

NUTRITION IN ADVANCED AGE POPULATION

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Abstract

Nutritional status of an individual is affected by genetic and environmental factors, access to nutrients, personal preferences, nutritional awareness, comorbidities and daily habits. The number of individuals aged over 65 is increasing globally. This review will look at strategies for nutritional screening and diet therapy in the elderly, taking into account phenomena that influence nutrition and commonly affect this age group.

Malnutrition can be assessed via criteria that account for loss of weight, muscle and subcutaneous fat, in combination with decreased energy intake and functional status. Malnutrition and involuntary weight loss are associated with an increased mortality risk, while some studies show that voluntary weight loss reduces this risk. Malnutrition leads to a plethora of negative outcomes, and may signal dire underlying disease such as malignancy. Factors that predispose to malnutrition in the elderly include: anatomical and physiological changes of the gastrointestinal tract, endocrine system and body composition, and impairment of sight, smell and taste. Concomitant illnesses affecting the heart, lungs, liver and kidneys, and depression and dementia also negatively impact nutrition, while socio-economic changes interfere with access to food. Once identified, malnutrition can be mitigated via diet therapy which aims to tailor nutrition to the aforementioned changes, compensate any deficiencies and prevent future recurrence. Special attention should be paid to caloric, protein and fat requirements and diet supplementation with vitamin D, B12, iron and calcium.

Focused nutritional assessment can aid in timely detection of malnutrition and its constituent components, which include anorexia, cachexia and sarcopenia. This also provides the opportunity to identify underlying malignancy, and systemic and psychiatric conditions. Diet therapy can then be tailored to accommodate for these conditions and to

the changes known to occur in the elderly, potentially mitigating malnutrition and reducing mortality risk.

Key words: Nutrition, Elderly people, Diet therapy.

1. Introduction

Global trends show that the number of people aged over 65 is increasing. This demographic shift imposes the need for special nutritional guidelines for this vulnerable, and often ill group of individuals. The nutritional needs of the elderly are determined by numerous factors which include specific health conditions, physical activity, the balance between consumption and caloric needs, access to food, its preparation, ingestion and digestion, as well as personal tastes and preferences. Moreover, aging is characterized by reduced functional reserves of organ systems and reduced homeostatic control, which are influenced by a plethora of genetic and external environmental factors. The aforementioned changes increase the nutritional risk in the elderly, with malnourishment bringing about serious detriment to overall health, and sometimes representing a manifestation of dire underlying disease [1].

This review will underline current strategies aimed at screening for malnutrition, assessing nutritional status, as well as the goals and methods of diet therapy and intervention.

2. Nutritional status assessment, age-related changes, and goals and methods of diet therapy

2.1 Criteria for malnutrition in the elderly

Studies show that up to 71% of hospitalized elderly individuals are malnourished or at nutritional risk. Moreover, they show that malnutrition is associated with an increased risk of mortality [2]. The Academy of

Nutrition and Dietetics (Academy) and the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) recommend that a standardized set of diagnostic characteristics be used to identify and document adult malnutrition in routine clinical practice [3]. These two organizations have set the following diagnostic criteria:

- Reduced energy intake.
- Weight loss.
- Loss of muscle mass.
- Loss of subcutaneous fat.
- Decreased functional status assessed by strength of a handshake.

Universal use of this single set of diagnostic criteria will facilitate the recognition of malnutrition, contribute to more valid estimates of its incidence and prevalence, guide interventions, and influence expected outcomes. This standardized approach will also help predict the human and financial cost and burden associated with the prevention of malnutrition more accurately [3]. Although nutritional status is complex and affected by a myriad of factors and indices, its assessment does not have to be difficult. In fact, the simplest way to assess the nutritional status of people of advanced age is serial body weight measurements. The data shows that weight loss, especially when involuntary, has a negative predictive value for the risk of mortality in this age group [2]. As such, making use of these serial measurements can help determine clinically significant weight loss by the straightforward use of the criteria below. Weight loss should be considered clinically significant as follows:

- $\geq 2\%$ reduction in body weight in 1 month,
- $\geq 5\%$ reduction in 3 months,
- $\geq 10\%$ in 6 months.

