Dietary Protein Needs

One of the questions I frequently get is “how much protein should I be eating?” or “which protein supplement do you recommend?” These are great questions, but the answer is not necessarily straightforward. Protein is an important (if not *the* most important) macronutrient for human health. It really is much, much, much more than simply, “how much.” It’s how much protein, when do you eat the protein, what type of protein, the types of amino acids in the protein, are you exercising, are you losing weight, and how old you are???!!!

Because this is such a big and important subject (did I say complex?) I am breaking it down into two chapters. This first chapter simply answers, “How much protein” with modifications for protein in exercise, weight loss, and aging. We also explore the *best times* to eat protein.

The juicy stuff, like animal vs plant protein, and the effects of protein on longevity or lifespan, and healthspan (quality of health while you are alive, not how long you live) will be discussed in the next chapter.

HOW MUCH?

Let’s start with the easy (maybe) part — how much protein do I need? The National Institute of Health (NIH) recommended daily allowance (RDA) of protein is 0.8g/kg body weight for individuals age 19 or older. This number has been around for over 70 years and is derived from the estimated average requirement (EAR) for protein (0.66g/kg body weight per day) plus a safety variance of >20%. The EAR is defined as “the average daily nutrient intake level estimated to meet the requirement of half the healthy individuals in a particular life stage and gender group”.

In 2007 the World Health Organization published a 265-page report explaining in great detail their derivation methods and exceptions for protein and recommended 0.83 g/kg (WHO, 2007). The WHO comments that intakes up to twice that amount are *probably* safe but use caution when going 3–4 times this amount. Here is our first hint that too much of a good thing can be bad!

Weight (lbs)	0.8 g/kg	1 g/kg	1.2 g/kg	1.4 g/kg	1.6 g/kg	1.8 g/kg	2 g/kg
110	40	50	60	70	80	90	100
120	44	54	65	76	87	98	109
130	47	59	71	83	94	106	118
140	51	64	76	89	102	114	127
150	54	68	82	95	109	122	136
160	58	73	87	102	116	131	145
170	62	77	93	108	123	139	154
180	65	82	98	114	131	147	163
190	69	86	103	121	138	155	172
200	73	91	109	127	145	163	181
210	76	95	114	133	152	171	191
220	80	100	120	140	160	180	200

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Table 1 Total daily protein in grams per day by weight in pounds – the column is total grams allowed at the top referenced amount. Use a healthy weight with a BMI of 22-25, NOT your current weight if you are overweight or obese.

NOTE: In the above table I expanded the weight to a whopping 220#. You should use a "healthy" weight based on a BMI of 22 to find your protein level, not your actual current weight. If you are 7-foot-tall, a healthy BMI of 22 is 220 pounds!

The Institute of Medicine established the acceptable macronutrient distribution range (AMDR) for dietary protein at between 10–35% of your total calories (the average American consumes 16%). Let's put this recommendation into perspective.

An average 21-year-old, 5'10", sedentary man with a healthy BMI of 22 needs about 2500 calories per day to *maintain* that weight. At 10% of calories as protein that is 62 grams of protein. The average woman at 5'4" requires 1933 calories which is equal to 48 grams of protein. These numbers are close to the 0.8g/kg recommendations.

> *A safe recommended amount of protein is 0.8g/kg of your ideal body weight (BMI=22) or approximately 10% of your ideal energy needs.*

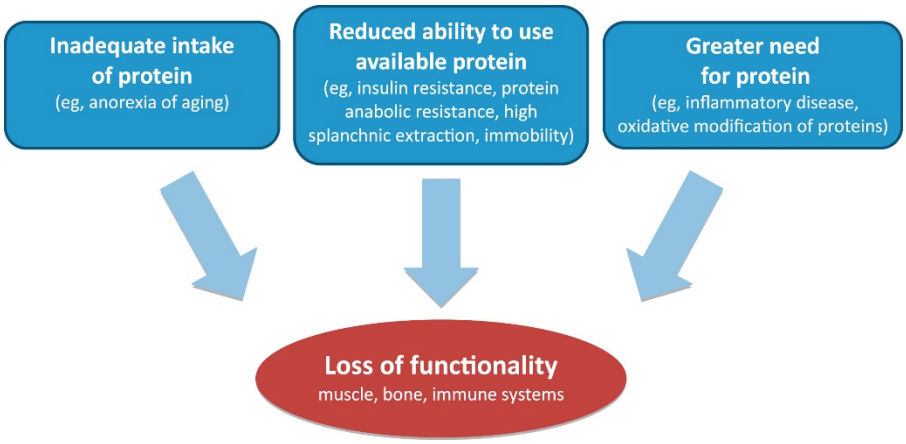
Protein Requirements Need Modifications

If only life were that simple. The recommendations above are for healthy individuals at a stable weight (not losing weight) under the age of 50–70, with a sedentary lifestyle.

