AUGMENTED PROTEIN INTAKE FOR ATHLETES: ARE SAFETY CONCERNS WELL FOUNDED?

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INTRODUCTION

Numerous reviews of scientific research on protein needs of various athletes have concluded that high-protein diets are appropriate and beneficial, particularly for those interested in accretion of muscle tissue through resistance exercise. A high-protein diet, for our purpose, is 1 that supplies greater than the recommended dietary allowance (RDA) of 0.8 g protein per kg bodyweight per day. Research reviews have estimated that athletes generally require from 1.2 to 2.0 g protein per kg bodyweight per day, (1–7) with few contemporary writings disputing a greater protein need for athletes. (8, 9) Nevertheless, many concerns persist regarding the health risks potentially associated with a diet high in protein.

DISCUSSION

Is a high-protein diet linked to osteoporosis?

Protein and the minerals calcium and phosphorous have a complex relationship. The net effect of protein alone is to cause calcium loss in urine. The net effect of phosphorous is to decrease urinary losses of calcium in order to increase calcium retention.

The prominent belief that increased dietary protein perturbs calcium balance arises at least partly from studies that administered protein isolates devoid of their natural phosphorus while keeping dietary calcium and phosphorus constant. For example, 1 study tested calcium retention against diets containing 47, 95, and 142 g protein per day, with the protein above 47 g per day being supplied as protein isolates. (10) The researchers found that the extra protein significantly increased urinary calcium excretion. Similarly, another study assessed the effects of a diet containing 75 g protein daily versus 225 g protein daily while attempting to hold

phosphorus intake constant. (11) These investigators, too, concluded that the high-protein diet increased calcium excretion, also showing that maximum calcium excretion occurs within 3–5 days of beginning a high-protein diet and remains elevated for at least 3 months. It has been reported that a minimum of 8 other studies were conducted in a similar fashion, keeping calcium and phosphorus intakes constant across various protein intakes. (12)

In contrast to the above findings, another study raised protein and phosphorous consumption proportionately, rather than increasing protein intake alone. Protein intakes were 50 versus 150 g per day; no significant disturbances to calcium balance were documented. (12) To this point, all previously cited studies allowed only 500 mg calcium per day (<50% of the recent RDAs of 1300 mg for 25 to 50 year olds). Further research revealed calcium losses are minimized when an increase in meat protein is accompanied by an increase in the phosphorus naturally present in the meat. (13) This study also tested a high-protein group including dairy products to bring the calcium ingestion from 590 mg per day to 1370 mg per day, which resulted in a highly positive calcium balance. Yet another study reported that increasing protein intake may have a favorable effect on bone mineral density when subjects were simultaneously supplemented with calcium and vitamin D. (14) Finally, a recent study assessed the effects of dairy supplements, which are high in both calcium and protein, on bone mineral density in teenage girls. After a 2-year randomized controlled study, those who had a significantly increased calcium and protein intake from dairy sources showed a significant increase in bone mineral content in the trochanter, lumbar spine, and femoral neck. (15)

In addition, epidemiological studies have failed to show a negative impact of high amounts of dietary protein on bone. In their review, Arnaud and Sanchez cite 2 studies, 1 on fracture rate and 1 on bone mass, that found no adverse associations between protein intake and bone. (16)

Regarding calcium losses and protein ingestion, the National Research Council, which formulated the previ-

ously utilized RDAs, acknowledges that as dietary protein intake increases phosphorus intake naturally follows: "Because of the opposing effects of protein and phosphorus on urinary calcium and calcium retention [the former decreasing calcium retention and the latter promoting it], a simultaneous increase in the intake of both, a pattern characterized by milk, eggs, and meat ingestion, has but little effect on calcium balance at recommended levels of calcium intake." (17) Hence, that chronic high-protein consumption may contribute to osteoporosis appears unlikely.

In consideration of the resistance-training enthusiast, observation reveals many protein supplements for strength-trained persons are commonly fortified with 25–100% of the RDA for phosphorus and 25–160% of the RDA for calcium. Moreover, resistance training itself is a strong stimulus for bone mineralization. (18,19) A very recent study comparing body builders with other athletes did not find an increase in calcium excretion in bodybuilders even though they consumed nearly 50% more protein and more calcium than the other athletes. (20)

Given this body of evidence, it is unlikely that increased protein consumption will have negative effects on calcium retention in individuals engaged in resistance training who consume the majority of protein as meats, eggs, dairy products, or fortified whole-protein supplements.

