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## On The COVER

### CALCIUM

#### Keep What You Take



Today, there is overwhelming evidence that osteoporosis is a preventable disease, yet most women fail to consume the nutrients that are proven to maintain bone mass. Now it's easy to follow a mineral supplement program that is scientifically substantiated to prevent and partially reverse osteoporosis.

By William Faloon

Calcium is the first nutrient approved by the FDA for the prevention of a specific disease. A scientific consensus on the importance of adequate calcium intake has caused calcium preparations to become popular dietary supplements. While consumers understand the critical need of maintaining healthy bones, few supplements provide the proper amount of calcium and other nutrients required to prevent osteoporosis.

The sheer number of Americans affected by osteoporosis makes it a major health problem. There are now 25 million Americans afflicted with osteoporosis; hip fractures will occur in nearly one-third of all women. Bone fractures caused by loss of bone density compete with senility as the primary reason aged people are forced into nursing homes.

#### Are You Absorbing Your Supplemental Calcium?

There are several different forms of calcium available to consumers. Each form has a different degree of solubility and absorption. Young people produce high levels of stomach hydrochloric acid and can easily solubilize and absorb almost any form of calcium. Older people, on the other hand, often have a stomach acid deficit or take drugs such as Prilosec that block stomach acid production. Those with insufficient stomach acid output have been shown to absorb only about 4% of calcium carbonate supplements, whereas these same people will absorb 45% of calcium citrate supplements. Even people with normal levels of stomach acid only absorb about 22% of calcium carbonate supplements. Most commercial calcium preparations found in pharmacies contain low-cost calcium carbonate, including OTC anti-acid products that claim to have a high calcium content. Supplement companies often promote the benefits of oyster-shell calcium, but this form is really only calcium carbonate obtained from oyster shell. Another form of calcium that has gotten a lot of recognition is calcium hydroxyapatite, which comes from purified bone meal. One study showed that this expensive form of calcium has an absorption rate that is about 32% less than calcium carbonate.

Since the body needs between 1000 and 2000 mg of elemental calcium a day, the rate of mineral absorption into the bloodstream is a critical consideration. The wrong form can result in a person swallowing a lot of pills and absorbing little actual calcium into their blood stream. Calcium citrate is most often used by the informed consumer who understands the importance of getting calcium into the bloodstream where it is used to maintain and re-mineralize bone.

While calcium citrate is superior to most commercial calcium supplements, there are two other forms of calcium that have shown better solubility and absorption. When the chelating agent malic acid is added to calcium citrate, calcium citrate malate is created, a compound that is 10 times more soluble than calcium citrate.

"Solubility" refers to the amount of a mineral that can be dissolved in water at a neutral pH. If stomach acid levels are high, most forms of calcium are soluble. But as people grow older, the need for a soluble form of calcium can become critical. Based on human absorption studies, calcium citrate malate is about 30% more absorbable than calcium citrate. Calcium is first solubilized in the stomach, and then absorbed into the bloodstream through the intestine. A highly alkaline intestine can interfere with calcium absorption, but vitamin D3 can increase intestinal absorption.

The most absorbable form of calcium is called calcium bis-glycinate. This form of calcium is 205 times more soluble than calcium citrate. In human studies, calcium bis-glycinate was shown to absorb 1.8 times better (180%) than calcium citrate and 21% better

than calcium citrate malate.

Conventional nutritional scientists have long looked at "solubility" as being critical for mineral absorption. This assumption is being challenged by studies showing that other factors are involved in calcium absorption. The fact that calcium bis-glycinate is 1.8 times better absorbed compared to calcium citrate, but that bis-glycinate is 205 times more soluble than citrate, clearly shows that solubility is only one determinant of how much calcium is actually absorbed into the blood.

### Why Women Don't Get Enough Calcium

The body requires large amounts of calcium to maintain bone density. The problem with commercial calcium preparations is that a lot of pills are required to be swallowed in order to get the recommended 1000 to 2000 mg of elemental calcium per day. The greatest area of confusion is with the labeling. A capsule that contains 1000 mg of calcium citrate provides only 220 mg of elemental calcium. Some women mistakenly take just one or two capsules a day, because the bottle may say "Calcium Citrate 1000 mg." An examination of the label, however, will reveal that the amount of actual calcium per capsule is considerably less.