So, if you are over 50 or (and I hope you are) physically active, you need more protein. Let's start with the big one, age!

Protein Intake for Older Persons

Our senior population actually needs *more* protein than younger individuals. With age we begin to lose muscle (sarcopenia), bone mass (osteoporosis) and our immune system weakens. According to the PROT-AGE (Bauer, 2013) working group, seniors should have between 1.0–1.2g/kg, that's up to 50% more than recommended for younger persons.



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Seniors have several compounding factors: Inadequate intake (anorexia or appetite loss); reduced ability to use protein (insulin resistance, resistance to building new protein, and immobility); and a greater need for protein due to inflammatory disease and oxidative damage.

Paddon-Jones et al in his review on protein from the Protein Summit 2 regarding healthy aging (Douglas Paddon-Jones W. W., 2015) made the following comments:

- 1/3 of adults over 50 fail to meet the RDA of protein (0.8g/kg).
- Sarcopenia (muscle loss) results in a 3 - 8% reduction in muscle mass per decade beginning in the 4th to 5th decade of life.
- Catabolic stressors: acute/chronic illness, injury, physical inactivity (did I say sedentary lifestyle!!!) speeds up muscle loss.
- Amino acid (building blocks of protein) absorption and its subsequent stimulation of muscle building is minimal after a 10 gram protein meal. It increases substantially at 20 grams per meal and is at its highest after a 35 gram protein meal (Pennings B, 2012)

The recommendations for a higher protein intake in seniors are especially important as seniors become weaker (frail) and more likely to succumb to falls and fractures. Mobility is reduced and enjoyable activities are forgotten or abandoned.

As a side note, the efficacy of calcium for remodeling bone is also protein limited. We need >1.2g/kg of protein for the beneficial effects (Layman, 2009) of calcium on bones.

Protein and Diabetes

Diabetics have a faster loss of muscle and higher rate of disability (another good reason to control your diet). If you have diabetes and sarcopenic obesity (both muscle loss and obesity) then you will definitely benefit from additional protein. However, if you have severe kidney disease, a side effect of your diabetes, you will most likely need to follow a *protein restricted diet*.

The American Diabetes Association recommends a normal protein intake of 15–20% of energy needs as long the kidney function is normal.

If you do have kidney disease, a low-protein diet slows the progression of diabetic nephropathy. The Kidney Disease Outcomes Quality Initiative of the American National Kidney Foundation (KDOQI) guidelines call for adults with chronic kidney disease (CKD) and diabetes to follow the same low-protein diets (0.8g/kg) as people with CKD (KDOQI, 2007). Remember, 0.8g/kg/day is approximately 10% of your total calories.

However, the amount of kidney protection with protein restriction is minimal and may not be worth the sacrifice in the elderly. The elderly still need to protect muscle loss as a result of aging. Yet, one more reason to get rid of candy, sodas, cakes, pies, cookies, and ice cream.

Protein and Kidney Disease

A study of 1,624 women in the **Nurses' Health Study** evaluated the effect of protein on normal and mild kidney disease (Knight EL, 2003). The author concluded that high protein intake *was not* associated with declining kidney function in persons with normal kidney function, however, women with mild kidney

disease do experience worsening kidney function with high protein intake. Of note, he further commented that the decline is accelerated with nondairy animal protein, i.e. red meat.

According to PROT-AGE (Bauer, 2013) other studies show that patients with CKD stages 3 and 4 benefit with a lower protein diet (0.6g/kg) which slows the progression to dialysis by 30%. An Italian study of older (>70) patients close to starting dialysis were able to delay dialysis by 11 months when on a 0.3 g/kg protein diet (G Brunori, 2007). A similar Dutch study of older patients on a diet of 0.6g/kg delayed the start of dialysis by 6 months (S Eyre, 2008).

The final recommendations by PROT-AGE for patients with CKD are:

- Severe CKD (GFR < 30) limit protein to 0.8g/kg
- Moderate CKD (GFR <60) protein > 0.8g/kg is safe but monitor
- Mild CKD (GFR > 60) protein can be increased as needed.

