Essential amino acids are just that...essential to skeletal muscle and protein status

Amino acids are the building blocks of the protein. Essential amino acids (EAA) are those amino acids that need to be obtained through diet and cannot be made by the body in sufficient quantities. Those amino acids that can be synthesized within the body and don’t need to be obtained from the diet are termed nonessential amino acids (NEAA). The eight essential amino acids including leucine, isoleucine, valine, lysine, phenylalanine, tryptophan, methionine, and threonine are considered the anabolic nutrients that induce protein synthesis in human muscle. Furthermore, the elderly seem to be just as responsive to the anabolic effects of EAA supplementation, when compared with much younger age groups. It is also clear that a reason why high carbohydrate and low protein diets have failed to promote protein synthesis in the elderly is because of insufficient concentration of EAA content in such diets. Moreover, the decreased glucose tolerance and insulin sensitivity which accompanies sarcopenia in the senior population, along with negative energy balance creates a state of pronounced muscle catabolism. Essential amino acids may provide a viable method of circumventing the dilemmas of negative energy balance and insulin resistance. EAA supplementation alone is sufficient to induce protein synthesis providing caloric intake is adequate. There is a body of literature suggesting the elderly have a unique “selective” insulin resistance. Specifically, there appears to be a blunted protein synthesis to insulin in old age. Two potential mechanisms for this observation of selective insulin resistance include: 1) blunted molecular signaling for muscle protein synthesis; and 2) diminished nitric oxide induced vasodilatation (blood flow) causing a decrease in amino acid delivery to muscle. In fact, there is scientific data to suggest that insulin may impair the anabolic response of muscle to EAA in the elderly. Hence, essential aminos provide a more efficient avenue for the aging individual to work around the potential roadblock created by this “selective” insulin resistance observed in the geriatric population. Studies also indicate that a subgroup of essential amino acids known as the branched-chain amino acids (BCAA) is particularly useful in the proper clinical setting for inhibiting excess muscle catabolism and promoting positive nitrogen balance. More recently, the amino acid L-leucine has received great interest in the scientific and clinical world for its ability to induce protein synthesis directly, and amplify key anabolic signals within skeletal muscle. Leucine’s downstream metabolites, hydroxyl-methyl butyrate (HMB) and keto-isocaprole (KIC) may play supportive roles in slowing the progression of sarcopenia.

Here are some recommendations regarding EAA:

- Supplement your diet with at least 10 grams of free form EAA (that is not bonded together molecularly to form longer peptide chains of protein) a day to help build functional muscle mass and strength, by inducing muscle protein anabolism (providing caloric intake is adequate).
- Supplementing your diet with 10-30 grams of free form BCAA can help maintain lean body mass, by potentiating insulin signaling and other aspects of the muscle’s anabolic machinery.
- The doses, timing and frequency of intake mentioned above may vary considerably according to the individual’s need from diet, activity, training and medical history.

When there’s a will there’s...Whey (protein)

Whey protein is a milk derived protein found in most protein powders. Whey protein is a high quality protein rich in EAA and BCAA. In fact, many of the anabolic attributes of whey protein are due to its high concentration of EAA when compared to other proteins such as meats and vegetable-derived proteins.

Another important characteristic of whey is the kinetics or speed of absorption and assimilation. Whey protein is considered a “fast protein”; i.e., it is immediately soluble in the digestive tract, quickly digested, and its constituent amino acids are rapidly and transiently absorbed into the bloodstream. This pattern of a transient rise in amino acid concentration in blood plasma is associated with protein synthesis in humans (i.e., anabolic properties). In this respect, whey protein is a very cost-effective way of increasing calories (to maintain positive energy balance) and providing an anabolic stimulus. Moreover, the combination of calcium supplementation with whey protein as part of a healthy protein-emphasized diet may help improve or preserve lean body mass, decrease body fat through enhanced metabolic health and hence abate dysfunctional metabolic syndromes.

