With aging comes the realization that bone health is fundamental to an active, healthy life. What was once taken for granted, now requires attention. But ensuring skeletal health begins in youth, with bone reaching the maximum strength and density around age 30. Adequate dietary levels of bone nutrients are critical during childhood, adolescence and early adulthood. A common concern for aging women due to decreasing levels of estrogen, bone loss also affects many men. Current statistics indicate that more than 40 million Americans have low bone mass, which represents approximately 55 percent of adults over age 50.

Worldwide, osteoporosis affects 30 percent of women and 8 percent of men over age 50. Fractures related to loss of bone mass, occur in approximately 40 percent of women diagnosed with osteoporosis. In the US, the medical cost of osteoporotic fractures was estimated to be $13.8 billion in 1995, and it continues to grow. With an increasing number of aging Americans, the financial burden will become onerous. In addition, the quality of life for individuals with poor bone health may also be greatly reduced. Bone health is a major health concern in the United States and throughout much of the world. Yet for many individuals, the outcome can be modified through dietary and lifestyle changes.

A healthy diet, supplying adequate levels of protein, vitamin D, calcium and other nutrients, is vital to maintaining strong healthy bones. Some people are simply unable to consume a healthy, well-balanced diet. Others, like many vegetarians and vegans, are actively pursuing optimum nutrition from the foods they choose to eat, but may struggle to get enough bone-nourishing nutrients. Supplements offer another option to help strengthen the skeleton.

While calcium and vitamin D form the foundation for bone health, many other nutrients have been found to play critical roles including other minerals and vitamins. The US National Institutes of Health has reported that more than half of American adults consume insufficient levels of magnesium, vitamin K, vitamin C and other essential bone nutrients. In addition, other dietary factors including antioxidants, proteins and enzymes can play an important supporting role in helping to build or maintain the skeletal system. Supplementation beyond calcium and Vitamin D is important to strong bones and offers a way to differentiate new products or to expand an existing product line.

**MAGNESIUM** is an essential mineral with a wide array of biological functions that continues to gain recognition for its role in supporting bone health. Sixty percent of the magnesium in the human body is found in the bones and teeth. Studies indicate that more than 50 percent of Americans consume less than 250 mg of magnesium each day. While calcium and vitamin D have been the cornerstones for healthy bone support, modern research has found that adequate levels of additional nutrients including magnesium are also vital. The role of magnesium in building healthy bones may be especially important during childhood. In addition, post-menopausal women may also exhibit significant skeletal benefits with magnesium supplementation.

**BORON** is a trace mineral that is now known to play an important role in bone health. Though there is no established recommended daily
allowance, it is estimated that the majority of Americans consume less than 1 mg per day. This low level of consumption may increase the risk of poor bone health. Good dietary sources of this mineral include prunes, dried apricots and avocados. Boron has been shown to stabilize and extend the half-life of vitamin D and may support improved retention of calcium and magnesium. Also, researchers have shown that women who consumed a boron deficient diet had increased losses of calcium and magnesium when compared with a group that consumed supplemental levels of boron. The role of boron in supporting bone strength and mineralization is also supported in animal studies. Supplementation of up to 3 mg per day has been recommended to help maintain the skeletal system.

SILICON is another trace mineral that has been linked to compromised bone health when insufficient levels are consumed. Diets rich in cereal grains, legumes and leafy greens provide a dietary source of silicon. Likewise, consumption of certain mineral waters may also provide the mineral. Animal products generally do not provide significant amounts of silicon other than certain seafood like mussels. Once considered non-nutritive, researchers now believe that silicon plays a vital role in initiating bone mineralization. Epidemiological studies support the connection between higher dietary intakes of silicon and higher bone mineral density in both men and pre-menopausal women. Supplementation of this mineral in osteoporotic subjects has been shown to increase femoral and lumbar spine bone mineral densities. Silicon has also been found to bind to connective tissue components like glycosaminoglycans and mucopolysaccharides. It is believed that silicon may play a role in stabilizing collagen which may contribute directly to the minerals bone-building benefits.

VITAMIN K is well known for its role in blood clotting and the healing of cuts and wounds. Lesser known is the vitamin’s role in maintaining healthy bones. The skeletal system is continually being maintained with osteoblasts constructing new bone tissue and osteoclasts destructing old bone tissue. Vitamin K is involved in the activation of osteocalcin. This protein is the most abundant non-collagenous protein found in bone where it is believed to act as a regulator of bone mineralization and remodeling activity of osteoblasts and osteoclasts. Insufficient levels of this vitamin are associated with decreased bone mass and increased fracture risk. Bone mineral content and other markers of bone metabolism are also improved in children when vitamin K status is improved. Research indicates that daily supplementation of 180 mcg of vitamin K2 improves bone mineral content and density as well as bone strength in post-menopausal women. According to the Third National Health and Nutrition Examination Survey, approximately half of all adults in the United States consume less than the recommended intake of vitamin K.

Many antioxidants may also be beneficial in maintaining bone health. Oxidative stress and inflammation have been linked to bone mineral density in aging populations.