Even women who know they should be getting more supplemental calcium fail to do so because they don't want to swallow more pills. That is why taking a highly absorbable calcium supplement is so important. Based on human absorption studies, a woman taking 1000 mg of elemental calcium in the bis-glycinate form would be absorbing the equivalent 1820 mg of calcium if taken in the citrate form (calcium citrate). When calcium is bound to glycine to form calcium bis-glycinate, it becomes an amino acid chelate that can be utilized by cells throughout the body. Amino acid chelating agents promote the assimilation of the mineral into the cells to facilitate the Krebs energy cycle. A fascinating human study on calcium absorption can be found in the journal *Calcified Tissue International* (1990, 46:300-304).

The recent availability of low-cost calcium bisglycinate enables people to get more calcium into their bloodstream while taking fewer capsules per day.

If there is one supplement that should be taken in capsule form, it is calcium. When calcium is put into tablet form, it may not break down in the digestive tract. Small amounts of calcium are used as binding agents for making tablets. When the entire tablet is made of calcium, it becomes impossible for some people to break down the hard tablet.

### Bones Need More Than Just Calcium

While calcium by itself can prevent some bone loss, there are other critical minerals that should be supplemented for the long-term prevention of osteoporosis.

The hard mass characteristic of healthy bone is formed by inorganic minerals such as calcium, magnesium and phosphorous. This hard part of the bone is sometimes referred to as the "mineral mass."

The structural framework that holds the "mineral mass" in place is called the "organic bone matrix." The organic matrix is comprised of proteins that require adequate amounts of zinc, manganese and copper in order to properly function. The trace minerals zinc, manganese and copper are essential co-factors for enzymes involved in the synthesis of the constituents that make up the bone matrix.

A group of scientists at the University of California-San Diego began an investigation into the minerals needed for the organic bone framework after star basketball player Bill Walton developed multiple stress fractures in response to an unorthodox diet that provided very low levels of zinc, manganese and copper. The scientists conducted a literature search, and found that animals lost bone density when placed on diets that were deficient in zinc, manganese or copper. The findings of these animal studies demonstrated that:

- Zinc deficiency causes a reduction in osteoblast activity along with impaired collagen and chondroitin synthesis. (Osteoblasts are bone forming cells.)
- Manganese deficiency inhibits the biosynthesis of mucopolysaccharides that are used for organic bone matrix formation.
- Copper deficiency prevents the healthy cross-linking of elastin to collagen.

The scientists noted that mature bone matrix is a complex, highly mineralized tissue with a structural framework composed primarily of collagen along with other connective tissue cells. The bone matrix is a living protein complex that provides the structure needed to hold calcium, magnesium and other minerals that give bone youthful strength and density.

The next step the University of California scientists undertook was a study on postmenopausal women with a mean calcium intake

of 606 mg a day. The results showed that those who consumed less than 606 mg a day of calcium had lower bone mineral densities compared to those whose calcium intake was above the mean. These same studies showed that women with low blood levels of copper also have lower bone mineral density levels.

The final study was a two-year, placebo controlled trial on 225 postmenopausal women. One group received calcium supplements only, the second group zinc, manganese and copper, the third group received calcium plus zinc, manganese and copper, while the fourth group received a placebo. After two years, the only group who experienced an improvement in bone mineral density was the group taking calcium plus zinc, manganese and copper. All the other groups (calcium only, zinc-manganese-copper only, and placebo) lost bone density. The placebo group lost 2.23% of bone mineral density, while the calcium plus trace minerals gained 1.28%. The calcium only group showed a 0.50% loss of bone mineral density. The most significant difference was the large bone density reduction the placebo group compared to the increase in bone density in the group who received calcium plus zinc, manganese and copper. This series of studies were first published in the *American Journal of Clinical Nutrition* (1993; Vol 12, No. 4, pp-384-389).

Magnesium may be as important as calcium in the prevention and treatment of osteoporosis. Women with osteoporosis have lower bone magnesium levels than people with healthy bone mass. One study involving 31 postmenopausal women found that magnesium supplementation by itself resulted in a slight improvement in bone density compared to the placebo group who showed a slight decrease in bone density. Not only does magnesium contribute to bone mineral mass, but it is critical for the proper function of vitamin D.

### Preventing Excessive Urinary Excretion of Calcium and Magnesium

A mineral that regulates estrogen and testosterone metabolism in postmenopausal women is boron. Published studies consistently show that the administration of small amounts of boron (2-3 mg/day) reduce the amount of calcium and magnesium urinary excretion. The effect of boron in preserving critical minerals is more apparent when dietary intake of magnesium is low. In response to boron supplementation, estrogen and testosterone levels increase in postmenopausal women when magnesium intake is low. The findings on boron indicate that 3 mg a day will help prevent excessive urinary loss of calcium and magnesium and thus reduce age-associated bone demineralization.

