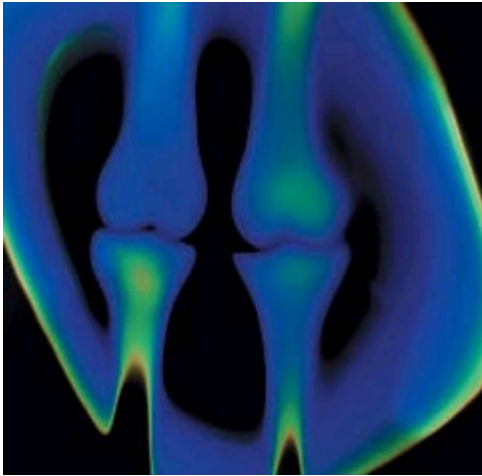


REPORT

Weak Bones Cause Heart Attack and Stroke
How To Avoid Becoming The Next Statistic!

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News stories about nutrition research tend to give the impression that certain nutrients have only one function in the body, or that they can act as "magic bullets" to prevent or cure diseases. While this approach makes for striking headlines, it often causes nutrients to get noticed only when news is overwhelmingly good or bad. The diverse biological roles played by nutrients are too often overlooked.

Take vitamin K, for example. Most of what has been written about this vitamin has to do with its participation in the clotting of blood. People taking anti-coagulant drugs to prevent abnormal blood clots are warned to avoid foods containing vitamin K for fear that the nutrient will counteract the blood thinner's effects. The association between vitamin K and blood clotting has become this vitamin's most newsworthy characteristic.

However, the facts show that vitamin K has other important roles in the body such as building bone and maintaining blood vessel integrity. For at least four years, compelling evidence has existed that most people don't get enough vitamin K to protect their health. Despite this documentation, the vast majority of multivitamins do not contain any vitamin K, and few health conscious consumers understand the importance of supplementing with it.

The tide is about to turn. Research supporting vitamin K's usefulness against osteoporosis and heart disease is becoming too abundant to overlook. Here's what you need to know about the next big news story in nutritional medicine.

by Melissa Block

The recommended daily allowance (RDA) for vitamin K is currently 65 micrograms for adult females and 80 micrograms for adult males. Human clinical studies have used as much as 45 milligrams per day without problems, thus showing that ingesting more than 450 times the RDA of vitamin K is safe. Unlike other fat-soluble nutrients, vitamin K does not build up in the body.

Vitamin K deficiency was, until recently, considered a rarity in adults. A healthful diet was thought to provide plenty of this nutrient for children and adults. The problem is that the consumption of K-rich dark leafy greens is at an all-time low in the U.S., having been supplanted by processed foods, french fries and iceberg lettuce. Deficiency of vitamin K can also be produced by the use of cholesterol-lowering drugs (which decrease the amount of lipoprotein complexes on which fat-soluble K can "hitch a ride" for transport to where it's needed), antibiotics (which kill off K2-making bacteria in the GI tract), and synthetic estrogens. (In healthy people, vitamin K1 is converted into K2 in the body.) People with gallstones, liver disease or gastrointestinal disease are also subject to vitamin K deficiency. [1,2]

Vitamin K and calcium regulation

Vitamin K's actions on bone and the circulatory system arise from its effects on the utilization of calcium in the body. Calcium is generally thought of as a bone-building mineral, but the buildup of this mineral isn't always a good thing. When calcium deposits form in blood vessel walls, those vessels become stiff and noncompliant—a process known as



Vitamin K's actions on bone

arteriosclerosis or, in the vernacular, "hardening of the arteries." Arteriosclerosis isn't always caused by atherosclerosis, where cholesterol-filled lesions build up and obscure blood flow through the coronary arteries; atherosclerosis is only one type of arteriosclerosis.

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Calcium deposition in the artery walls increases heart attack risk.[3] In the world-famous Framingham study, subjects with detectable arterial calcification at the age of 35 were seven times more likely to have a heart attack during the course of the study.[4] A recent study by researchers in Oakland and San Francisco, California, found that women whose mammograms showed arterial calcification in their breasts had significantly increased risk of stroke.[5] Calcification can also occur in the kidneys, lungs and brain, and wherever it happens, it disrupts the normal function of those organs. Understanding the actions of vitamin K may be the key to understanding and reversing harmful calcium deposition in blood vessels.

Vitamin K "turns on" proteins that regulate the deposition of calcium during a process called carboxylation. When these proteins have insufficient vitamin K supplies, they are not able to fully carboxylate these calcium-controlling proteins. Their state of undercarboxylation prompts them to allow calcium to drift from bone into arteries and other soft tissues.[6] Gamma-carboxyglutamic acid (Gla) is the name of one group of these calcium-controlling proteins. Fifteen of these proteins have been discovered, and all of them are dependent upon vitamin K for their activity. Properly carboxylated Gla strongly inhibits calcium deposition in the walls of blood vessels, while incomplete carboxylation handicaps this process. Lab mice bred to lack the gene for one type of Gla develop severe vascular calcification.[7] When the drug warfarin-which prevents blood clot formation by inhibiting the vitamin K-dependent process that creates Gla-is given, an increase in arterial calcification is likely to result.