My personal comment is that you also need to limit animal, especially red meat, if you have kidney disease of any degree.

Protein with Exercise

The American College of Sports Medicine recommends increasing protein to 1.0g/day at age 50 and even more if you exercise regularly (ACSM). If you want to increase muscle mass in combination with physical activity, then the ACSM recommends weightlifting and the use of 1.2–1.7g/kg of protein.

The Navy Seals are arguably one of the fittest groups of young men in the world. Here are some excerpts from their nutrition guide (Patricia A Deuster, 2012).

> *"Protein needs are determined by age, body weight, and activity level. Many athletes believe that if they eat more protein, their muscles will increase in size, but this is not true. Excess calories from protein can be converted to and stored as fat. Additionally, large quantities of protein strain the liver and the kidneys."*

Nevertheless, the military recommends up to a doubling of normal protein intake for the most strenuous of workouts (but think about this – are you working out like a navy seal?). This recommendation is consistent with ACSM for intense weightlifting.

Activity Level	Protein range (g/kg)
Low to moderate	0.88–1.1
Endurance training	1.3–1.76
Strength/Weight training	1.3–1.76

Here is another comment from the Navy Seal manual:

> *"Importantly, if protein intake is high, and eaten at the expense of carbohydrates, glycogen stores may be reduced and performance compromised."*

Protein and Weight Loss

During weight loss you will lose muscle, as much as 20–30% of your total weight loss (Edda Cava, 2017) and over 35% if you are normal weight to begin with and lose weight. But, does additional protein preserve muscle during weight loss? The results from a recent review and meta-analysis found a small

but significant benefit of high protein during weight loss (Kim JE, 2016). High protein diet *slowed*, but did not prevent, muscle loss. Only resistance exercise prevented muscle loss and improved strength.

Lidia Santarpia et al in their summary of the Proceedings of the Protein Summit 2 stated: (Lidia Santarpia, 2017)

- **Weight loss**: use higher protein in the range 1.2–1.6 g protein kg/body weight (90–150g) with 20–30g of protein at each main meal (breakfast, lunch, dinner) to maintain muscle mass. This was reaffirmed in 2016 in a study of 60 obese adults in a 13 week weight-loss program with a recommendation of 1.2g/kg body weight (Weijs PJM, 2016).
- Use >= 2.2g of the amino acid leucine with each meal (not as a supplement, in your food).
- Elderly should consume between 1.0–1.5 g/kg body weight (ideal body weight).
- Santarpia uses ideal body weight (BMI 18.5–25), not current body weight.

Most of the studies on protein in weight loss are looking at the older population which we already know have a hard time preserving muscle mass already and need to increase protein intake. A 2016 study of older adults during weight loss showed that a protein intake of 1.2g/kg reduced the decline in lean tissue by 45% (Gordon I Smith, 2016).

What about younger persons? A look at young resistance-trained athletes on a 40% calorie restricted diet compared a 15% or a 35% protein content over two weeks (METTLER, MITCHELL, & TIPTON, 2010). The high protein group lost 0.3kg of muscle compared to 1.6 kg for the 15% group. Remember, these are trained athletes which already require more protein due to exercise and higher levels of muscle mass. The point is, increasing the protein helped to spare, not eliminate, muscle loss.

Another study looking at young athletes on a 40% restricted diet with 1.2 or 2.4g/kg protein *DURING* intense exercise. The higher protein group gained 1.2 kg muscle compared to 0.1kg for the lower protein group (Longland TM, 2016).

A large study performed at Curves on their members (C Kerksick, 2009) looked at several diets including high protein and low protein. There was no significant difference in the high protein group. My personal opinion is that while ladies at Curves do exercise, the intensity of resistance training is still minimal.

Overall, it seems reasonable that increasing protein should help spare muscle loss, however, it is still dependent on exercise. My belief, from these studies, is *IF* you are a trained athlete doing *LOTS* of exercise, then yes, increase protein. If you are a regular person exercising for health and weight loss, there is no need to go beyond 1.2–1.6g/kg (90-150g) (Rodriguez, 2015), *DURING* the exercise and weight loss period. After weight loss, 0.8 to 1.0g/kg/day unless you are over 60, in which case 1.0–1.2 g/kg/day is plenty.

Resistance weight training is the only sure fire method of maintaining your muscles.

