

Review

Protein and Older Adults

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Body composition changes as people get older. One of the noteworthy alterations is the reduction in total body protein. A decrease in skeletal muscle is the most noticeable manifestation of this change but there is also a reduction in other physiologic proteins such as organ tissue, blood components, and immune bodies as well as declines in total body potassium and water. This contributes to impaired wound healing, loss of skin elasticity, and an inability to fight infection. The recommended dietary allowance (RDA) for adults for protein is 0.8 grams of protein per kilogram of body weight. Protein tissue accounts for 30% of whole-body protein turnover but that rate declines to 20% or less by age 70. The result of this phenomenon is that older adults require more protein/kilogram body weight than do younger adults. Recently, it has become clear that the requirement for exogenous protein is at least 1.0 gram/kilogram body weight. Adequate dietary intake of protein may be more difficult for older adults to obtain. Dietary animal protein is the primary source of high biological value protein, iron, vitamin B₁₂, folic acid, biotin and other essential nutrients. In fact, egg protein is the standard against which all other proteins are compared. Compared to other high-quality protein sources like meat, poultry and seafood, eggs are the least expensive. The importance of dietary protein cannot be underestimated in the diets of older adults; inadequate protein intake contributes to a decrease in reserve capacity, increased skin fragility, decreased immune function, poorer healing, and longer recuperation from illness.

Key teaching points:

- Body composition changes with advancing age, with the loss of protein tissue being most significant.
- All body protein compartments are reduced in size.
- RDA for protein for adults is not adequate to maintain nitrogen equilibrium in elderly adults; at least 1.0 g/kg/body weight is needed for equilibrium in healthy, ambulatory older adults.
- Additional levels of protein are required to meet the needs demanded by physiological stress.
- High levels of dietary protein will not affect renal function in an individual who does not have predisposing renal disease.
- Eggs provide an excellent source of dietary protein that is inexpensive, easy to prepare, and readily available; blood lipids decrease as a risk factor for heart disease in later life.

INTRODUCTION

As people age, there are physiologic changes that occur slowly over time, which are common to all living organisms. The most noticeable feature of aging is that body composition (protein, water, fat and bone) changes as people get older. Bone density decreases with advancing age, as does muscle mass and other protein compartments. Bone density declines over time in both females and males in the absence of disease; these changes

may be related to early life nutrition (inadequate protein, calcium, vitamin D and trace metals), weight-bearing exercise, hormone level changes, and a variety of other factors. Osteopenia is a common occurrence in both men and women as they age; osteoporosis is a rapid decline in bone mineral mass that will eventually contribute to the risk of bone fractures, vertebral collapse with compression of the abdominal organs, balance and gait problems, tooth and oral health problems, and other functional challenges [1].

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A decrease in skeletal muscle is the most noticeable manifestation of the change in body composition but there is also a reduction in other physiologic proteins such as organ tissue, blood components, and immune bodies as well as declines in total body potassium and water that are not readily apparent. Total body water decreases along with the reduction of muscle mass, but total body fat may increase proportionally. The increase in fat tends to be noticeable because it is laid down in the truncal area, increasing fat tissue around organs and thickening the torso.

The most notable metabolic change associated with a reduction of muscle mass is a decrease in energy requirements. The most metabolically active body compartment is protein tissue and when the protein compartment is reduced in mass, then basal energy requirements needed to maintain the protein tissue decreases [2].

The reduction of protein compartments, including red blood cells, white blood cells, platelets, stem cells, antigens, antibodies, hormones, enzymes and others, contributes to impaired wound and fracture healing, loss of skin elasticity, an inability to fight infection, muscle weakness potentially leading to falls, decreases in functional capacity, and an inability to maintain tissue integrity [3,4]. These changes may have a profound effect on the health and well-being of older adults. Although it will take longer for older patients to return to pre-injury status, they can heal wounds and repair fractures although it will still require more time for older patients to return to baseline status than it will for younger adults; if there is a deficit of protein and energy, it will take even longer. Older adult patients may also develop pressure ulcers rapidly due to a lack of adequate subcutaneous fat pads, skin fragility, and poor muscle tissue integrity.

Physical Activity

Another factor, along with physiologic aging, that contributes to the loss of lean body mass is lack of exercise leading to muscle atrophy [5]. The impact of immobilization, or not being able to move voluntarily, is often overlooked in older adults who are confined to bed or chair or are simply inactive due to bone and joint disease. Muscle loss may occur simply because of disuse but the loss tends to occur rapidly in older adults. This rapid loss may contribute to chronic negative nitrogen balance, depleting whatever available protein stores might be available for healing, fighting infection, and making new tissue. The ability to manage the activities of daily living which are personal hygiene and self-care may be dependent on ambulation, strength, and physical competence.

There is evidence that frail, older adults can benefit from non-impact, strength training exercises [6–8]. Muscle tissue may be positively affected by training exercises that build strength. Regular exercise will stimulate protein tissue turnover and maintain muscle mass. However, it is essential that adequate energy and protein be provided from exogenous sources

so that muscle tissue and other protein components can be restored.

Protein Requirements in Later Life

The recommended dietary allowance (RDA) for adults for protein is 0.8 grams of protein per kilogram of body weight. For young adults, skeletal muscle accounts for approximately 45% of total body weight but by age 70, that percent has decreased to approximately 27% of total body weight. Protein tissue accounts for 30% of whole-body protein turnover but that rate declines to 20% or less by age 70. There is some controversy about the relative alteration in protein turnover rate with age, with some investigators reporting an increase in protein turnover rate and some reporting a decrease in protein turnover rates [9–10]. Research studies [9–14] have demonstrated that older adults require more protein than the RDA of 0.8 grams in order to maintain nitrogen equilibrium. The result of this phenomenon is that older adults require more grams of dietary protein/kilogram body weight than do younger adults. Over the past two decades, and with renewed interest most recently, it has become clear that the requirement for exogenous protein is at least 1.0 gram/kilogram body weight with additional amounts needed to heal wounds or pressure ulcers, to fight infection, or to build new tissue to replace normal losses [11–14]. Despite some concern about high levels of dietary protein in older adults contributing to renal disease, there is no evidence to support this [15,16].