Research on vitamin K and cardiovascular disease

Supplemental doses of vitamin K are gaining recognition as valuable helpmates in the prevention of cardiovascular disease.[8] In one study, rats were fed a diet designed to cause calcium buildup in their blood vessels. Some of the rats were given vitamin K, while others got vitamin E. The ratio of arterial calcification between animals receiving supplemental vitamin K or no K was an astonishing 1 to 17.5.[9] Vitamin E had an even greater inhibitory effect on calcium buildup, and both K and E were found to reverse heart valve damage incurred by the diet.

In a more recent study, researchers in the Netherlands lent support to the theory that arterial vessel walls have a high preference for accumulating and utilizing vitamin K2 over K1. In rats treated with blood thinners (anticoagulant drugs), it was found that high Gla concentrations exist around calcium deposits within blood vessel walls.[10] This finding led the research team to conclude that undercarboxylated Gla is indeed a risk factor for vascular calcium deposition, and that the present RDA for vitamin K does not supply enough vitamin K2 to prevent these deposits from forming.

Another study, performed by a team at Wake Forest University in North Carolina, provides a review of current knowledge about bone-related proteins in the regulation of arterial calcification.[11] They describe studies that identify undercarboxylated Gla as an inhibitor of the principal osteogenic (bone-building) growth factor. When Gla is not properly modified with the aid of vitamin K, this growth factor induces the deposition of calcium in soft tissues.

An Australian research group administered warfarin to rats from birth until up to 12 weeks of age. They gave the rats K1 to counteract warfarin's effects on blood clotting factors made in the liver, allowing only K2 to become deficient. (Both are depleted by warfarin.) All of the treated animals were found to have extensive arterial calcification at the experiment's end. This study is of major importance in highlighting the essential nature of K2 for the prevention of calcification.[11]

Vitamin K and osteoporosis

The flip side of vitamin K's role in arterial health is its role in the prevention of osteoporosis. (In fact, this nutrient has been used as an osteoporosis therapy in Japan since 1995.) Osteoporosis and artery disease have long been known to be epidemiologically related; patients with osteoporosis have a significantly greater chance of dying from stroke and heart disease-and even cancer-than age-matched counterparts without thinning bones.[12-15] New research shows that osteoporosis may well be a warning that calcium that ought to be going into the bones is ending up in the arteries.

Three Different Forms of Vitamin

Vitamin K1 (phylloquinone) is found in chlorophyll-rich plant foods, especially dark green leafy vegetables. Vitamin K2 (menaquinone) is made by the

When calcium isn't directed into bone and tooth, as it should be, it means these tissues aren't being built up as they need to be to prevent the thinning of bones that eventually leads to fractures. One side effect of the blood thinner warfarin, which works by blocking the activity of vitamin K in the clotting cascade, is increased calcium excretion and increased risk of osteoporosis.[16] In the Nurses' Health Study, women with high intake of vitamin K were found to have 1/3 less likelihood of ending up with a hip fracture.[17] Other research has indicated that those at risk for calcium loss- including men who are being treated for prostate cancer with androgen-blocking medications-benefit from supplemental

probiotic bacteria that reside in the intestinal tract, and vitamin K3 (dihydrophyloquinone) is produced during the hydrogenation of oils. Vitamin K2 can be made from K1, but the efficiency of this conversion is not always adequate to provide enough K2. Both K1 and K2 are essential for different aspects of good health; K3 is a free radical producer that doesn't act like real vitamin K in the body, and should not be considered a good source of vitamin K.* Vitamin K3 may, however, prove to be useful in the treatment of certain cancers.

* Blackwell GJ, et al, Inhibition of human platelet aggregation by vitamin K. *Thromb Res* 1985; 37:103-14.

Lipsky JJ, Nutritional sources of vitamin K. *Mayo Clin Proc* 1994;69:462-66.

vitamin K, which slows the loss of calcium through the urine.

In a Japanese study of 94 postmenopausal women, researchers administered hormone replacement therapy (HRT) and vitamin K2 to women who, despite the use of HRT, were losing bone mass. (HRT usually causes slight increases in bone mass for two to three years, and maintains it thereafter.) The women who added vitamin K to their HRT regimen showed a significant improvement in bone mineral density during the three-year study.[18] In fact, the Nurses' Health Study-mentioned earlier-demonstrated that high vitamin K intake via green vegetables was more effective at preserving bone mass than HRT. This is a good thing, considering that mainstream HRT has been found to have significant risks in recent studies.