International nutrition and healthcare organizations agree that screening is essential in identifying patients that should undergo further assessment in order to determine the appropriate nutritional intervention. Numerous nutritional screening tools are available and applied in hospitals, however many have never been validated with regards to the care setting, patient population, or outcome that they are meant to determine and identify. Therefore, it is important for clinicians to understand how these tools were validated, which population groups they were meant to assess and in which settings, in order to determine whether the tool is appropriate for use in their institution [4].

2.2 Laboratory markers of malnutrition

Clinical indices of malnutrition can be augmented by use of biochemical markers. In fact, many malnutrition assessment tools, make use of a combined approach. It is important to note, however, that laboratory markers can aid in diagnosing malnutrition under a specific set of circumstances, and that the presence of certain

conditions essentially makes them not applicable. For example, one important group of proteins that has both a traditional and current application is serum visceral proteins. It includes albumin, transthyretin (prealbumin), transferrin, and retinol binding protein. These products are mainly synthesized by the liver, and have different molecular weights and half-lives. They have been found to variably correlate with malnutrition. However, in the circumstance of impaired liver synthetic function or nephrotic syndrome, low levels may be not be an indicator of nutritional status. Furthermore, in inflammation, when the liver heavily produces acute phase reactants, their levels may decrease despite adequate or even increased nutritional intake. Finally, both albumin and transthyretin were found to be inadequate for nutritional assessment in patients with anorexia nervosa. Nevertheless, their value in patients without inflammation and liver and kidney disease holds steadfast and in fact has a wider value in determining prognosis in the postoperative state. Transthyretin is especially useful in assessing for more recent onset malnutrition due to its shorter half-life when compared to albumin. Levels under 10 mg/dL are strongly associated with malnutrition, and low levels of this marker have also been decidedly linked with sarcopenia and decreases in lean body mass. Other laboratory markers for malnutrition include urinary creatinine, urinary 3-methylhistidine, serum cholesterol, insulin like growth factor-1 and others. It can be determined that while laboratory markers cannot alone serve to pinpoint malnutrition and its severity, or its underlying cause for that matter, they carry potential when combined with a clinical nutritional assessment tool [5].

2.3 Involuntary weight loss

Although weight loss generally reduces the risk and slows the progression of some diseases, many observational studies suggest that it is associated with an increased mortality risk. As a result, many clinicians are reluctant to implement a weight reduction regime. Involuntary loss of 5 - 10% of body weight or more in the elderly within one year is an important clinical sign that is associated with an increased risk of mortality, and warrants further assessment and investigation into the underlying cause. However, it can be difficult to determine whether weight loss is in fact involuntary, therefore the mortality risk associated with intentional weight loss may be misrepresented [6]. In a 2010 study, volitional weight loss in older adults was not associated with increased total mortality, and on the contrary reduced mortality risk [6]. In the circumstance that weight reduction is deemed the best option for an individual with moderate to severe obesity, it is imperative that the strategy be founded on exercise and physical activity in conjunction with a moderate reduction in intake.

The Special Interest Group (SIG) on cachexia-anorexia in chronic wasting diseases was created within ESPEN. The aim of this SIG was to facilitate the development and spread of knowledge and understanding related to the basic and clinical aspects of cachexia-anorexia, and to raise awareness of these conditions among healthcare professionals and providers. In its consensus paper from 2010, European Society of Clinical Nutrition and Metabolism (ESPEN) Special Interest Groups (SIG) put forth the formal definition of cachexia, pre-cachexia and sarcopenia, and also defined criteria for differentiation between these conditions as well as other conditions associated with sarcopenia in geriatrics [7]. Therefore, involuntary weight loss can be considered a consequence of the following factors or a combination thereof:

- Improper diet - loss of appetite (anorexia).
- Muscle atrophy (sarcopenia).
- Inflammatory effects of some diseases (cachexia).