Although individuals will adapt to lower dietary protein intake, older adults may adapt by compromising their functional capacity, losing muscle mass, and compromising their immune status [3]. Consequences of inadequate dietary intake, particularly of protein and energy, may be serious; protein energy malnutrition is a factor in susceptibility to infectious disease, poor wound healing, and negative outcomes to interventions for chronic and acute conditions.

Dietary Protein for Older Adults

Adequate dietary intake of energy and protein may be more difficult for older adults to obtain because of the cost of nutrient dense foods, perceived intolerance to certain food groups, difficulty tearing or chewing fibrous foods, or fear of consuming too much fat or cholesterol. Dietary animal protein is the primary source of high biological value protein, iron, vitamin B₁₂, folic acid, biotin and other essential nutrients. Animal proteins are considered to be of high biological value, meaning that they contain all of the essential amino acids in appropriate ratios based [17–18].

Vegetable proteins, in general, do not have complete amino acid profiles and are considered to be a low biological value, although some have a good ratio among the amino acids. Most vegetable proteins, with the notable exception of soy, require additional sources of other vegetable protein to maximize the effectiveness and amino acid profile. This is usually achieved

by mixing protein sources with complementary amino acids [19]. One good example of how proteins can be mixed to yield a protein meal that has higher biological value than the meal components by themselves is a rice and beans combination where the amino acid profiles complement each other to make a more complete protein of higher biological value than either food alone. Nevertheless, animal proteins are a more efficient way to obtain adequate high biological value dietary protein.

The amino acid profile of egg is considered to be the standard against which all other proteins are compared. Compared to other high-quality protein sources like meat, poultry and seafood, eggs are the least expensive (Table 1). This is especially important for older Americans who are often budget-conscious, living on a fixed income, and have limited cooking facilities. A fairly sophisticated knowledge of nutrition and protein metabolism is required to mix vegetable proteins appropriately, so consumption of high biological value proteins is the most effective way to achieve adequate dietary protein. Eggs offer a convenient, inexpensive, and easy to prepare source of high quality protein.

The greatest obstacle to adequate consumption of dietary protein is the common belief that eating foods that contain cholesterol is a major factor in coronary heart disease; in fact, dietary risk factors for heart disease change with advancing age. Dietary cholesterol and other dietary fats become less of a factor in heart disease risk than in young and middle ages, with cholesterol levels diminishing as people get older. Other risk factors become more highly correlated to coronary heart disease in later years, with systolic hypertension becoming a more reliable indicator of potential future coronary events. Diabetes tends to be a factor that contributes to the risk of a future heart attack. The combination of diabetes and systolic hypertension increases the likelihood that heart disease may contribute to premature death.

The importance of dietary protein cannot be underestimated in the diets of older adults; inadequate protein intake contributes to a decrease in reserve capacity, increased skin fragility, decreased immune function, poor healing, and longer recuperation from illness.

Assessment of Protein Nutrition

Inadequate protein nutrition may present serious challenges to many older adults as their health conditions advance. Susceptibility to infectious disease can lead to poor outcomes and

Table 1. Cost of Protein Foods/20 Grams

Eggs	\$0.25
Pork Roast	\$0.40
Ground Beef	\$0.42
Chicken Breast	\$0.50
Frankfurter	\$0.94
Pork Chop	\$1.09
Rib Roast	\$1.43

serious complications for older adults. For institutionalized, non-ambulatory or functionally impaired elderly people, protein undernutrition increases the risk for pressure ulcers, chronic infection, and bone fractures. If these conditions develop, the processes of healing or fighting infection require a higher level of both protein and energy than just meeting requirements.

A great challenge for clinicians is the diagnosis of protein energy malnutrition in elderly patients and determining what level of protein is needed to replace lost stores and meet extraordinary needs. Assessing protein status is difficult in older adults. Standard references for nutritional status are validated on younger populations and the validation studies rarely include older adults [20]. Loss of skeletal muscle mass occurs in older people even if they are in excellent health so using anthropometric measures validated on young adults does not yield a reliable diagnosis of protein undernutrition. Perhaps the most commonly used laboratory measure used to diagnosis protein deficiency is serum albumin. Studies have indicated that low levels of serum albumin are associated with morbidity and mortality [21,22].

However, serum albumin is not as reliable an indicator of nutritional status than is generally accepted. Serum albumin must be evaluated as part of the clinical context of the patient's health status, laboratory methodology, hydration and fluid compartment shifts, and dietary consumption of protein. Cancer, renal or liver disease, inflammatory disease, congestive heart failure, and protein-losing enteropathies all impact the validity of serum albumin as a nutritional marker [23].

Other serum proteins, such as transferrin, are also affected by other factors. For example, serum transferrin declines to low normal levels when tissue iron stores are saturated. Other proteins, such as prealbumin, retinol-binding protein, C-reactive protein, and insulin-like growth factor (IGF-1) may be better markers of protein status but are not readily available in long term or chronic care settings.

Conclusion

Assessing nutritional status is more complicated than relying on a single marker, particularly in an elderly person with many chronic diseases. A reasonable strategy to maintain health in older adults is to assure adequate dietary protein intake with high biological value protein that is inexpensive, easy to prepare, and well-tolerated.

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