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REPORT

**Vitamin K**

Stunning new research shows that vitamin K may be one of the most extraordinary anti-aging vitamins ever discovered. It has unique powers no other vitamin possesses

by Terri Mitchell

Vitamin K never gets any press. It's just not very exciting. Other vitamins do daring things like throw themselves in front of free radicals to keep you from aging. Vitamin K's only claim to fame is that it helps blood coagulate. Big deal. It comes from green vegetables. Ho-hum.

Well, that was then, and this is now. Put on your party hat because vitamin K is about to throw the bash of the century. Vitamin K is a lot more exciting than anybody ever dreamed. It may be a key anti-aging vitamin. It may prevent both heart disease and osteoporosis. And it's a stronger antioxidant than vitamin E or coenzyme Q10.

Vitamin K may be the future of treating certain kinds of cancer. And it may have something to do with Alzheimer's disease. Stand back: this neglected vitamin is stepping into the limelight.

Arteries, aging and vitamin K

Bad arteries kill more people in America than any other condition. The medical term for hardened artery is "arteriosclerosis," a dangerous condition that leads to heart attack and stroke. A normal artery is pliable like an inner tube. Its built-in muscle contracts to send blood through. A hardened artery loses its muscle tone, and can't contract. Aging is the main cause of arteriosclerosis.

While doing autopsies in a public hospital in the early 1900s, a German pathologist named J.G. Mönckeberg noticed that the middle layer of arteries from people who died of heart attacks was calcified. This layer (the "media") wasn't considered important in Mönckeberg's time. His colleagues focused on the innermost layer of the artery where damage is visible. Mönckeberg's observations went against the grain, but he dutifully recorded them in Virchow's Archives.

Although nobody paid much attention to him, Mönckeberg was later proven correct. "Arteriosclerosis," or hardening of the arteries, occurs in the middle of the artery where it's not visible. "Atherosclerosis" occurs inside the artery, where lesions are visible. Arteriosclerosis is associated with aging, and has nothing to do with cholesterol. Instead, it has to do with calcification.

Vitamin K protects the heart

Sudden death from heart attack is associated with calcification of the aorta, especially in young men. In the Framingham Heart Study, 35 year-old men with calcifications in the aorta had a 7 times increased risk of dying of a sudden heart attack. The risk decreases with age, but the chance of suddenly dying of a heart attack is doubled in people under 65 if their aortas are calcified.

Calcification is just as dangerous as fatty build-up. Researchers in Japan fed rats a heart attack-friendly diet based on vitamin D and cholesterol. (Vitamin D is used by researchers to create heart disease in animal models. It causes rapid hardening of the aorta. Vitamin D, along with cholesterol, creates both aspects of human-like heart disease, i.e., hardening of the arteries and lesions). Some of the animals were given 100 mg/kg of body weight of vitamin K, along with the heart attack diet. Others were fed 40 mg/kg of vitamin E.

After three weeks, the amount of calcium in the aorta was measured. In the animals that didn't get the vitamins, calcium levels averaged 17.5 μ /mg. Vitamin K reduced the level of calcium in the aorta to approximately 1 μ /mg, and vitamin E reduced it even more. Valve damage from the heart attack diet was drastically reversed by vitamins K and E .

Vitamin K and bones

The flip side of hardened arteries is softened bone. At the same time arteries calcify with age, bone decalcifies. Bad bones, like bad arteries, are a big problem for healthcare. Between them, they soak up billions of dollars.

The drug approach to bone loss in women is estrogen drugs with serious, even life-threatening, side effects. The dairy industry approach to osteoporosis is cow's milk. Neither approach gets at the underlying cause of bone and artery deterioration.

Vitamin K regulates calcium

Imagine a vitamin that could keep calcium in bones and out of arteries. In so doing, that vitamin could stop heart attack and osteoporosis at the same time. Sound incredible? Maybe, but research shows that vitamin K does exactly that. It works by regulating calcium. Bones need it, arteries can't stand it. Vitamin K accommodates both.