2.4 Categories of changes brought on by aging and how they relate to nutrition

Malnutrition in the elderly is more common when compared to younger adults. It has a greater impact on physical function, healthcare needs and length of hospitalization, especially in the postoperative setting [8]. Furthermore, older individuals are less able to adapt to malnutrition, are less likely to feel hunger than younger people, and are less likely to regain weight that is lost even 6 months after the malnutrition period has ended. Illness that is concomitant or resultant to malnutrition, as well as psychological and social factors can contribute to the inability to compensate for and regain the lost weight and leads to a permanent change in body weight. This clearly points to factors related to aging that increase the risk of malnutrition. These changes can be roughly divided into three categories. The first group relates to anatomical and physiological changes of the digestive system, as well as general changes in body composition and neuroendocrine homeostasis. Second are socio-economic changes that commonly affect older adults, and the final category includes specific organ, systemic, and psychiatric conditions.

2.4.1 Anatomical and physiological changes of the digestive system in the elderly

Anatomical changes that pertain to the mouth and can typically affect older adults include bad teeth, gingival problems and decreased salivary secretion. This in turn leads to reduced chewing and less softening of swallowed food. Furthermore, the number of tongue papilla sensitive to sweet and savory decrease which in turn leads to consumption of sweeter and saltier foods in order to get the same taste. This is contrary

to dietary recommendations especially with regards to diabetes mellitus and cardiovascular disease, and can also lead to dehydration. Moreover, impaired taste and smell are thought to affect the cephalic phase of digestion, so the volume of ingested food, duration of inter-prandial periods, and satiety are altered as a result of their impairment. Also, satisfaction brought on by eating is affected by impaired smell and sight, which are changes that commonly affect the elderly population. Impaired esophageal motility is associated with advanced age, and this results in impaired swallowing and an increased risk of esophageal spasms. Reduced secretion of gastric juice and reduced digestion ultimately lead to decreased absorption of nutrients, vitamin B12, iron, calcium and zinc. Delayed gastric emptying in the elderly may result in prolonged gastric distension and increased satiety. Aging affects the production of, as well as central nervous system sensitivity to several digestive hormones including glucagon, cholecystokinin, leptin and others. Reduced gastric acid secretion also contributes to an environment which permits intestinal bacterial overgrowth, a condition that disrupts digestion. Finally, lowered intestinal motility and absorption lead to frequent bouts of constipation [9].

2.4.2 Physiological systemic and body composition changes in the elderly

At the age of 65 - 70 years, the fat to muscle ratio is increased. Fats are increased due to a positive balance between energy intake and expenditure, in the setting of reduced physical activity. An increased body weight with centripetal fat deposition is observed. At the same time a moderate decrease in muscle mass and bone tissue also occurs. This leads to obesity which has been linked with increased mortality in those who suffer from moderate to severe obesity. Moreover, higher levels of obesity are associated with new onset or worsening disability. Therefore, efforts to prevent disability in older adults should target those who are overweight or obese [10]. In the range over 75 years of age, there is a decrease in body weight with a loss of lean body mass. This reduces the body's proteins, which leads to an impaired immune response, especially in the event of stress. This is especially important considering the fact that functional reserves of organ systems generally deteriorate with age, increasing the risk of serious infection in the first place. Decreased proteins also lead to fluid loss and a tendency towards dehydration. With regards to the change in composition and fat distribution, peripheral insulin resistance is common in part due to increased body fat. Recurrent hyperglycemic bouts enhance peripheral insulin resistance and progressively result in Diabetes Mellitus type 2 [11].

