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Health Connections

LINKING NUTRITION RESEARCH TO PRACTICE

BEYOND MUSCLE

Protein's Powerful Package of Benefits

The plethora of studies on protein drinks and supplements suggests protein isn't just for the training table and weight room.[1] Approximately half of Americans say that they are trying to consume more protein, thinking it helps build muscle, induces satiety, helps with weight loss and is beneficial to the aging process.[2] This issue of *Health Connections* summarizes the evolving perspective on proteins, amino-acid composition and metabolic characteristics so that health professionals can customize dietary guidance to meet clients' health and activity needs.

Rethinking Protein Among the Macronutrients

For the first time, the 2010 Dietary Guidelines Advisory Committee (DGAC) looked at the relationship between protein and health outcomes. Past DGACs did not consider protein as a separate topic because average protein intake in the United States is adequate. Macronutrient recommendations have focused on carbohydrate/fiber sources (whole grains, fruits and vegetables), "healthy" fats and a nutrient-dense diet within caloric needs. With obesity continuing to be a public-health challenge and with new research accumulating on the array of benefits of protein,[3] the role of high-quality protein in weight loss and satiety,[4] body composition and lean body mass,[5] muscle function[6] and glucose control[7] is getting a second look (see Side Bar).

A diet "high" in protein is a relative term. The Acceptable Macronutrient Distribution Range (AMDR) established by the Institute of Medicine (IOM) suggests 10 – 35 percent of total calories come from protein for adults—allowing flexibility to meet individualized needs. In response to questions on the safety of habitually consuming higher protein levels, a review of the literature indicated that there is a lack of significant research linking protein intake (at about 1.5 g/kg/d) and the initiation or progression of renal disease in *healthy individuals,* although protein restriction may be appropriate treatment for *existing* kidney disease.[8]

Amino Acids—At the Core of Metabolic Benefits

Essential tissues and organs (skin, brain, heart, liver) rely on a steady supply of amino acids as precursors to synthesize new proteins and to balance the rate of protein breakdown that occurs in all tissues. In the absence of nutrient intake, muscle protein is the principle reservoir to replace blood amino acids taken up by other tissues. Diets based solely on plant foods may be low in the indispensable amino acids lysine, sulphur amino acids and threonine. Although plant products can be combined to improve quality, the calories needed for adequate protein intake must be considered.[9] Animal products provide both greater quantity and quality of protein than plant products—particularly important when protein needs are high during growth and development and conditions of a stressed state (infection, recovering from critical illness, surgery or burns).[6]

Satiety, Weight Management, and Blood-Glucose Control

Protein's thermic effect of food, amino-acid composition and effect on gastrointestinal hormones are cited as possible reasons for improved

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satiety, which has been reported in short-term (single meal and over 24 hr) and in longer-term studies.[4] Diets higher in protein and lower in carbohydrate draw upon the liver to manage blood glucose, preventing large swings in glucose and insulin levels and resulting in more constant levels. Research still is unsettled, as sometimes the satiating effects of protein are less apparent. Fiber intake, food matrix and form (liquid/solid) and intake of other macronutrients can influence reported satiety.[4]

Muscle and Bone Health

By increasing systemic amino-acid availability, protein intake—up to a point—directly affects muscle protein.[6] However, there appears to be a maximum amount that can be used at one time (see Interview). Bone turnover requires a continuous intake of new protein, because a considerable fraction of the amino acids in bone collagen cannot be reused in new bone protein synthesis.[10]

Despite a widely held belief that diets high in protein—particularly animal protein—result in bone resorption and increased urinary calcium, higher-protein diets are actually associated with *greater* bone mass and fewer fractures *when calcium intake is adequate*. Most of the apparent conflict can be explained by: (1) the interdependence of the two nutrients for bone health and (2) probable delayed adaptation to altered intake, such that short-term studies may fail to capture the steady-state relationship between protein intake and calcium balance. At the whole-body level, most studies show that high protein intake is osteoprotective when calcium intake is adequate; similarly, metabolic evidence indicates that the protective effect of calcium for the skeleton is evident only when protein intake is relatively high.[11]