### Active Vitamin D3 Has A Direct Anabolic Effect on Bone

Vitamin D is often combined with calcium supplements to enhance absorption of calcium into the bloodstream and improve the utilization of serum calcium into the bone matrix. Some human studies show that vitamin D3 and calcium improve bone density, but that calcium by itself does not. Vitamin D3 consistently shows its hormone-like properties by directing serum calcium to the bone and suppressing excess parathyroid hormone levels (that can pull calcium from the bone).

The active bone building metabolite of vitamin D3 is a hormone called calcitriol. Those with severe osteoporosis are prescribed calcitriol in the form of a prescription drug, but for prevention and general treatment purposes, vitamin D3 itself provides calcitriol in a safer form than by taking the calcitriol drug.

In a meticulous study published in the journal *Endocrinology* (1998, Vol 139, No 10), the ovaries of female rats were removed for the purpose of inducing an estrogen and progesterone deficiency. The effects of estrogen-progesterone ablation was a severe 90% reduction in tibial bone and a 43% reduction in vertebral bone. This structural deterioration of bone was seen throughout the skeleton and provides an acute view of the catabolic effects of hormonal deprivation. The scientists administered varying doses of calcium and/or active vitamin D3 to these hormone-deprived rats and measured the effects on bone density. After three months, relative to the rats not given the supplements, there was a 22.5% average increase in bone mass in the rats receiving low-dose active vitamin D3 alone or with calcium, and a 36.5% average increase in bone mass in the group receiving high-dose active vitamin D3 alone or with calcium. The results of this study showed that active vitamin D3 by itself produced a direct anabolic effect on bone that was not dependent on supplemental calcium. The scientists concluded by cautiously recommending that human osteoporosis patients might benefit by taking higher doses of active vitamin D3 with only maintenance levels of calcium.

### How Prevalent is Osteoporosis in Men?

Men experience substantially less overall bone loss than women, but there are some skeletal sites where men have a high rate of fractures. Men suffer an accelerated loss of cortical (outer layer) bone density that starts at age 40 and then begin to lose vertebral bone mass starting after age 50. About 25% of hip fractures occur in men. A study published in *Calcified Tissue International* (1998, Vol 63, pp-197-201) showed that intestinal calcium absorption in men decreases progressively with advancing age, and this impaired absorption is caused by a lack of vitamin D3 combined with inadequate dietary calcium intake. There is a significant decrease in vertebral bone mass in aging men that directly correlates to blood levels of vitamin D3 and dietary calcium. Scientists speculate that a vitamin D3 deficiency causes a slight increase in the release of parathyroid hormone (PTH) that results in calcium being pulled from the bone. The effect of over-secretion of PTH is especially damaging to bone when dietary sources of calcium are low.

Bone loss patterns in men are different than women, but one study shows that men and women suffer equal loss of bone density to the spine. This reduction in vertebral bone mass could explain why aged men and women develop spinal deformities that result in a humped over posture.

A review of the published literature indicates that healthy men approaching age 40 should take about two-thirds the amount of calcium as women. So if women are supposed to take six capsules a day of a bone-building calcium formula, men should take four capsules. Men who undergo testosterone ablation therapy to treat prostate cancer are at a great risk for losing significant bone mass over a relatively brief period of time. These men should take at least as much calcium as women. Anyone taking chronic doses of corticosteroid drugs, drinking excess amounts of caffeine or alcohol, smoking cigarettes or not exercising may need extra calcium and other minerals required to maintain the protein (organic) structural bone framework and the inorganic (mineral) bone mass.

#### Minerals Can Prevent Cardiovascular Disease

Magnesium has been clearly established to protect against cardiovascular disease. In a study published in the journal *Epidemiology* (1999; 10:4-6, pp331-36), researchers examined the levels of magnesium and calcium from 16 different municipalities in Sweden. They then obtained information on all women in the study areas who died between the ages of 50 and 69 years from 1982 to 1993 and compared the causes of death to the different water supplies where the women lived. The researchers concluded that higher levels of both calcium and magnesium in drinking water appeared to protect women's hearts. For men, water calcium had no effect on heart attack, but for women, a low level of calcium appeared to be a risk factor.

This article summarized the broad-array of nutrients that are required to maintain strong, healthy bones for a lifetime. The next article discusses natural hormone replacement therapies that are required for bone repair and remodeling, followed by The Foundation's revised Osteoporosis Prevention and Treatment Protocol.

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