Is a high-protein diet atherogenic?

Proteinaceous foods such as red meat, eggs, and dairy products commonly contain considerable saturated fat and cholesterol. Although a high-protein diet may therefore be thought to provide excessive lipid content that could contribute to formation of atherosclerotic plaque, studies on the dietary habits of recreational and competitive resistance-exercise trainees have repeatedly shown very low total fat and saturated fat consumption. (21,22) Moreover, a recent epidemiological study by Hu et al. demonstrated that high protein intakes were actually associated with a lower risk of ischemic heart disease. (23) Not only was the decrease in heart disease related to vegetable sources of protein, but animal sources contributed to this decrease in risk as well. (23)

Body building-type exercise itself has been shown to positively affect blood lipid parameters with short-term (24) and long-term programs. (25–27) These positive effects, however, are not seen in trainees who abuse

anabolic-androgenic steroids. (28) Provided a steroid-free resistance trainee makes an effort to maintain a moderate intake of saturated fat by opting for lean meats and reduced-fat dairy products, high-protein diets are not atherogenic.

Is a high-protein diet deleterious to renal function?

Possible negative effects of a high-protein diet on renal function were speculated by Brenner et al (29) who proposed that narrowing of the renal microvasculature, a common consequence of aging, is accelerated by excess protein intake. But, Brenner and colleagues deemed this possible risk "acceptable" for healthy individuals. The National Research Council indicates that there is no human study supportive of excess protein leading to renal sequelae. (17) Notably, at least 1 murine study has shown a beneficial effect of high-protein diets on renal function. (30)

There is a distinction between a high-protein diet versus a diet with excess protein. A diet with excess protein is just that: a diet with protein beyond physiological needs that must be degraded and its resultant waste products (eg, urea) excreted in the urine. A high-protein diet for the resistance trainee, on the other hand, should provide enough protein to maintain muscle mass and a little extra for growth. Hence, a high-protein diet in a strength-trained individual is not necessarily an excessive-protein diet and would not impose any additional load on the renal system. A recent study suggests a modestly excessive-protein diet may be more wasteful than it is lethal. This study (20) indicates that even though body builders normally over-consumed protein beyond that necessary to increase a marker of lean body mass, body builders showed no evidence of harmful effects on any of several markers of kidney function despite this excessive protein intake averaging 250% of the RDA. Accordingly, neither was the other group of athletes observed in this study, who consumed a more moderate 170% of the RDA, found to have compromised kidney function. The authors conclude, "...Up to 2.8 [g protein per kg bodyweight per day], we cannot detect any serious harmful effects from high dietary protein intake."

What should clinicians tell athletes?

Based on research conducted with trained and untrained individuals, there seems to be no basis for fear of supra-physiological protein consumption by healthy persons. (31,32) As further evidence of the relative safety of high-protein diets, a recent murine study re-

vealed decreased oxidative stress in rats consuming a high-protein diet as compared to an adequate-protein diet. (33) The National Research Council essentially supports this view on safety, writing, "Habitual intakes of protein in the United States are substantially above the requirement, and although there is no firm evidence that these intake levels are harmful, it has been deemed prudent to maintain an upper bound of no more than twice the RDA for protein" [1.6 g per kg per day]. (17)

CONCLUSION

The vast majority of Americans, especially certain athletes, already consume protein in amounts greatly surpassing the conventional recommendations. (22,34,35) In fact, many physically active people, particularly body builders, consume an abundance of high-quality protein, (22) which would conceivably decrease physiological stress because there is less waste product generated. If the average, typically sedentary, American consumes 2–3 times the RDA of protein but does not routinely develop kidney disease, there is little reason to suspect that healthy active persons consuming generally healthier diets containing higher quality protein would be at risk for renal disease. Nor are there convincing data that osteoporotic or atherosclerotic sequelae would result from a high-protein diet, particularly if consumed in conjunction with an exercise regimen.

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