A Closer Look

You know protein is important for athletes, but have you heard about the latest research on recommended doses, which sources are best, and protein's role in recovery? In this roundtable discussion, our expert talks with leading nutrition researchers about those topics and more.

By Dr. Janet Walberg Rankin

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Editor's Note: Scroll to the bottom of this page to see biographical information on the five nutrition researchers interviewed in this article.

Few topics in sports nutrition are as controversial as dietary protein. But despite the many unknowns and uncertainties, protein is a major dietary focus for many athletes. A recent survey of over 300 athletes at an NCAA Division I university showed that nearly half believed protein was a major fuel source during exercise, and about a third believed that taking protein supplements was a necessity.

Does research support the value of protein for performance, muscle building, and enhancing glycogen recovery after exercise? How much protein should athletes consume, when should they consume it, and what specific protein sources are best? To answer these questions and others, I talked to five researchers who are well known for their work exploring protein needs among athletes.

In some areas, a clear consensus emerged, providing athletes with practical advice and guidelines on the best strategies for protein intake. In other areas, the researchers didn't agree, and in their conflicting responses we see the newest frontiers and most contentious areas of inquiry into protein and athletic performance. They were also able to dispel a few protein-related myths, providing information that every athlete can benefit from.

What research is your lab currently conducting regarding dietary protein and athletes?

Stuart Phillips: We are interested in how muscle loading interacts with different amounts and types of protein to affect muscle protein turnover (synthesis and breakdown). We think proteins that are digested and absorbed rapidly and are rich in leucine, such as whey, are particularly effective. Our recent data has also shown that relatively small doses of protein (20 grams) are effective for stimulating protein synthesis.
**Brian Roy:** Our current interest is the influence of hydration state on muscle and protein metabolism. We have developed an isolated muscle model to evaluate the acute influences of fluid shifts into and out of skeletal muscle. We are also interested in the signaling processes involved in protein synthesis and degradation within skeletal muscle.

**Elisabet Børsheim:** Our lab is focused on determining the role of essential amino acids in the regulation of muscle protein synthesis. Our research demonstrates that the change in blood essential amino acid concentration is more important than the absolute concentration for stimulating muscle protein synthesis. This may help us find the optimal pattern of ingestion--for example, suggesting that frequent, small doses may be more valuable than one large dose.

We have also shown that providing 22 grams of essential amino acids in two equal doses (11 grams each) per day increases lean body mass and muscle strength in elderly people. More recently, our research has turned to the effect of amino acids on fat metabolism.

**Martin Gibala:** First, we are interested in the impact protein has on skeletal muscle metabolism when ingested during aerobic exercise. Various theories have been advanced to explain some authors' finding that ingesting protein and carbohydrate together improves exercise performance compared to ingesting carbohydrate alone, but no studies have investigated the mechanisms. Second, in collaboration with Dr. Phillips, we are exploring the impact of protein ingestion following aerobic exercise on muscle protein turnover. The effect of nutrient ingestion on muscle protein metabolism during recovery from endurance exercise remains largely unknown.

**Nancy Rodriguez:** My research relates to the interactions between exercise, protein intake, and energy balance on skeletal muscle protein turnover. For example, we have evaluated the effects of different protein intakes on skeletal muscle protein metabolism, and looked at whether a short-term reduction in energy intake affects the use of protein as a fuel at rest or during recovery from exercise. In addition, we have explored the effects of specific protein sources on recovery from an endurance exercise bout.

**How much protein do you recommend that athletes consume daily?**

**Børsheim:** For endurance athletes, I would say 1.2 to 1.4 grams per kilogram of body weight per day--only slightly more than the typical recommendation for sedentary individuals. The absolute use of protein for energy in any given workout is likely small, but it can translate into higher needs for those with high training volume.