Protein Frequency

Research has been done concerning protein frequency throughout the day same as research on meal frequency. The current Western dietary pattern is to consume 10 grams of protein at breakfast, 20 grams at lunch and a whopping 60 grams at dinner (Layman, 2009). According to Layman, adults require

at least 15 grams of essential amino acids (EAA) or 30 grams of total protein to fully stimulate muscle protein synthesis. The EAA leucine is the critical signal for trigging synthesis.

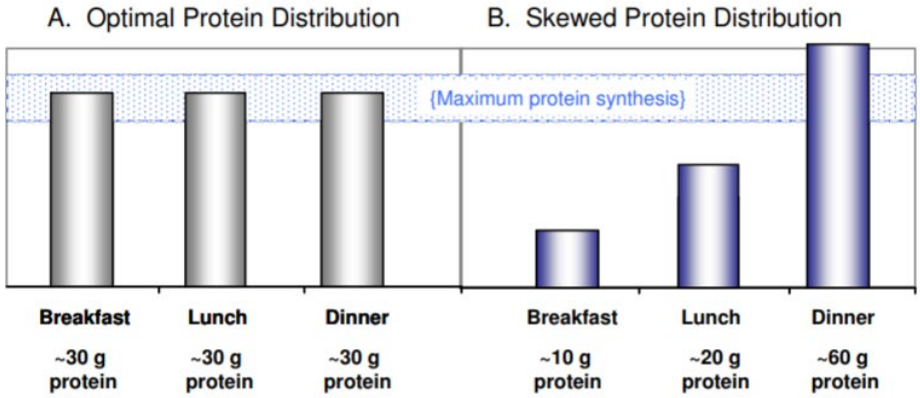


Figure 1
Protein distribution at meals. A) Ingestion of 90 grams of protein, distributed evenly at 3 meals. B) Ingestion of 90 grams of proteins unevenly distributed throughout the day. Stimulating muscle protein synthesis to a maximal extent during the meals shown in Figure 1A is more likely to provide a greater 24 hour protein anabolic response than the unequal protein distribution in Figure 1B. (Adapted from Paddon-Jones & Rassmussen Curr Opin Clin Nutr Metab Care 2009, 12: 86–90.)

Paddon, in his summary of the Protein Summit (Douglas Paddon-Jones, 2015) presented a series of hypothesis:

> *"Habitually consuming 25–30g protein at breakfast, lunch, and dinner provides sufficient protein to effectively and efficiently stimulate muscle protein anabolism and may delay the onset of sarcopenia, slow its progression, and/or reduce the magnitude of its functional consequences."*
>
> *"Including high-quality protein at each meal improves postprandial muscle protein synthesis and may delay the onset of sarcopenia, slow its progression, and/or reduce the magnitude of its functional consequences."*
>
> *"Performing physical activity in close temporal proximity to a high-quality protein meal enhances muscle anabolism and may delay the onset of sarcopenia, slow its progression, and/or reduce the magnitude of its functional consequences."*

Mamerow et al (Mamerow MM, 2014) showed that muscle protein synthesis over a 24-h period was 25% higher when the same quantity of protein was consumed evenly over three meals compared with a skewed pattern. The protein quantity/meal threshold is supported by a study looking at either 10, 20, or 35 g of whey protein in an IV drip. At 10 g protein synthesis was limited, it increased at 20 g and was the highest at 35 g of protein (Pennings B G. B., 2012).

In the introduction to Protein Summit paper by Rodriquez (Rodriguez, 2015) she also comments on the use of 25-30 grams of protein at each meal containing at least 2.2 grams of the essential amino acid leucine.

Elite athletes also benefit from spreading protein out during the day instead of the normal skewed pattern of making dinner our largest protein meal, and there is a *threshold*. Four 20g meals worked better than eight 10g meals or two 40g meals (JL Areta, 2013). Don't rush out and start eating four

meals, these are ELITE ATHELETES. The point is that there is a certain minimum amount of protein required per meal to stimulate muscle synthesis.

In a study of adults aged 55–85 more frequent consumption of meals containing 30–45g protein resulted in the greatest increase of leg lean mass and strength (JP Loennecke, 2016).

Protein, Supplements, and Exercise

Direct from the *Navy Seal Manual* regarding protein supplements:

> "Protein supplements, which provide excessive amounts of protein or selected amino acids, are ***discouraged***. Although heavily advertised, and in some cases endorsed by celebrities, very high protein intakes from supplements are not needed to build muscle. A properly balanced diet can meet your protein needs very effectively."

