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Nutrition, Exercise and Muscle*

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Big muscles are often associated with weightlifting, men and sports. However, for most people, the benefits of gaining muscle mass include improvement in gross motor skills, lower risk for chronic disease and a potential decrease in age-related loss in muscle mass and function (sarcopenia). When discussing the building of muscle mass, a term you need to be familiar with is *muscle protein synthesis* (MPS). In general, in order to gain muscle mass, you need to make more muscle than your body is breaking down. Research on muscle mass has shown that an outside stimulus, such as resistance exercise, is needed for building muscle. Resistance exercise is any exercise that uses resistance to muscular contraction to build strength, tone, mass and/or endurance. The resistance can be dumbbells, rubber exercise tubing, your own body weight, bricks, bottles of water or any other object that causes the muscles to contract. More recently, it has been discovered that nutrition, specifically in the form of protein, also plays a vital role in the physiology of this process [5, 6].

Research has shown that eating high-quality proteins (e.g., animal sources of protein) can stimulate MPS in both young and elderly individuals, following a meal [8]. This effect may be due to the quality (the type of amino acids) – not just the quantity (how much protein you eat) – of the protein. High-quality proteins tend to be from animal sources and include eggs, poultry, beef, fish and dairy, which are high in essential amino acids (EAA), particularly the branched-chain amino acid leucine. Data show that leucine promotes MPS at a greater rate than that of the other EAA due to leucine's ability to activate the pathway that regulates MPS [1, 3]. Other recent studies demonstrate the positive relationship between EAA and MPS [4, 9].

Resistance exercise can also increase MPS and increase muscle mass. There are two primary principles of exercise that need to occur in order for someone to successfully add muscle mass – *progression* and *overload*. The most important for MPS is overload, defined as placing additional stress on a muscle above normal conditions, and includes exercises such as weight lifting and swimming. Therefore, in order for someone to "bulk up," they must have an outside stimulus that serves to initiate MPS inside the body. There are various ways to achieve overload such as adding more weight or increasing a swimming distance, and research is still being done regarding how to maximize MPS.
A recent study examined the effect of resistance exercise on eight trained men [2] to determine if enzymes that signal muscle building were progressively increased as more sets of resistance activity were performed. The investigators concluded that performing additional sets showed a greater increase in MPS than just a single set of lifts.

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Is there an additive effect of protein ingestion and resistance exercise? As stated above, both exercise and nutrition initiate MPS, and ideally, one would have both in order to maximize muscle building within the body. For example, the effect of eating four different amounts of beef (0, 57, 113 and 170 grams) coupled with resistance exercise was recently tested in 35 middle-aged men. Results of this study showed that eating 170 grams of beef in addition to exercise significantly increased MPS when compared to the other groups [7].

In summary, MPS is complex and can be influenced by both nutrition and exercise. Both can activate MPS individually, but research shows combining the two is best to promote MPS. More research is needed to understand the long-term impact of this combination as well as the practicality of higher protein intake for individuals in order to maintain and increase muscle tissue.

Using Your Body Weight for Resistance Exercise [10]

A simple example of resistance exercise is bodyweight exercise, in which your own body's weight creates the resistance needed to strengthen your muscles. These exercises are suitable at the gym and at home, but are ideal at home if you don't have free weights or if you're on a budget. Bodyweight exercises can include:

- Squats
- Lunges
- Burpees
- Pushups
- Crunches
- Mountain climbers
- Planks

For more information on resistance exercise, see exercise fact sheets at http://www.uaex.edu/health-living/health/fitness/fit-in-10.aspx.

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