VITAMIN C may positively impact bone health through its antioxidant activity. It is also theorized that the vitamin’s skeletal benefits may result from its collagen stabilizing action.

Insufficient dietary VITAMIN E and low serum levels are associated with an increased risk of fracture in elderly individuals. A 2010 study indicates that supplementation with the antioxidant vitamins C and E may decrease bone loss. The impact on bone health of antioxidants including alpha lipoic acid, was the subject of a recent study in fifty post-menopausal women. The researchers reported that the antioxidant supplementation decreased bone loss in the study population.

ALPHA LIPOIC ACID is a powerful antioxidant that works throughout the human body in both intracellular and extracellular environments. In addition to the antioxidant combination reported above, research indicates that supplementation of alpha lipoic acid has beneficial effects on the skeletal system. Other antioxidant compounds that may support improved bone health include ginsengosides, green tea polyphenols, resveratrol, lycopene and isoflavones.
LACTOFERRIN is a bioactive protein isolated from bovine milk known for its pro-anabolic, antioxidant and anti-inflammatory activities which may be beneficial in promoting healthy bones. Research indicates that lactoferrin is able to affect bone health through numerous mechanisms including the stimulation of osteoblasts and the inhibition of osteoclasts. Recent animal studies show that lactoferrin improves bone formation and reduces the loss of bone mass. Meanwhile, cellular studies support the use of the lactoferrin metabolite, lactoferricin to support repair of bovine intervertebral disc matrix. Though few human studies have been conducted, preliminary research has been positive. A recent small trial of 38 healthy post-menopausal women showed significant reduction in bone resorption and increased bone formation over a six month period.

PHYTASE is an enzyme that hydrolyzes the destruction of phytate and releases bound minerals. Some foods contain dietary phytase that may help break down this anti-nutrient. In addition, the intestinal microbiota may contribute to the degradation of phytate and promote the bioavailability of calcium and other bound minerals. The enzyme is also available as a supplement and may be especially useful for those who consume a vegan or vegetarian diet.

The ability of vegetarian diets to provide the required nutrients to maintain bone health has been debated for many years. Unless bound to phytate, oxalate or other anti-nutritive compounds, the calcium from most fruits and vegetables is highly bioavailable. Unfortunately, these foods are not generally rich sources of the mineral. In 2006, a review of the scientific literature found that vegans consistently have lower bone mineral density than people consuming the average diet. However, the impact on fracture incidence was inconclusive. Studies indicate that low levels of certain nutrients are common with vegan diets including vitamin D. It is commonly recommended that vegans supplement with vitamin D but additional supplements may also be especially useful for these individuals.

Certain plant-based foods contain high levels of phytate. This compound inhibits the absorption of certain minerals including zinc, iron and calcium. Foods rich in phytate include cereals, legumes and starchy roots or tubers. Because the combination of cereal grains and legumes offers a complete amino acid profile, these foods are often the foundation of vegetarian and vegan diets. While the interaction of phytate with calcium is generally not a concern, the vegan diet may contribute to an increased risk of calcium deficiency. Interestingly, research indicates that mineral levels are impacted to a greater extent in younger women than older women. Supplemental phytase, with its ability to break down phytate and release bound minerals, may provide a nutritional advantage for these women.

LACTASE is another enzyme that may help ensure adequate bone nutrition for certain people. This enzyme hydrolyzes the milk sugar lactose. For more than 70 percent of the world population, lactase production decreases significantly during childhood. Consumption of dairy foods is often very low due to symptoms of gastrointestinal discomfort, bloating, flatulence and diarrhea. The problem is that in the U.S., dairy foods are one of the primary dietary sources of calcium and vitamin D. Lactose maldigestion is especially prevalent in certain ethnic groups including African-Americans, Asian-Americans and Hispanic-Americans. The avoidance of dairy foods due to self-diagnosed lactose intolerance has been linked to an increased risk for calcium deficiency and poor bone health. Individuals with dairy intolerance must take steps to ensure that they are getting an adequate supply of calcium and vitamin D. One option is supplementation of the required nutrients. Another is to consume low-lactose containing dairy foods like hard cheeses and yogurt. Use of a lactase supplement is another option that provides individuals with the full nutritional benefits available from dairy foods including protein, lactoferrin, calcium, vitamin D and other nutrients.

A healthy, active life is dependent upon maintaining bone mineral levels and bone strength. This requires adequate exercise, protein, calcium, vitamin D and many other nutrients. Building and maintaining a healthy skeletal system is a life-long endeavor. The diversity of ingredients shown to support bone health offers
supplement manufacturers and distributors the opportunity to design products targeted to different demographics and physiological needs. National Enzyme Company offers the expertise and experience to develop innovative bone nourishing supplements for any supplement company seeking new products.

References:

26. Sacco, Horcajada & Offord. Phytonutrients for bone health during


33 Hurrell. Influence of vegetable protein sources on trace element and mineral bioavailability. J Nutr 2003; 133(9): 2973S-7S.