2.4.3 Socio-economic status and nutrition

This is another important category that affects nutrition in numerous ways. Older individuals often have lower financial income, and this significantly limits opportunities for healthy nutrition. The obvious reason is a lower pension in comparison to income prior to retirement. However, another factor is that the elderly need to spend finances on medication and medical procedures that had previously been allotted to healthy food. Elderly individuals often live alone and this is related to nutrition in several important ways. First and foremost, they are frequently dependent on others for mobility, maintaining hygiene, obtaining and preparing food and feeding, and in this regard absence of aid can seriously deter healthy eating. Furthermore, studies show that older adults who eat together with others consume more food than those who eat alone. Also, the increased likelihood of isolation during meals means that the opportunity to detect and identify difficulties in chewing and swallowing are missed. Finally, living alone and absence of companionship increase the risk of low mood, dysphoria and depression. This leads to the loss of desire to acquire, prepare and consume food in sufficient amounts. The topic of depression as a psychiatric condition that interferes with healthy nutrition will be discussed in greater detail in the next section. Generally, assessment of an elderly individual's socio-economic status and its impact on his or her nutritional habits offers the healthcare provider the opportunity to determine an adequate nutritional intervention. Equally as important is the opportunity to tap into social programs that provide third party aid to older adults, and also to consider the option of placement into a nursing home [12].

2.4.4 Diseases and psychiatric conditions associated with aging and their relationship to nutrition

Many diseases and conditions that typically affect the elderly also impact one or more aspects of diet or the body's handling and metabolism of nutrients. For example, diseases of the cardiovascular system are common, and these include hypertension, cerebrovascular disease and stroke, as well as renal changes that lead to a reduction in glomerular filtration rate and thereby a decreased retention of sodium. Osteoarthritis is a chronic degenerative condition that impairs and reduces mobility. As such, it can play an important role in limiting access to proper nutrition. Dysphagia is present in 7 - 10% of the elderly and has a negative effect on energy intake. Oro-pharyngeal dysphagia may be due to amyotrophic lateral sclerosis or Zenker's diverticula, while esophageal dysphagia can be a result of achalasia or scleroderma. Furthermore, a significant

number of patients with acute cerebrovascular stroke or Parkinson's disease suffer from dysphagia [4]. Assessment of nutritional status is important in stroke care, however admittedly little is known with regards to the prognostic role of nutritional status on long-term functional outcomes among stroke survivors [13]. The most important medical and psychiatric causes of weight loss in the elderly are malignant diseases and depression, respectively. Malignant diseases are the cause of weight loss in 9 - 36% of the elderly. With regards to psychiatric conditions, depression and dysphoria have a particularly adverse effect on diet and often remain unrecognized. Depression, hardness, and emotional well-being are all significantly associated with appetite. This association elucidates the components of mental health that contribute to poor appetite in this population. As noted above, these represent an independent cause of weight loss in individuals in nursing homes and in the community alike. Simple self-reported measures of mental health status administered to older adults may predict and indicate poor appetite. Therefore, they may aid in identifying potential interventions for timely prevention of malnutrition and negative health outcomes [14]. Other medical conditions related to nutrition arising from the endocrine system include hypothyroidism and diabetes mellitus. Moreover, conditions such as chronic cardiomyopathy, end stage renal disease, chronic obstructive pulmonary disease, liver failure and finally neurological conditions such as Parkinson's and Alzheimer's disease can seriously adversely affect nutrition. In addition to the direct effect of some diseases on nutrition are the adverse side effects of some medications including anorexia, nausea, vomiting, diarrhea, and impaired absorption of nutrients, vitamins and minerals. The elderly population is a special category from a social aspect, however also from a nutritional and health point of view.

2.5 Objectives of diet therapy

There are many different approaches to nutritional therapy in the elderly, however in essence the objectives can be narrowed down to:

- Provide adequate nutrition according to the needs and changes caused by age.
- Treat any existing nutritional deficiencies and to prevent their future recurrence.