Just adding protein as a supplement, whey protein, to persons losing weight ***did not*** lead to any improvement in quality of weight loss in the study by Arsen (Arsen AE, 2018).

The following is from the wonderful summary by Bauer et al. (Bauer, 2013).

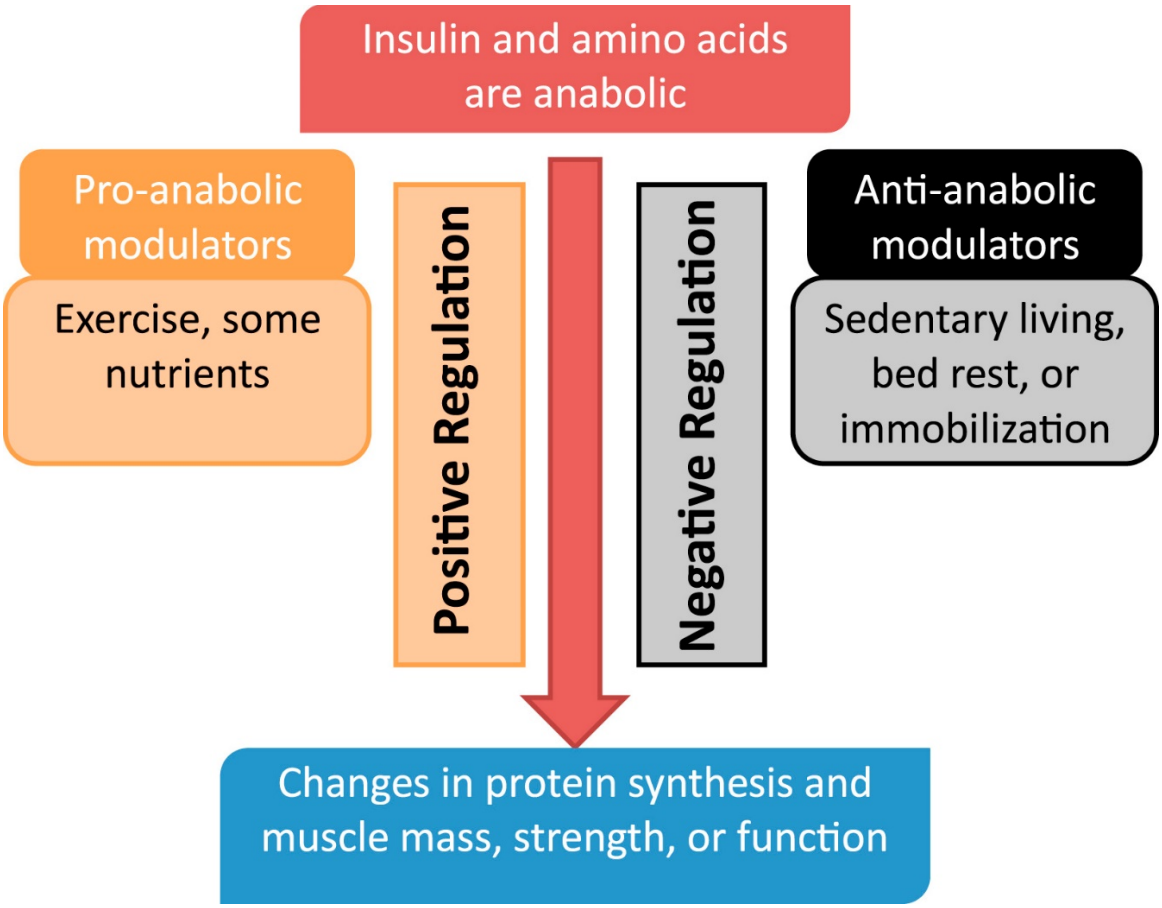
"Both insulin and amino acids induce the body to make proteins (anabolic effects) and this is enhanced by physical activity and some nutrients like omega-3 and vitamin D. The anabolic effects are impaired by a sedentary lifestyle (emphasis added). As we age, the ability to make protein slows and the response to dietary protein and amino acids is limited. Research shows that exercise and an increased intake of protein counteracts this normal aging decline in muscle."

Younger and older persons react differently to protein supplementation. In younger adults there is an increase in insulin with protein ingestion which helps build muscle (Insulin and protein metabolism., 2001). It is less clear in the elderly. The addition of carbohydrates (which increases insulin) to an amino acid supplement blunts the anabolic response (Volpi E, 2000) in the elderly. In younger individuals' carbohydrates increases protein synthesis.