Side Bar: Protein and Individualized Health Goals

Goal	Protein Benefit
Meet More Than Minimal Needs	The AMDR of 10 – 35 percent of calories from protein helps customize intake levels for active adults. A higher percentage of calories from protein is needed when calorie intake is reduced. For example, for someone consuming less than 1,500 calories at 10 percent calories from protein (150/4 or 38 g), the RDA of 0.8 g/kg/bwt for a 55 kg woman (44 g) would not be met. For additional examples and calculations, see: http://www.dairycouncilofca.org/PDFs/hp_hc_fall04.pdf.
Satiety	Protein generally increases satiety to a greater extent than carbohydrate or fat.[4] A higher-protein diet (within the AMDR, but accompanied with a decrease in other macronutrients) supports more constant glucose and insulin levels, which spare some individuals the "constantly hungry" feeling experienced on high-carbohydrate diets.
Glucose Control	The branched-chain amino acid leucine, found in whey, helps regulate blood glucose through the insulin-signaling pathway.[7] Glucose stabilization is important for those at risk for or diagnosed with type 2 diabetes.
Weight Management	In addition to increasing satiety, higher-protein diets are associated with increased thermogenesis — the increase in energy required for digestion, absorption and disposal of ingested nutrients. Protein contributes to muscle/lean body mass and, although perhaps comparatively small relative to total energy expenditure, a small difference in the amount of more metabolically active tissue could affect energy balance.[6]
Muscle/Strength	About 30 g of high-quality protein (4 ounces of a protein-rich food) increases the rate of muscle protein synthesis about 50 percent.[12]
Bone Health	Diets providing about 1.0 to 1.5 g/kg/d protein are associated with normal calcium metabolism and do not alter bone metabolism. However, protein intakes at the RDA (0.8g/kg/d) are associated with lower calcium absorption.[10]
Recovery	Branched-chain amino acids such as leucine help minimize muscle wasting under conditions of protein breakdown and help stimulate muscle protein synthesis after endurance exercise.

INTERVIEW

Douglas Paddon-Jones, Ph.D., Departments of Physical Therapy and Internal Medicine, The University of Texas Medical Branch, Galveston

Douglas Paddon-Jones, Ph.D.

Q. What are some key issues regarding protein need and intake?

A. When the RDA is viewed as a number—the amount of protein needed daily—it appears superficially that intake is adequate, but is meaningless if you look at how people tend to eat.

What is typically missed is the distribution of protein throughout the day. Breakfast is often carbohydrate-based, with limited protein; lunch is often carbohydrate-heavy too. Often, an exaggerated portion of protein is end-loaded into the evening meal. A not-too-unusual 12-ounce portion of a lean, protein-rich food would provide about 90 g of protein (1.2g/kg body weight), or more than the RDA for a 70-kg reference man in a single meal!

Our research has shown that about 30 g of protein (4 ounces of high-quality, protein-rich food) is the maximum amount of protein that can be used at one time.[12] Exceeding this amount is like trying to put 90 gallons of fuel into a 30-gallon tank—it spills over. For clients, the 'spill over' or excess is oxidized as glucose or stored as fat—extra energy that can contribute to obesity.

Let's be clear—we aren't advocating simply throwing extra protein at consumers. The message for health professionals is to encourage clients to shift some of the protein consumed at dinner throughout the day's meals and snacks to help optimize the potential for muscle growth and to contribute to overall nutrient intake while helping control total energy intake.

Q. Why the emphasis on 'high-quality' protein?

A. You want the best bang for your buck. Whey protein is a good example of a high-quality dairy protein. It has all the amino acids the human body needs and is an efficient means to support muscle protein synthesis.

My conceptual framework for a high-quality, optimized diet encompasses many aspects of a client's lifestyle—taste, practicality, as well as the client's condition or health. If you get the basic "high quality" dietary framework in place first, you can tweak the diet for individual needs. This approach works for almost everyone—an athlete, older adult or someone recovering from injury.

My suggested framework (a moderate intake of high-quality protein three times a day to provide 25 – 30 g of protein per meal) provides inherent flexibility throughout the day to optimize the potential synergistic effect of exercise and nutrition (amino acids/protein), regardless of when you prefer to exercise.

Q. What about protein supplements?

A. For the general population, I support getting the "dietary framework" in place first. Supplements (like whey protein) can be very convenient and helpful in some situations (e.g., the post-workout recovery drink), but don't go beyond what your body can actually use and always pay attention to your total caloric intake. Watch out for misguided or unsupported claims—for example, the amino acid leucine is a popular supplement and certainly plays a key role in muscle growth, but you only need so much; most of us get all the leucine we need from regular high-quality protein in our diet. With the exception of some older adults and groups with restricted dietary practices, a leucine supplement probably won't help.

Practice Points for Health Professionals

- Encourage several moderate-sized servings (4 ounces) of high-quality, lean, protein-rich foods over the course of the day to optimize the potential for muscle growth and contribute to overall nutrient intake.
- Older active adults may benefit from smaller, more frequent meals to optimize dietary protein efficiency. Suggest eggs, low-fat milk, cottage cheese, yogurt or nuts for snacks and mini-meals.
- Suggest clients include a mix of animal and plant protein sources—cooked dry beans, peas and lentils in casseroles, soups and stews, combined with lean meats, poultry and fish can provide essential amino acids in the appropriate ratios.
- Low-fat milk is a convenient post-activity recovery beverage. It provides carbohydrate to restore glycogen; proteins—specifically leucine for muscle metabolism and protein synthesis; and helps replace fluids, electrolytes, sodium and potassium.