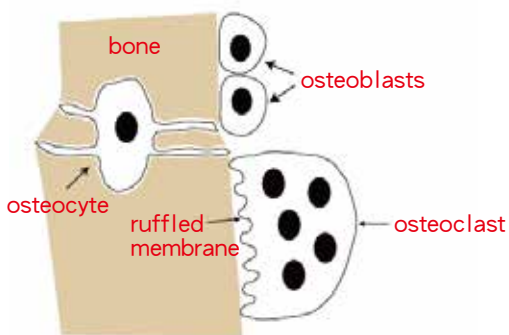




## Micronutrients for Bone Health

The skeleton serves as a mineral storehouse for our bodies, acting primarily as a reserve for calcium and phosphorus. While it may seem like an inert structure, the skeleton is made of tissues and cells that are continually active throughout our lifetimes. Bones grow in size and shape during childhood, adolescence, and early adulthood. The replacement of old bone tissue by new bone tissue, known as a process called 'remodeling' – occurs throughout our lives. The remodeling phase consists of a constant process of bone resorption (breakdown) and formation, resulting in the replacement of old, damaged and brittle bone with new bone. During this process calcium and phosphorus are released into the circulation as needed.



(Two types of bone cells are involved in maintaining mineral balance in bone. Osteoclasts dissolve bone, liberating mineral into the blood stream. Osteoblasts build the bone matrix, depositing mineral onto a collagen protein matrix which acts as a scaffold or framework. If our bodies are mineral deficient, the resulting bone will also be low in mineral density)

Beginning around age 34, the rate of bone resorption exceeds that of formation, leading to an inevitable loss of bone mass with age. If bone mass falls to a critically low level, bone softening (osteomalacia), pre-osteoporosis (osteopenia), osteoporosis, and bone fracture can occur.

Nutrition and physical activity play important roles not only in building bone mass during childhood and young adulthood, but also helps to slow bone mineral loss as we age.

### ① Calcium

Calcium, a major structural element in bones and teeth, contains 99% of the calcium in our bodies. This important mineral resides in blood and soft tissues and critically supports functions like muscle contraction, nerve impulse conduction, or constriction and relaxation of blood vessels.

Our bodies tightly regulate blood calcium concentrations. When calcium intake drops, calcium leaches from our bones in order to maintain normal calcium blood concentration. Therefore, adequate dietary calcium is critical to limit bone resorption (demineralization) and preserve skeletal integrity and health.

Chronically low calcium intake in childhood and early adulthood prevents bone from reaching optimal mineral mass and density and will increase the risk for osteoporosis and bone fracture later in life. Low calcium intake as an adult can accelerate the decline in bone mineral density.

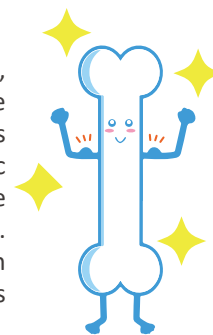
### ② Vitamin D

An important function of vitamin D is to control the blood concentration of calcium and phosphorus in order to preserve normal physiological function. Very severe vitamin D deficiency causes rickets in children and osteomalacia in adults (which can lead to immune system disorders later in life as well).

Vitamin D is found naturally in only a few foods. The primary source of active vitamin D remains sunlight exposure (especially the UV portion of the light spectrum) via the conversion/synthesis of Vitamin D3. Unfortunately, sunscreen use effectively blocks vitamin D production in the skin. Supplementation may be needed in children and adults to reach recommended levels. The American Academy of Pediatrics advocates 400 IU/day of supplemental vitamin D for all infants, children, and adolescents. Adults are advised to take 2,000 IU daily. Physicians can perform blood tests to determine if our vitamin D status is low. Some studies have found that combining vitamin D and calcium supplementation in older adults can reduce the risk of fall or fracture.

### ③ Magnesium

About 60% of our magnesium is found in bone, where it influences the size and strength of the component crystals. Low magnesium intake has been associated with decreased osteoblastic and osteoclastic activity, osteopenia, bone fragility, and vitamin D resistance or reduction. In postmenopausal women, low magnesium intake also correlates with more rapid bone loss and lower bone mineral density.



### ④ Other micronutrients

Many other micronutrients work tenaciously to ensure our bone health, including fluoride, vitamins A, C, K, and some B vitamins. Some health behaviors such as reducing sodium (salt) intake while increasing that of potassium (for example, by eliminating processed foods and increasing fruit and vegetable intake) is likely to indirectly benefit bone health through improving overall health. In addition, physical activity provides great benefits for bone health during development and throughout life. Any amount of physical activity, even in the frail and elderly, provides some benefits for our bone health; with high intensity major muscle group strength training providing the greatest benefits when coupled with quality nutrients/nutraceuticals in a complex and clean, bioavailable form.