Another protein source rich in EAA, in particular, methionine, glutamine and arginine (conditionally essential) is soy protein. Soy protein has been used successfully in small studies to en-
hance recovery from exercise. Finally, another protein source that is worthy of mention is casein; also a milk-based protein that in contrast to whey, is considered a “slow protein” because its coagulation in the digestive tract slows absorption. As such, it leads to steady levels of amino acids trickling into the bloodstream and attenuating protein breakdown (i.e., anti-catabolic properties).

Here are recommendations with regards to protein supplementation:

- Supplementing your diet with a combination of 15–40 grams of whey protein, and/or 6-30 grams of casein is a safe way to increase daily caloric and protein intake. Nutrient density as opposed to energetic/caloric density becomes more critical in older age. Protein and EAA are an even more efficient, high-yield component of the elderly’s diet due to the decline in appetite and food intake that parallels aging.

- Adding calcium, EAA and/or BCAA with your whey protein or soy protein, and casein supplement will help build and preserve lean muscle tissue, while providing the structural building blocks for improving bone health.

- Combining your favorite whey/casein protein shake with 15–35 grams of a high-fiber and minimally processed carbohydrate source such as: oats, beans/legumes, whole grain pasta, whole grain/wild rice, barely, whole grain bread, fruits/veggies, or “green-food” supplements with 3–8 grams of mono/poly-unsaturated fats (omega-9 MUFA/omega-3 PUFA) is a great way to prepare a meal replacement to displace unhealthy snacks or meals.

PRevent dysfunctional aging and sarcopenia with PRE (Progressive Resistance Exercise)

Strength training or resistance exercise is the preferred method of exercise to prevent and treat the clinical effects of sarcopenia, osteoporosis, and it even addresses the problems of glucose intolerance/diabetes, and obesity that characterize the dysfunctional metabolic state associated with sarcopenia and aging. The classic view of exercise in the medical field was the emphasis of aerobic exercise for cardiovascular and general health benefits. Although it is true that aerobic training specifically increases aerobic fitness and endurance, it does not address the specific needs of strength and power development for optimal performance of most daily personal, higher-level, work and recreational activities. After all, the decrement in strength, power and endurance that accompanies sarcopenia are most detrimental to disability and quality of life. More recent studies also show that resistance training improves metabolic health, body composition, and even cardiovascular health, such as hypertension—a benefit traditionally attributed almost exclusively to aerobic exercise. There is also preliminary evidence to suggest that the metabolic benefits specific to PRE may improve longevity. Another important point is that gains in muscle strength and hypertrophy, as well as metabolic/cardiovascular health benefits occur in as little as 3–6 weeks for both men and women, even as old as 90 years of age. Finally, compliance to such programs (in the proper setting) was as high as 80–90 percent. Clinically, the combination of aerobic and progressive resistance exercise is ideal for optimal functioning, quality of life, aging, and health. The bottom line: PRE is the most effective...
single, long-term intervention for attenuating and/or preventing sarcopenia.

Some general recommendations regarding exercise:

- Always check with your physician before starting any exercise program.
- A base-level progressive resistance exercise (PRE) program could be 2–3 days a week for 20–45 minutes and working anywhere from 4–8 body parts per day. It would be optimal for most to be under the guidance of a qualified fitness professional to choose the appropriate resistance and exercise technique. A good starting point would be to choose a weight that is 50–60 percent of your theoretical 1-rep max (RM), i.e., if a weight can theoretically allow you to perform only one rep in proper form... this is your RM. Therefore, 50 percent of this weight is known as "50 percent of your RM". Over the course of 3–4 weeks, the weight is progressively increased so that you'll be lifting up to 80–90 percent (on occasion) of your RM in good technique. This general model has been shown effective even in men and women ages 60 to 90 years of age. Most persons would benefit greatly from being in the hands of a qualified professional, who would "periodize" or cycle the training parameters. Periodization is effective not only for maximizing recovery, long-term gains and adaptation, but also for preventing boredom or staleness in any strength-training regimen.
- In addition to PRE, take your new found strength and perform aerobic activity (at both multiple levels of intensity) for 2–3 days a week (comprised of walking, running, or favorite sporting activity) for 15–45 minutes a day.
- For patients living with hypertension and cardiovascular disease, PRE is not only safe but should be an adjunct to aerobic exercise. The combination of exercise modalities is more effective than aerobic exercise alone.