Vitamin K works through an amino acid called "Gla," which stands for gamma-carboxyglutamic acid. Gla is part of a certain kind of protein that controls calcium. Fifteen such proteins have been found so far; and researchers believe there are at least one hundred scattered throughout the body. Vitamin K makes them work and it's the only vitamin that does.

Vitamin K performs a feat on the proteins called "carboxylation." Carboxylation gives the proteins claws so they can hold onto calcium. Once the protein grabs onto calcium it can be moved around. Proteins that don't get enough vitamin K don't have the claws. They're "undercarboxylated" and can't control the mineral. Without a functioning protein to control it, calcium drifts out of bone and into arteries and other soft tissue.

The most famous Gla protein is "osteocalcin." You may have heard of osteocalcin in connection with bone density. What you might not have heard is that it requires vitamin K to work. Undercarboxylated osteocalcin (osteocalcin without vitamin K) can't regulate calcium. When this happens, calcium leaves bone and teeth. Women with "undercarboxylated osteocalcin" excrete calcium, and their bones are porous. Vitamin K reverses this trend.

Vitamin D

You may be saying, "Wait a minute, I thought vitamin D was the bone vitamin." You are right. Vitamin D plays several roles in bone. One of them is provoking the osteocalcin gene into action. Once synthesized, however, osteocalcin needs vitamin K to function properly.

Vitamin D has dominated discussion on bone because it is a hormone that acts swiftly and dramatically. But the slower-acting vitamin K is just as important. And although it doesn't act as quickly on bone as vitamin D, new research indicates that vitamin K may actually be more of a hormone than currently appreciated.

The truth is that although vitamin D has gotten a lot of press as the bone vitamin, bone maintenance requires many factors; among them, parathyroid hormone, estrogen, calcium and calcitonin (another thyroid hormone). When all of these factors plus vitamin K are present in adequate amounts, the skeleton will be totally replaced every 8 to 10 years with good, dense bone. If not, problems occur.

Eat lettuce, not burger

One of the most scrutinized groups in America is the 85,000 female nurses who took part in The Nurse's Health Study. Researchers have been tracking the eating habits and health histories of these women since 1980. One of the things they've looked at is which participants are more likely to break a bone. Fractures are the classic symptom of osteoporosis.

Since eating animal protein has been linked to osteoporosis, an analysis was undertaken to determine whether meat-eating had an adverse effect on the nurses' bone density. In 1996, the results were reported. Meat showed up as a factor in the incidence of broken bones. Nurses who ate three ounces of meat or more per day had a significantly increased risk of forearm fracture compared to those who ate less than two ounces.

One explanation for the finding is that people who eat more meat eat less vegetables, and vegetables are high in vitamin K. However, another group of researchers decided to look at the possible relationship between vitamin K intake and hip fracture in the same nurses. Using 10 years worth of data on 72,000 participants, they came to the conclusion that the nurses who got the most vitamin K were about a third less likely to get a hip fracture. Those who ate lettuce everyday slashed their risk of hip fracture 50% compared to those who ate it once a week or less (lettuce is a source of vitamin K). The effect of vitamin K was greater than synthetic estrogen which didn't protect the nurses' bone density in this study. Nor did vitamin D. In fact, women who took a lot of vitamin D, but had a low intake of vitamin K, doubled their risk of hip fracture!

Most osteoporosis studies are done on postmenopausal women because this group experiences a dramatic decline of bone density. Vitamin K shows remarkable results against bone loss in this population. In a study from the Netherlands, 1 mg of vitamin K per day for two weeks increased carboxylated Gla 70-80% in postmenopausal women, restoring it to premenopausal range. Another study shows that vitamin K slows calcium loss by one-third in people who have a tendency to lose it (including men). Men treated with prostate cancer drugs that block androgens are a group that worries about osteoporosis.