For athletes doing resistance training, I would recommend up to 1.6 or 1.7 grams per kilogram per day, but the precise amount is controversial. The increased need in these athletes is caused by frequent elevated muscle protein synthesis following workouts. Interestingly, more experienced resistance athletes appear to require less protein than those just starting a program. Generally, most healthy
young athletes ingest sufficient protein through their ordinary diet to support muscle growth.

Rodriguez: Although there is not much contemporary research on the subject, athletes who are in energy balance likely only need the recommended daily allowance (RDA) of protein—0.8 grams per kilogram of body weight per day—to maintain nitrogen balance. However, findings in our lab indicate that this amount may be insufficient to optimize skeletal muscle protein, and we've observed a better protein balance with daily protein intake of 1.6 grams per kilogram. Therefore, from a practical perspective, I recommend a range of 1.2 to 1.7 grams per kilogram per day for endurance athletes, with special attention paid to energy balance.

Roy: I support the contention that protein requirements of athletes are likely similar to those of the general population. Early nitrogen balance studies suggest that athletes who consume an adequate amount of energy do not require much more protein than the RDA.

What is the maximum protein intake you recommend for athletes?

Phillips: Roughly two grams per kilogram of body weight per day would be the ceiling beyond which I'm not sure benefit occurs. At some point, protein actually begins to "steal" carbohydrates from the diet, and we know how important carbohydrate is to athletic performance.

Roy: I would recommend a maximum protein intake of around 1.3 grams per kilogram per day. This should be more than adequate to meet the needs of both resistance and endurance athletes. Research suggests that intake above this amount has no added benefit, and may carry some risks.

Børsheim: There is no support for athletes consuming more than 2.5 to 3.0 grams per kilogram of body weight per day, nor is there good evidence that these doses are dangerous. Any excess protein will be used as fuel and not used to boost muscle protein. However, in some instances, high protein intake may reduce carbohydrate intake, which could negatively impact training.

Rodriguez: I do not believe protein intake above 1.8 to 2.0 grams per kilogram per day confers any additional benefit. If the kidneys are healthy, concern about high protein consumption hampering renal function is likely unwarranted, but there is some evidence that very high protein intake can lead to dehydration.

What does the latest research say about the timing of protein consumption?

Roy: I believe timing is the most important variable in regard to protein intake. Since most athletes consume enough protein during the day, timing is likely the most critical factor affecting protein synthesis and recovery from exercise. There is still no definitive answer on the possible benefits of adding protein to carbohydrate beverages during endurance exercise, but there is some evidence that protein ingestion during endurance work may decrease muscle damage. More research is needed in this area.

That said, I would caution athletes that consuming too much protein during exercise could slow the digestion or absorption of carbohydrates and electrolytes. Protein ingestion while exercising may increase glycogen synthesis
post-exercise, but there is still scientific controversy on this topic. In contrast, there is no debate that consuming high-quality protein after resistance exercise stimulates increased protein synthesis. We just don't have the long-term data to conclude whether it's better to consume protein during or after workouts.

**Gibala:** A growing body of work suggests that the strategic timing of protein ingestion around a workout can affect training-induced gains in lean mass and strength. For example, one study reported that young men who consumed a protein-containing supplement immediately before and after each workout for 10 weeks had more gains in lean mass, strength, and muscle fiber area than those who consumed the same supplement at other times of the day.

**Børsheim:** I believe there is currently not enough evidence that protein consumption is needed during aerobic exercise or even after exercise for muscle glycogen replacement if enough carbohydrate is ingested (approximately 1.2 grams per kilogram of body weight per hour during the first two to five hours). However, if the optimal carbohydrate amount is not ingested, adding protein in the first hours after exercise may increase glycogen replacement. For resistance exercise, the literature suggests ingesting protein within the first two hours after a workout, as well as several times throughout the day, to promote maximum protein synthesis. A supplement or food containing roughly 10 to 15 grams of essential amino acids seems to maximally stimulate muscle protein synthesis.