Diet should be tailored to ensure sufficient intake of nutrients for energy which ranges from 25 to 35 kcal/kg of body weight. It is important to take into account reduced needs due to a decrease in lean body weight as well as a lower level of physical activity. Elderly individuals should be encouraged to snack between main meals in order to meet dietary requirements. Adequate protein intake is 0.8 - 1.0 g per kg of body

weight. Special care should be invested into proper selection of foods that contain high quality animal and vegetable proteins which do not contain saturated fat. The amount of protein usually changes according to new onset of conditions. This generally refers to increases in catabolic activity which is seen in certain conditions such as stress, trauma and malignancies, and decreases in association with renal and liver diseases. Adequate protein intake can prevent the development of pressure ulcers as well as promote healing of pressure ulcers once they have formed [12].

2.6 Caloric needs of the elderly

Depending on the gender the caloric needs of the elderly can also be calculated using the different available equations [15]. These include formulas that are recommended by the Institute of Medicine and the US National Academy of Nutrition (Table 1).

Table 1. Equations for calculating caloric needs recommended by the Institute of Medicine and the US National Academy of Nutrition

Gender	Equations
Women	$354.1 - (6.91 \times \text{age [years]}) + \text{CFA}^* \times (9.36 \times \text{body weight [kg]} + 726 \times \text{height [m]})$
Men	$661.8 (9.53 \times \text{age [years]}) + \text{CFA} \times (15.91 \times \text{body weight [kg]} + 539.6 \times \text{height [m]})$

Legend: *CFA - Coefficient of physical activity.

Table 2 shows the coefficient of physical activity (CFA) that can vary from 1.0 to 1.45 and is normatively distributed and defined using four different values.

Table 2. Distribution values of the coefficient of physical activity

Activity of the person	Value of the CFA
Inactive person	1
Slightly active person	1.12
Active person	1.27
Very active person	1.45

These equations show the significance of physical activity and inactivity in the elderly. Physical inactivity emphasizes and accelerates the process of muscle mass loss and increases the presence of body fat. This emphasizes the importance of regular physical activity and mobility in the elderly. Naturally, this must be in accordance to individual capabilities so as to prevent injury and disability.

Fat requirements do not change with age. With the reduction of energy consumption, the need for carbohydrates decreases (< 150 g/day). It is necessary to reduce the intake of sugar, because in advanced age there is impaired glucose tolerance and increase in postprandial glycaemia. The recommended adequate intake of dietary fiber is 25-30 g/day. Some authors

note a requirement of intake of dietary fiber as high as 45 g/day. It is important that this is accompanied by sufficient fluid intake, in order to facilitate bowel motility and healthy and regular bowel habits. 1.6 L of fluids in females, and 2 L of fluids in males is considered adequate to mitigate low intake dehydration. Although evaluating mucous membranes and skin turgor are valuable in identifying dehydration in the general population, these clinical signs are not recommended for use in the elderly per the ESPEN guidelines. In this population, low intake dehydration should be assessed for by measuring serum osmolality, or if unavailable, calculating osmolarity. A value higher than measured 300 mOsm/kg or calculated 295 mmol/L should be reason to consider increasing the volume of administered fluids, possibly via the intravenous route [12].

Similarly to lipid requirements, the needs for micronutrients also do not change. Vitamins are an exception to this general rule. In particular, Vitamin D should be taken via the oral route in recommended doses to mitigate the risk of its deficiency. Deficiency can be brought on by numerous factors, and these include decreased sun exposure as a result of less frequent outings, impaired synthesis of progesterin D in the skin, and impaired metabolism in the kidneys as part of chronic renal changes. Renal changes that impair vitamin D metabolism are especially pronounced in the setting of chronic renal disease. As a result, it is necessary to increase vitamin D intake to 10 - 15 Eg per day. Another example of a vitamin that needs to be ingested in a higher dose in the elderly is vitamin B12. This is due to poor absorption of vitamin B12 which is naturally found in adequate amounts in certain foods, as a result of intrinsic factor deficiency.

