or is used in the course of the disease (radiotherapy acute/chronic effect, chemotherapy-mucositis) loss of appetite can be seen as a result of side effects [44]. It causes some changes in carbohydrate, lipid, and protein metabolism. With the decrease in insulin sensitivity, impaired glucose tolerance develops, gluconeogenesis increases, and serum lactate level rises. Lipolysis increases and serum triglyceride levels increase
and lipoprotein lipase activity may decrease. Negative nitrogen balance occurs as a result of excessive protein degradation. Proteolysis triggering factor and lipid mobilizing factor released by tumor cells cause excessive muscle destruction and lipolysis in the hypercatabolic process, and cytokines (TNF-alpha, IL-1, IL-6) oversynthesized by the body contribute to this [45]. A correlation was found between IL-6 level and disease stage, acute phase response, and malnutrition status in patients with lung cancer [46]. A relationship was found between TNF-alpha, reduced oxygen products, reduced glutathione and vitamin E levels, and the development of anorexia-cachexia syndrome [47]. Circulating TNF levels were found to be higher, and serum albumin and IGF-1 levels were found to be lower in those with weight loss of >10% [48]. A relationship was found between anorexia-cachexia syndrome and parathormone-related peptide (PTHrP) levels, and it was understood that weight loss stopped and weight gain occurred when PTHrP was neutralized [49].

The ESPEN guideline states that “the nutritional status of cancer patients should be evaluated at frequent intervals and supportive treatment should be started early when deficiency is detected.” There is no routine enteral nutritional support during chemotherapy and/or radiotherapy. Enteral nutrition should be started to make up the difference between the need and the calories taken from the diet, and 1.2–2.0 g/kg/day protein support should be provided during the treatment. It has been stated that there is no clear data that standard products can be given, immunonutrition products and antioxidant vitamins increase survival. In cases where enteral nutrition is not possible or insufficient, parenteral nutrition should be given [50].

4. Neurological diseases and malnutrition

Neurological diseases known to cause malnutrition include Alzheimer’s disease, Parkinson’s disease, myastenia gravis, cerebrovascular accident, multiple sclerosis, and amyotrophic lateral sclerosis. Severe dysphagia may occur in the course of these diseases. The most important causes of malnutrition developing in the course of neurological diseases are depression, impaired self-care, difficulty in swallowing, and drugs. The result is muscle atrophy (extremity/respiratory), pressure sores, falls, osteoporosis, infection risk, and reduced survival. In the presence of cerebrovascular accident, malnutrition is diagnosed in 15% of patients at the time of admission, 22–35% in the second week, and in 50% of the patients during follow-up. In the presence of swallowing dysfunction, the risk of food aspiration increases and may result in death. It may be undesirable to give oral food before the first 48 hours of consciousness change. In a study comparing nasogastric catheter vs. PEG application in patients with dysphagia as a result of acute stroke, mortality rates increased nearly five times in those fed with nasogastric feeding tube [51]. Before the tube is inserted, the patient should be evaluated in detail and the indication for long-term supportive treatment should be discussed. In this case, 55 PEG (percutaneous endoscopic gastrostomy) should be inserted instead of the tube. In theory, tube enteral nutrition should be used for a maximum of 6 weeks, and PEG should be preferred in cases exceeding this. On the other hand, malnutrition causes pressure ulcer development. In the ESPEN guideline, enteral nutrition is recommended for those with severe neurological dysphagia, oral nutritional support therapy, or tube feeding is recommended for patients with early-middle stage dementia, and tube feeding is not recommended for advanced dementia. Supportive therapy with high protein content regresses pressure sores. It is stated that PEG should be inserted instead of long-term tube feeding [52].
5. What else should we pay attention in malnutrition?

Efficacy should be considered during enteral or parenteral nutrition therapy. Apart from the improvement in general condition, weight gain, increase in serum proteins, and decrease in acute phase response are good indicators of treatment success. Close monitoring of potential side effects is important for treatment success. Especially in cachectic patients who have lost weight for a long time, rapid supportive treatment may cause serious metabolic complications. “Re-feeding syndrome” in which one or more of the conditions such as severe electrolyte imbalances, osmolarity changes, arrhythmias, overload, dehydration, acute kidney failure, sudden death, hyperglycemia, hypoglycemia can be seen together can be fatal. The most important way to prevent this is to reach the target calorie requirement slowly, especially in cachectic patients, this time can be much longer. “Re-feeding syndrome” is more common in such patients, especially during parenteral nutrition. In the follow-up, daily blood glucose monitoring, 2–3 times a week electrolyte, Blood Urea Nitrogen, creatinine monitoring (especially potassium, phosphorus and magnesium) are recommended. Trace element and vitamin support should not be forgotten during parenteral therapy. Thiamine deficiency is common in prolonged fasting. It can cause serious neurological disorders (i.e., Beri-beri) [44].
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