**Do you believe particular types of protein are superior to others for athletes?**

**Phillips:** A number of studies support the finding that milk-based proteins, and whey in particular, are more effective than other proteins in the promotion of muscle hypertrophy.

**Roy:** Two recent studies showed that milk-derived proteins, taken acutely or chronically, are superior to protein from soy for stimulating muscle mass growth when combined with resistance exercise. Very recent work also suggests that whey hydrolysate might be superior to casein and soy protein after exercise, but further research and evaluation are needed to confirm this.

**Børsheim:** Various types of protein stimulate muscle protein synthesis differently after resistance exercise because of minor differences in amino acid composition and digestion rate. The amount of essential amino acids, specifically leucine, may be important. For example, research shows that milk is superior to soy protein in stimulating muscle protein synthesis after exercise. Whey protein is absorbed rapidly, and some evidence shows it to be superior to other protein sources, but long-term studies are needed in this area.

**Rodriguez:** Various studies in our lab have looked at diet interventions that incorporate high-quality proteins such as eggs and beef. Findings from this work suggest that protein quality and the intake of essential amino acids in the correct amounts are important to support muscle protein synthesis.

**Gibala:** Work from Dr. Phillips's lab has suggested that milk is superior to soy in terms of promoting the skeletal muscle adaptive response to resistance exercise. One study showed milk consumption to have a superior effect on protein
synthesis as compared to soy consumption in the hours after a weightlifting bout. Subsequent research demonstrated greater lean mass and Type II muscle fiber area gains over 12 weeks in those who consumed milk regularly after each workout as compared to those who consumed soy.

**Does the form of protein ingested affect athletic performance?**

**Roy:** Food-based proteins, such as those in milk, are more than adequate to meet the needs of athletes, as long as they are rich in essential amino acids. The value of co-ingestion with other nutrients remains unknown. The fact that food-based protein is generally consumed with other nutrients, such as carbohydrate and micronutrients, provides another advantage as compared to protein or amino acid supplements.

**Børsheim:** Ingestion of essential amino acids causes a more rapid response than intake of complete protein, because they enter circulation more quickly and thus begin to stimulate muscle protein synthesis. Ingesting carbohydrate with protein may lead to a more prolonged effect on muscle protein synthesis because of the enhanced insulin release. The best consumption strategy may be a combination of essential amino acids, protein, and carbohydrate after exercise, as this would cause both a rapid and a prolonged stimulation of protein synthesis.

**Do certain athletic populations have unique protein needs?**

**Phillips:** In my view, too few studies exist to support setting specific requirements for specific populations. However, there appears to be an advantage to maintaining higher protein intake (up to 35 percent of energy intake) for those looking to lose weight, at the expense of dietary carbohydrate (40 percent). Although these recommendations are at the ends of the acceptable macronutrient distribution ranges for general health, I think they can be extended to athletes who are not overly reliant on carbohydrate fuel.

**Børsheim:** Elderly individuals may require increased protein intake, or possibly amino acid supplementation, in order to avoid muscle loss. But overall, we know little about the specific needs of elderly athletes.

**What myths about protein exist in the athletic world that aren't supported by science and should be debunked?**

**Phillips:** The biggest myth is that "more is better" and that power training or resistance training athletes need more protein to achieve muscle growth or strength gains. Our work has shown that, if anything, these athletes actually require much less protein than those who are sedentary.

Among our research subjects, we’ve found that during resistance training, total protein balance is more positive and less protein is oxidized for energy than when the subjects are sedentary. This supports the concept that resistance exercise is anabolic and conserves body protein rather than increasing loss. Further, our data suggest that just 20 grams of protein maximally stimulates protein synthesis, and this response lasts for three to four hours. Thus, if you consume 20 grams of protein four to five times per day, you’re covered.

**Roy:** One myth that needs to be debunked is the idea that athletes must take protein via a supplement. It is evident from current research that foods containing
high-quality proteins with essential amino acids can maximally stimulate protein synthesis. Furthermore, food contains other valuable nutrients that may facilitate recovery, and it is generally a more palatable and cost-effective strategy than supplements.

