Bone Health in Athletes: Beyond the Basics
Written by: Claire Reinking MS, RD

Written by a Collegiate and Professional Sports Dietitians Association Registered Dietitian (RD). To learn more about sports nutrition and CPSDA, go to www.sportsrd.org.

A healthy skeletal system is essential for people of all ages, especially athletes. While dynamic load exercise can benefit bone health, nutrition also plays a crucial role in ensuring healthy bones throughout the lifespan. Undernutrition and consuming limited amounts of essential nutrients for bones can lead to serious injuries. For example, if there is an imbalance between training and nutrition, it can lead to injuries such as stress fractures, or it can cause the quality/structure of bone to change (osteoporosis). Athletes consuming restricted diets may have a limited calorie intake or fail to provide their bodies with enough nutrients to create healthy bones.

For an athlete, injuries can have significant impacts on their career. Stress fractures account for about 20% of all sports medicine injuries.[1] These injuries can take athletes out of training and competition for weeks to months while the bone heals. And assuming everything goes right, it might still take 6-8 months for any measurable change in overall bone density. The risk of additional stress injury may be high. Thus, it is important to ensure athletes get proper nutrition by consuming adequate calories for their energy expenditure and including specific vitamins and minerals that are vital for bone health. These nutrients include protein, calcium, vitamin D, vitamin K, and magnesium.[2]

Protein

Athletes require adequate protein to rebuild muscle and to aid in the recovery process surrounding training.[2] Beyond this sports nutrition staple, protein plays a crucial role in bone health because it is part of the bone matrix in the form of collagen. Protein also has a role in producing hormones and growth factors that modulate bone synthesis.[2] Bone undergoes continuous remodeling and thus needs an adequate supply of amino acids. We can provide the body with amino acids by regularly consuming protein throughout the day. Athletes should aim to consume 1.2-2.0g/kg of body weight based on activity levels for adequate muscle growth/repair and to ensure strong bones, which is above the RDA of 0.8g/kg for non-active individuals.

Food Sources: Meat/seafood, dairy, eggs, fish, beans, lentils, nuts/seeds, whole grains, soy[2]

Calcium

Dietary calcium intake plays a key role in skeletal mineralization and is necessary for normal growth, development, and bone strength.[3] Bone is a major storage site of calcium, but calcium is also needed for other bodily functions such as nerve signaling, muscle movement, hormone release, and vasoconstriction/vasodilation of veins. Inadequate calcium intake can cause calcium to be pulled from the bones (demineralization) to provide a source for these other critical functions. If this happens for long periods, it can cause bones to weaken, create bone loss, and produce a higher risk for bone injuries and osteoporosis later in life. It is recommended for athletes between the ages of 19-50 to consume at least 1,000 mg/day to support healthy bones.[4]

Food sources: Dairy products, tofu, green leafy vegetables, broccoli, okra, soybeans, almonds, fortified products (e.g. orange juice, some cereals)[2]

Vitamin D

Vitamin D plays a vital role in calcium absorption and bone mineralization. Inadequate vitamin D intake over long periods can limit calcium absorption and cause bone demineralization to occur.[5] Limited calcium absorption and continuous bone breakdown can weaken bones and increase fracture risk. Few foods naturally contain vitamin D, but it can also be synthesized on the skin through sunlight, and most people meet at least some of their needs through sun exposure. However, many athletes still have insufficient levels due to their time spent indoors or reduced sun exposure from clothing or geographic location.[5] The RDA for vitamin D is 600 IU per day to prevent a vitamin D deficiency, but athletes may need more in some cases. Supplemental doses of vitamin D3 may be necessary for athletes with low blood levels. Athletes may need to take between 2,000 – 5,000 IU daily, which can be determined by speaking with their sports dietitian or physician.[6]

Food sources: Fish, mushrooms, eggs, fortified foods (e.g. milk, cereals)[7]

Phosphorus, Vitamin K, and Magnesium

Phosphorus, vitamin K, and magnesium aid in bone formation and can help improve bone health. If the intake of any of these vitamins is low, it can cause bones to weaken and prevent bone healing.[2] Although abundant in foods, these nutrients need to be focused on as they are necessary to support strong bones. Supplementation for these three nutrients above the DRI is unnecessary as they may pose adverse health effects if high levels are consumed.

Food Sources:[2]

Phosphorus (700mg/day)	Dairy, meats, poultry, fish, nuts, beans
Vitamin K (120mcg/day for men, 90mcg/day for women)	Leafy greens, broccoli, soy foods, prunes, pumpkin
Magnesium (400mg/day for men, 310mg/day for women)	Pumpkin seeds, chia seeds, almonds, spinach, soy foods, avocado, cashews, legumes

Heavy metals and bone health:

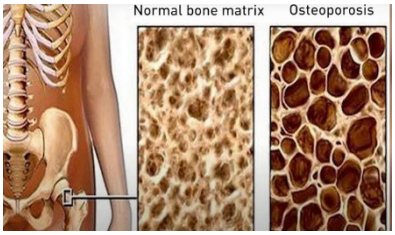
The presence of metals in the environment can be of some concern as they can enter the body through food, skin, or inhalation and accumulate in tissues and organs. Metal intoxication can negatively impact health and alter different systems in the body depending on the metal. Exposure to different metals can induce an imbalance in the bone remodeling process and alter the formation or breakdown of bone, leading to different bone diseases.[8] Some athletes, such as tactical athletes, may be at a higher risk for metal exposure due to their work with specific tools and different environmental exposures. For example, long-term lead exposure can cause bones to weaken and increase the risk of bone fracture. Bone is a storage site for lead, which has similar physical properties to calcium. Lead can replace the calcium in bones, causing decreased bone mineral density.[9] Adequate calcium intake is necessary to limit lead depositing in bone. It should be noted that vaping and e-cigarettes can also expose individuals to heavy metals such as arsenic, chromium, and lead.[10] If an athlete has exposure to heavy metals, it is important to avoid

nutrition deficiencies and speak to a qualified healthcare provider who can appropriately check lead levels.

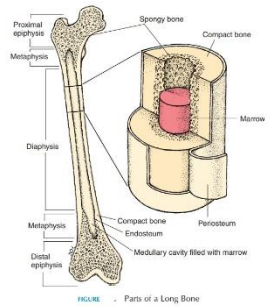
Nutrition ensures athletes build strong bones and can train/recover optimally. A balanced diet and overall calorie intake are foundational to building healthy bones while incorporating key nutrients can further support bone health and may help mitigate some sports-related injuries.

Possible pictures to include?

Stevens , R. (2023). *Stress fractures: Causes, risks, and treatment options*. Healthnews. https://healthnews.com/health-conditions/musculoskeletal-disorders/stress-fractures-causes-risks-and-treatment-options/



Blogpost. Are You at Risk for Osteoporosis? (2023). https://www.sunwaymedical.com/en/blogpost/are-you-at-risk-for-osteoporosis



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