Bone density predicts death

Osteoporosis may reflect serious health problems. If the Study of Osteoporotic Fractures is correct, bone density is a striking predictor of death. In its first report, every standard deviation from normal bone density equaled a 20% greater risk of mortality in women age 65 or older. Think of it: two deviations from normal bone density equals a 40% greater risk of mortality, according to this study.

Forty-six deaths occurred in women with the highest bone density compared to 78 in the lowest. But the surprise is that people with osteoporosis didn't die from broken bones, or complications from broken bones. Falling accounted for only 3% of the mortalities in this osteoporosis study. They died, instead, from heart attack, cancer and stroke. What could be the connection? According to this study, osteoporosis is a warning sign that the calcium that's supposed to be in bone is lodged in arteries instead.

In 1999, the study was updated. Eight year's worth of data was evaluated. Again, there was a strong relationship between bone density and mortality related to bad blood vessels. Just to give you an idea of the statistics, there was a 1.23 greater risk of dying if a woman had one or more back fractures. Severe humpback increased the risk of dying from a lung-related disorder, such as blood clot, by 2.6 times.

Vitamin K and stroke

Stroke is the brain's version of heart attack. The underlying cause is the same: bad blood vessels. Millions of dollars have been spent trying to prove that eating too much salt raises blood pressure, and causes strokes. After decades of trying, researchers still can't find a definitive link. A review of 58 studies published in JAMA concludes, "These results do not support a general recommendation to reduce sodium intake."

The reason why has been ignored for decades. Salt is not the only mineral that controls blood pressure. Calcium is also important. In 1985, Dr. David A. McCarron pointed out that calcium intake is more likely to cause blood pressure problems than salt. He's right. Calcium is so important that doctors looking for stroke-prone patients would do well to put down the blood pressure cuff and order a bone scan. One standard deviation from the norm of bone density equals a three times increased risk of having a stroke compared to 1.7 times increased risk for blood pressure.

Could vitamin K help regulate calcium and prevent stroke? In 1988 Dr. Louis Tobian of the University of Minnesota hypothesized that the high rate of hypertension in African Americans might be caused by vitamin K deficiency. Dr. Tobian noted that diets high in K prevent the thickening of arteries in stroke-prone rats.

Although the hypothesis was ignored, scientific studies show that Dr. Tobian is probably right. A recent report from the "Dietary Approaches to Stop Hypertension" (DASH) study indicates that it makes no difference how much salt you eat, or how much you weigh. What does make a difference is whether you eat fruits and vegetables. One of the important nutrients in vegetables is the calcium-regulating vitamin, vitamin K. Vitamin K may stop hypertension and reduce the incidence of stroke.

Vitamin K's anti-aging effects: stalking the killer cytokine

It has been said that a person need not fear aging itself, but the diseases of aging. Researchers have made tremendous progress in the last decade in understanding why age brings with it certain diseases. One thing they've discovered is that aging causes the body to downregulate some of its hormones and other biofactors while at the same time upregulating others.

One of the substances that age upregulates is Interleukin-6 (IL-6). IL-6 is a cytokine, a biochemical messenger for the immune system. In the aging body, IL-6 increases at the expense of other cytokines. This imbalance in the system creates inflammation. IL-6 has been discovered in arthritic joints and diseased blood vessels. In a striking study done at the National Research Institute in Italy, people with the highest amount of IL-6 were almost twice as likely to develop a disability related to mobility. It also turns out that people with Alzheimer's-like dementia have elevated IL-6.

Surprisingly, Vitamin K also inhibits both IL-6 and inflammation. Researchers don't know how it works yet, but some are suggesting that vitamin K could have major implications for degenerative diseases involving inflammation, not to mention aging itself.

Vitamin K and Alzheimer's Disease

Dr. Martin Kohlmeier of the University of North Carolina discovered several years ago that hemodialysis patients who are prone to broken bones are more likely to have a certain form of apolipoprotein E (apoE). Those broken bones were a tip-off to the doctor that vitamin K might be dysregulated in people with the E4 form of the protein.