Requirements for minerals also remain largely unaltered. Again, as with vitamins there are exceptions. Calcium metabolism can become altered in the setting of advanced age, ultimately resulting in its reduced absorption. This can progressively lead to osteoporosis and consequently an increased risk of fractures. Therefore, calcium needs are estimated at 1,200 mg/day. The other exception is iron, with estimated daily requirements of 8 mg/day. It is important to take a differential approach towards iron deficiency. Namely, when iron deficiency is detected in the elderly, investigation into loss due to occult bleeding from the gastrointestinal tract should be undertaken without delay. One effective way is to perform a fecal occult blood test, also known as guaiac, which when positive is an indication for further evaluation of the digestive tract.

Some of the special instructions that should be taken into account when treating malnutrition in the elderly are:

- In case of difficulty with chewing and swallowing, the food should be mashed, grated or cut, and have a soft consistency.
- In order to achieve a favorable effect, advice should be given to the individuals and their families that older adults may eat more when in company, as opposed to eating alone. Also, having a family member observe the individual eat may end up identifying certain difficulties with chewing and swallowing which may otherwise go unnoticed.
- With regards to elderly individuals with lower financial income, it is wise and productive to provide consultation and advice concerning cheaper sources of proteins, vitamins and minerals.
- Restrictive dietary regimens in overweight patients with diabetes mellitus should be avoided as they can result in bouts of hypoglycemia.
- Patients with urinary and/or fecal incontinence issues may be reluctant to eat and drink, and should be appropriately accommodated in order to mitigate these fears [12].

When oral nutrition is insufficient, the need for enteral and or parenteral nutrition should be evaluated. Enteral nutrition should strongly be considered if oral intake is expected to be unfeasible in three days duration, or is expected to be less than half of dietary requirements for seven days or more. ESPEN guidelines recommend that enteral feeding be given via a nasogastric tube if it is expected to be necessary for less than four weeks. On the contrary, if the duration is expected to be longer than four weeks, then enteral feeding should be administered via a percutaneous gastrostomy. Parenteral nutrition, similarly, is indicated if both oral and enteral feeding are deemed impossible in three days duration, or will provide less than half of the dietary requirements in a period of seven days or longer. It is important to note that both enteral and parenteral feeding should be considered in individuals with a reasonable prognosis, in whom these methods will likely improve quality of life and increase the chance of recovery. If there is no evidence to draw this conclusion, then they should be avoided and comfort feedings should be administered as possible. Refeeding syndrome is best avoided if the amount of food is gradually increased in the first three days. These methods bear a risk of resulting in low levels of magnesium, phosphate, potassium and vitamin B1. As such, it is important to monitor their levels, especially during the first few days, in order to avoid unwanted deficiencies [12].

3. Conclusions

- Involuntary weight loss in adults is mainly due to one or a combination of the following 4 reasons: inadequate diet, loss of appetite (anorexia), muscle atrophy (sarcopenia), or changes due to inflammatory

disease (cachexia). Aging-related changes that affect nutrition can be divided into anatomical and physiological changes of the digestive system and body composition, socio-economic changes and associated diseases and psychiatric conditions. Depression is the most commonly associated condition, followed by malignant diseases as a cause of malnutrition.

- Treatment should focus on identifying the cause of malnutrition and ascertaining appropriate and effective dietary modifications and interventions. Diet therapy should be provided with the aim of tailoring caloric intake according to age, physical activity, protein and fat requirements. Furthermore, diet will usually have stark differences when compared to younger populations as far as reduced carbohydrates, but at the same time abundance of dietary fiber, in combination with adequate intake of micronutrients. With the exception of vitamins D, B12 and calcium and iron, intake of micronutrients and minerals will be very similar when compared to individuals of a younger age. Physical activity should be encouraged whenever possible and according to individual capabilities.

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