Another myth is the perception that the greater the amount of protein consumed, the greater the amount of hypertrophy. That just isn't supported by research.

**Rodriguez:** A myth still persists that eating more protein will result in increased muscle mass. Athletes must eat enough food to have a positive energy balance and adequate protein levels. But more protein isn't always better.

**What current research on protein and athletes are you watching most closely, and why?**

**Phillips:** I am interested in the research looking at leucine supplementation. Studies support both sides of the debate on this essential amino acid. Reading some magazines and Web sites, you would think leucine will result in amazing muscle gains. In my view, that concept is completely off-base.

**Gibala:** I think there is going to be an explosion of interest in the potential for protein ingestion during recovery from aerobic exercise to maximize recovery and augment training-induced adaptations. Numerous studies have investigated the influence of protein source, amount, and timing on muscle accretion after resistance exercise, but the effect of nutrient manipulation on muscle protein metabolism during recovery from endurance exercise remains largely unexplored. Techniques are now available to quantify changes in specific fractions of the muscle cell, as well as the molecular process involved in the adaptive response.

**What unanswered questions are most in need of further research regarding protein intake for athletes?**

**Phillips:** Although difficult and expensive to research, we need to determine whether ingesting certain levels of additional protein over time really confers benefits for muscle mass gain and strength development. This is especially important to study in the elderly.

In addition, we need to develop new methods to more accurately measure requirements for protein. Nitrogen balance is a tired old method that gives no useful information about actual protein requirements. No physiological outcome has ever been associated with being in "nitrogen balance."

**Børsheim:** Areas that are still not fully understood include the impact of type and timing of protein, concurrent ingestion of other nutrients with protein, and whether protein requirements vary for athletes in specific sports and activities. In fact, relatively little is known about the protein needs of athletes competing in sports other than running, cycling, and resistance exercise. The effect of an athlete's gender on protein needs, and the effect of protein intake on fat metabolism, are also unresolved.

**Gibala:** A major unanswered question is: Does protein ingestion during and/or immediately following aerobic exercise attenuate skeletal muscle fiber disruption, and if so, what is the mechanism? Several studies have reported that protein ingestion attenuates the rise in markers sometimes used to estimate muscle
damage, such as creatine kinase, whereas other studies have failed to show a difference. Despite widespread use of these indirect markers, they correlate poorly with changes in muscle function and might not represent true muscle damage. New techniques may emerge that offer more sensitive indicators of muscle damage and can help clarify our understanding of how protein ingestion might improve recovery following exercise.

Sidebar: **OUR PANEL**
Elisabet Børsheim, PhD, recently joined the Department of Sports Medicine at the Norwegian School of Sport Sciences as a Professor. Before that, she was with the Metabolism Unit, Department of Surgery, at the University of Texas Medical Branch (UTMB) for more than nine years. She still holds an appointment with UTMB.

Martin Gibala, PhD, is a Professor of Kinesiology at McMaster University in Canada. He has served as a consultant to several leading sports organizations, and co-authored consensus statements on sports nutrition for the International Olympic Committee and the International Association of Athletics Federations.

Stuart Phillips, PhD, is a Professor of Kinesiology at McMaster University in Canada with a cross-appointment in medicine. He is frequently an invited speaker and writer of reviews related to exercise and protein.

Nancy Rodriguez, PhD, RD, CSSD, FACSM, is a Professor of Nutritional Sciences in the College of Agriculture and Natural Resources at the University of Connecticut, where she holds joint appointments in the Departments of Kinesiology and Allied Health Sciences. She also serves as the Director of Sports Nutrition in the Department of Sports Medicine.

Brian Roy, PhD, is an Associate Professor of Physical Education and Kinesiology, and the director of the Centre for Muscle Metabolism and Biophysics at Brock University in Canada.

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