The E4 form was subsequently connected to Alzheimer's Disease (AD). People with E4 are more prone to AD. They also have lower vitamin K levels. Kohlmeier believes it's no coincidence. He thinks there's a connection between the lack of vitamin K, apoE4 and the ability to regulate calcium in the brain.

Here's why: remember osteocalcin? It's one of the calcium-grabbing proteins in bone. But bone is not its only location. It's also found in the brain, along with other vitamin K-dependent proteins. People with the E4 protein have undercarboxylated osteocalcin not only in their bone, but also in their brains. Kohlmeier believes that people with E4 clear vitamin K too fast from their bodies. This leaves too little vitamin K for the brain proteins. Calcium can't be regulated properly and may cause some of the damage seen in AD. Studies show that AD patients have severely dysregulated calcium in their brains.* Kohlmeier believes that this has to do with their lack of vitamin K-the vitamin necessary for controlling calcium in both the brain and bone.

Vitamin K and blood sugar

The pancreas has the second highest amount of vitamin K in the body. This suggests the vitamin may have something to do with controlling blood sugar. In the first study of its kind, researchers in Japan looked at vitamin K's effect on glucose and insulin. In a study on rats, they found that vitamin K deficiency initially impedes the clearance of glucose, then causes too much insulin to be released. This can be plotted on a graph that looks very similar to what occurs in diabetes.

Mega antioxidant

Some studies show that vitamin K is more powerful than vitamin E and coenzyme Q10 for scavenging free radicals. In a study on animals subjected to oxidative stress, vitamin K by itself completely protected the liver from free radicals (but not muscles). In another study, vitamin K was 80% as effective as vitamin E in preventing the oxidation of linoleic acid (a polyunsaturated fatty acid). According to researchers in the Netherlands, warfarin (a blood thinner) abolishes the antioxidant effect of vitamin K. Vitamin E and glutathione protect vitamin K's antioxidant effect.

Vitamin K and anticoagulants

Anticoagulant drugs work by interfering with vitamin K. Therefore, people taking "blood thinners" such as warfarin or heparin should not take vitamin K.

People who chronically take these drugs are, in effect, vitamin K deficient. Do such people show effects on bone and blood vessels? The answer is yes. Studies show that long-term anticoagulant users have osteoporosis and a tendency to hemorrhage. One study shows that long-term anticoagulant use doubles the risk of stroke. Occluded arteries have been documented in people taking heparin, and some researchers conclude that the drugs work no better than aspirin in preventing heart attacks.

Vitamin K prevents blood clots

Those taking ginkgo, aspirin, garlic or ginger to prevent blood clots and increase blood flow needn't worry that vitamin K will undo the effects. Vitamin K also prevents blood clots! It works by preventing "platelet aggregation," a process that is different from coagulation. Aggregation has to do with oxidative stress and free radicals, whereas coagulation is about the calcium level in cells.

Vitamin K gets away with its dual personality because blood aggregation is different from coagulation, and coagulation is such a complex process. Although it's not commonly appreciated, coagulation involves at least 13 factors, some of which can function in dual roles as either promoting or preventing coagulation. Strangely enough, vitamin K also plays a role in activating two factors that reverse clotting: proteins S and C. Studies show that people who have a deficiency of protein S and C get blood clots.

Why you never heard this before

Unfortunately, vitamin K's role in blood coagulation has seriously dampened its career as a vitamin that does anything else. Because the focus has been on how much K it takes to make blood clot, the issue of how much a person needs to maintain solid bone and clear arteries hasn't been adequately researched.

The RDA of 85 micrograms is roughly based on how much vitamin K is required to maintain clotting factors. According to evidence

we have obtained, this amount is dangerously inadequate for bone and arteries. Far more may be required to maintain brain function, and more still may be required for general anti-aging effects.