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Currently, long-term space travel is not possible for humans because the lack of gravity causes rapid resorption of bone along with suppression of new bone formation. This effect can be mimicked by suspending the tails of rats so that they are not subject to the pull of gravity. Another group of Japanese researchers used this animal model to examine the effects of vitamin K on bone mass. When vitamin K was given orally in high doses-22 mg/kg body weight-the structure of the bones in the rats' tails was maintained at almost normal levels.[19]

Ovarian hormone production has a strong preservative effect on bone mass, and postmenopausal women have the greatest risk of ending up with osteoporosis. Following ovariectomy (removal of the ovaries) in rats, vitamin K was administered. The K supplement attenuated the decline in bone mineral density typically seen after ovariectomy.[20,21] In another study, researchers found that postmenopausal women given one milligram of vitamin K daily for two weeks showed an increase of 70% to 80% in carboxylated Gla[22]-a good sign that calcium is going where it should.

One of the best ways to prevent osteoporosis in old age is to maximize bone density during youth. This can be accomplished with exercise and adequate nutrition during the height of a child's growth phase, and supplemental vitamin K may prove a valuable adjunct to these bone-building efforts. To determine whether nutrient supplementation in youth can increase peak bone mineral density, 168 three-month-old female rats were divided into five groups. One got a control diet; the other groups received either vitamin D, vitamin K, calcium, or vitamins D and K plus calcium. In all four groups with added nutrients, peak bone mineral density (BMD) was higher than in the control group. The greatest improvements in increasing bone density in the short-term was seen in the calcium-only group, but the smallest decreases in bone mineral density (BMD) over the course of the study was seen in the group that got the combination of nutrients. In other words, all three nutrients (calcium, vitamin D and vitamin K) taken together protected against bone loss better than any of them by themselves.[23]

Bone loss is a common complication of cirrhosis of the liver. When patients were given vitamin K, carboxylation of osteocalcin-one of the Gla proteins-significantly improved.[24]

Other benefits of vitamin K

The benefits of vitamin K don't stop at osteoporosis and heart disease prevention. Further research has demonstrated that this nutrient also relieves inflammation. With age, concentrations in the body of a substance called interleukin-6 (IL-6) increase. IL-6 is a biochemical messenger called a cytokine. It accelerates inflammation when produced out of balance with other cytokines. People who suffer from arthritis and Alzheimer's disease have high IL-6 concentrations, as do blood vessels affected by atherosclerosis. A study performed at the National Research Institute in Italy revealed that subjects with the highest levels of IL-6 were nearly twice as likely to end up with a mobility-related disability.[25]

Diabetics may be poised to benefit from vitamin K supplements more than any other segment of the population. Type II diabetics are more subject to all types of arteriosclerosis; the abundance of sugars and insulin in their systems accelerate the aging process that naturally predisposes people to pathological calcium deposition. The fact that the pancreas contains the second highest concentration of vitamin K in the body hints at its role in blood sugar regulation. Japanese researchers have found that when vitamin K deficiency is induced in rats, the clearance of blood glucose is impaired and insulin release increases-in other words, the rats developed the symptoms of early type II diabetes (i.e. hyperinsulinemia).[26]

Vitamin K's benefits may also be linked to its antioxidant activity. Some research has indicated that vitamin K has free radical-scavenging power comparable to that of vitamin E and coenzyme CoQ10.[27,28] The livers of animals subjected to oxidative stress gained complete protection when given vitamin K, and vitamin K has been found to be 80% as effective as vitamin E at preventing the oxidation of polyunsaturated linoleic acid.

Vitamin K and Coagulation

Coagulation-more commonly known as blood clotting-consists of two separate processes: platelet activation and fibrin formation. The latter process is where vitamin K plays its part, controlling the formation of coagulation factors in the liver. Without these coagulation factors, the fibrin filaments that bind platelets together into a clot cannot form. Vitamin K is also a component of proteins that act as anticoagulants, as well as two bone matrix proteins that are required for normal bone metabolism.* Vitamin K thus provides a crucial balancing effect in the body.

* Blackwell GJ, et al, Inhibition of human platelet aggregation by vitamin K. Thromb Res 1985; 37:103-14.



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day. Those taking higher doses may wish to have their vitamin K levels evaluated. Ask your doctor or nutritionist to administer the osteocalcin test. This test measures levels of carboxylated osteocalcin, yielding an excellent picture of vitamin K status.

If you are using ginger, garlic, ginkgo or aspirin to keep your blood thin and prevent clotting, don't worry that taking supplemental vitamin K will counteract this. While vitamin K does participate in blood coagulation, it prevents platelet aggregation-a process of blood cell clumping that is spurred by increases in oxidative stress.[29] Keep in mind that K also plays a role in activating anti-clotting proteins, even while participating in the blood clotting cascade.

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Supplementing vitamin K may also help to prevent Alzheimer's disease. Those with the E4 form of the lipoprotein apoE-about 25% of the population-are known to have increased risk of developing this dreaded disorder. What many don't know is that people who carry the apoE4 gene have been found to have low vitamin K levels. The calcification and development of lesions in blood vessels that feed brain tissues is believed to be one aspect of Alzheimer's development, and further research may reveal an important role for high-dose vitamin K in its prevention.

Vitamin K supplementation guidelines

Generally, 10 mg per day is a good dose for any person interested in optimal health and longevity. Those suffering from osteoporosis may consider taking up to 40 mg a

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