One study demonstrated that 15 grams of essential amino acids stimulated muscle protein anabolism in both young and elderly persons (Douglas Paddon-Jones, 2004). There was one main difference, the elderly did not have an increase in insulin levels with the infusion. In 2012 Tieland showed that muscle strength and physical function (not muscle mass) improved when frail older people were supplemented with 15g of protein at breakfast and lunch (M Tieland, 2012). Again, this protein supplement should be from food, not powders.

According to PROT-AGE both the young and old make new muscle when exercise is combined with protein supplements. The effects were present for both aerobic and resistance exercise. Exercise alone reduced the difference between the breakdown of protein and the synthesis of protein. The synthesis only exceeded the breakdown of protein when supplementation of protein was added to exercise. Tieland again showed that resistance training and protein showed significant increases in muscle mass (Tieland M, 2012)

The quality of the protein has a major effect on the result. High leucine-containing and rapidly digested whey proteins showed an advantage over casein and soy proteins.



Recommendations from Tieland include:

- 20 grams protein after exercise.
- 2 - 2.5 grams of leucine should be part of the protein.

A review by Layman comments that meals with less than 1.8g leucine produce little muscle building response. Over 2.2g of leucine will stimulate muscle synthesis (Donald K Layman, 20015). Leucine works via the MTORC1 activation which is a signal to initiate muscle protein synthesis. Once the pathway is initiated, further increases in leucine does not affect it (in another words, more is not better). mTORC1 is activated within 30 minutes after a meal and maximum protein synthesis occurs at 60–90 minutes and then declines within 2–3 hours.

Physical activity changes amino acid utilization in muscle. Resistance exercise increases both synthesis and breakdown of muscle. In fasting conditions, the breakdown exceeds production for a net loss. There must be protein intake.

Regarding timing, the effects of exercise last at least 24 hours. Untrained (sedentary) subjects had a greater response to a meal 24 hours after resistance exercise (Burd NA, 2011). With training, the effect is shorter lived, and it may be best to consume protein within 2 hours of exercise (Hartman JW, 2007). The optimum meal response for older sedentary individuals is >25g protein, whereas, young, healthy,

active men respond to 15 grams. Exercise enhances the protein synthesis in older adults and reduces the minimum meal threshold (Yang Y, 2012).

According to the review by Layman, inactivity blunts the activation of the mTORC1 pathway. Short-term bed rest results in significant loss of muscle in both the young and the old. A study of older adults that reduced their daily step-count by 76% reduced muscle synthesis, increased insulin resistance and inflammatory markers. But, a single bout of resistance exercise before ingesting amino acids (protein) reverses the anabolic resistance.

PROTEIN SUMMARY

Note: body weight is your ideal body weight, NOT your current body weight

- Chronic Kidney Disease stage 3 or 4 — 0.6g/kg/day
- Recommended Dietary Allowance — 0.8g/kg/day
- World Health Organization — 0.83g/kg/day
- Institute of Medicine — 10–35% of calories
- American Diabetes Society — 15–20% (if you have diabetes without kidney disease)
- Persons in their 50s — 1.0g/kg/day
- Persons in 60s and older — 1.0–1.2g/kg/day
- Weight loss intensity — 1.2–1.6g/kg/day (90 - 150g) depending on exercise
- American College of Sports Medicine — 1.2–1.7g/kg/day (if exercising)
- Elite Athletes, during weight loss — 1.6–2.4g/kg/day

Timing of protein consumption

- Even distribution of protein with meals: 20–35 grams/meal for older adults; 15 grams/meal for younger adults.
- 20 grams protein within two hours of exercise.
- 2–2.5 grams of leucine should be part of the protein meals for maximum muscle sparing.
- Avoid protein supplements
    - Unless age 60 or greater and not able to consume adequate protein. If you do need to supplement use whey protein or branched chain amino acids with leucine.

NOTE: if you have diabetes and severe kidney disease you may need to decrease your protein to 0.6–0.8g/kg/day. Follow your doctors advise.

I realize that for most of us converting grams per kilogram per day into real life meals is difficult at best. I place the numbers here because that is how all the agencies and research studies put them. But fear not. I will be providing detailed food tables with various sources of protein together with grams of protein per ounce of food and the amino acid content for all important amino acids. In addition, I will be providing suggested meal plans and menus for you to follow.

The journey to a healthier, fitter, and better performing you continues!

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