Integration is the best medicine

The strategic timing of nutrient consumption around the exercise and recovery periods may be the best approach to prevent, abate, and naturally treat sarcopenia. We have introduced the importance of protein in the diet as well options for supplementation that seem to have positive effects on aging muscle independent of exercise. Numerous studies on the benefits of exercise on aging muscle independent of any specific dietary intervention have also been demonstrated. The combination of exercise and optimal nutrition is still the best recommendation. More specifically, exercise induces a metabolic state where the body is more receptive to the anabolic effects of nutritional intervention [nutrient timing (Chrono-Nutrition™), protein and amino acid supplementation]. Muscles seem most receptive in the "peri-workout" period, i.e., the period immediately surrounding exercise (before, during, and up to 2–4 hours after exercise).

General guidelines with optimal timing of nutrient consumption:

- About 2–3 hours before PRE, consume a balanced whole-food meal with low to moderate glycemic index carbohydrate with 10–30 grams of lean protein. Then 10–15 minutes before PRE, consume 6–10g of EAA (with or without small amount of moderate to high glycemic carbohydrate; e.g. sports drink).
- During any PRE or intense aerobic activity, consume a 10–20 gram BCAA drink/supplement (optional: mix within a dilute 3–6 percent sports drink, carbohydrate-electrolyte or carb-electrolyte-protein beverage).
- Immediately after every PRE, take 10–25 grams of whey protein supplement (or other fast-acting protein) mixed with 10–25 grams of carbohydrate drink and 5–8 grams of EAA/BCAA.
- Within 2 hours after exercise, consume a balanced whole food meal with moderate glycemic index/load carbohydrate, high quality protein, and functional fats (MUFA and omega-3 PUFA).
- Within 4 hours after exercise, consume another 15–25 grams mixture whey/casein/soy protein enhanced with 5–8 grams of EAA/BCAA to optimize and maintain protein anabolism.

As mentioned at the beginning of the article, the battle against sarcopenia and dysfunctional metabolic syndrome starts with a healthy nutritional lifestyle focusing on adequate protein intake, moderate carbohydrate intake, and a daily dose of healthy fats. A healthy nutritional platform provides an optimal metabolic springboard to increase physical activity/exercise safely and effectively. Finally, the rational use of dietary supplements (Rational Poly-supplementation™), in the setting of Chrono-Nutrition™ (nutrient timing) will not only enhance their utility, but also act synergistically with exercise to maintain active aging, health and wellness.

For references send a SASE to totalhealth magazine.

Joseph Jimenez, M.D., MBA, CSCS and Hector Lopez, M.D., MS(c), CSCS are physicians trained in the specialty of Physical Medicine and Rehabilitation. They are co-founders of Physicians Pioneering Performance®, LLCTM. PFP is a multi-specialty, interdisciplinary group of like-minded doctors who seek to seamlessly integrate musculoskeletal, spine and sports medicine, optimal aging, and rehabilitation, with medical and performance nutrition, athletic performance, and fitness to accommodate the needs of a diverse population. The PPP group has an interest in developing a new paradigm of rehab medicine... "Integrative/Metabolic Physiatry" through strategic, rational nutritional and metabolic intervention as another "tool" in the armamentarium to enhance functional/performance outcomes in patients, healthy laypersons, and athletes alike. PPP is collaborating with MyoTrend Nutritional Technologies (MNT) to educate and empower consumers in performance nutrition science and safety. The alliance with MNT seeks to bring forth supplements that have long-lasting value, and embody a true balance between the best appraisal of the available scientific evidence, and innovation through out-of-the-box thinking. Research interests of PPP include: 1) Applying advances in sports nutrition and exercise science to enhance the functional capacity and human/athletic performance of the rehabilitation patient population, athletes, and laypersons; 2) Nutritional and training strategies to improve health and performance of elite athletes, obese patients, able-bodied laypersons, and senior/aging population.

"PPP-Physicians optimizing athletic performance in sport... and human performance in day to day life for athletes, patients, and laypersons alike."