Why take vitamin K?

Dr. Kohlmeier believes that vitamin K may have major importance in aging. He points out that it has powerful effects in the brain, where it acts more like a hormone than a vitamin. He also notes that vitamin K is very hormone-like in its appearance and disappearance during growth and development. Newborns have almost no vitamin K. It kicks in later, reaches a zenith, and then begins to recede with age. This pattern is similar to the pattern of sex hormones.

About 25% of the population has the E4 form of apoE associated with Alzheimer's and a lack of vitamin K. But they don't know it. Testing for E4 is not routine for many reasons-including the fear that people who test positive might become the victims of discrimination. Although no one knows at this point whether the lack of vitamin K plays a role in Alzheimer's, it makes sense to assume that it might.

Unlike other fat-soluble vitamins, the body does not store vitamin K. Although the body recycles it, deficiency is common according to the latest research. This is probably due to inadequate diet, a lack of co-factors, drugs and environmental stress that place unusual demands on vitamin K reserves.

Vitamin K in food

Tufts University tests the vitamin content of foods for the U.S. Department of Agriculture which maintains a database. Not too long ago, new technology allowed a more precise determination of the vitamin K content of food. Using the new technology, Tufts researcher Dr. Sarah Booth discovered that the vitamin K content of most foods is lower than researchers previously thought.

Green leafy vegetables supply 40-50% of vitamin K for most Americans. Vegetable oils are the next highest source. Hydrogenated oils (margarine, for example) create an unnatural form of K that may actually stop the vitamin from working.

There are three different types of vitamin K: K1 which is from plants, K2 which is made by bacteria and K3 which is synthetic. Vitamin K3 is generally regarded as toxic because it generates free radicals. This version shows promise in the treatment of cancer. K2 specifically keeps calcium and phosphorus out of the aorta, and reverses the effects of heart-unfriendly diets. The body converts K1 to K2.

Taking vitamin K

How much vitamin K people should take is still in question. It partly depends on diet, age and what stressors are present. Vitamin K is not toxic in high doses, and unlike other fat-soluble vitamins it does not accumulate in the body.

High amounts of vitamin K will not cause your blood to overcoagulate. Coagulation proteins only have a certain number of spaces for vitamin K. Once those spaces are filled, vitamin K cannot affect coagulation proteins. Dr. Cees Vermeer of Maastricht University in the Netherlands compares it to what happens when you take vitamin C. Vitamin C is required for the hydroxylation of collagen (hydroxylation is similar to carboxylation). If you take too much vitamin C, however, you don't get too much collagen in the same way that if you take too much K you don't get too much coagulation. The processes are self-limiting.

Vitamin K is one of the most exciting vitamins of this decade. By keeping calcium bone where it belongs, vitamin K may help prevent heart disease, stroke, osteoporosis, Alzheimer's disease and more. Researchers are just now focusing on its potential roles in the pancreas and brain. Vitamin K is exciting because it seems to act like a hormone, but shows no toxicity.

Recently it was shown that foods have less vitamin K than previously thought. Most multi-vitamins don't contain any vitamin K at all. The ones that do don't contain enough for optimal health. Considering the importance of this vitamin, it's reasonable to ask yourself if you're getting enough.

Dosage and precautions

Vitamin K is not stored in the body, and is therefore nontoxic in high amounts. Forty-five milligrams a day were used in osteoporosis studies without any ill effect. Vitamin K has been approved in Japan for the treatment of osteoporosis since 1995. Several thousand times more than what people are currently getting in their diet has been taken without any toxicity. Dosage depends on an individual's diet, age, whether they are taking drugs, and what stressors are present. Generally, 10 mg/day is recommended.

If you want to get your vitamin K level tested, request the osteocalcin test. It is much more reliable than coagulation tests. The

osteocalcin test measures how much carboxylated osteocalcin you have. Since carboxylation is dependent on vitamin K, this test will give you a good idea of your vitamin K status, and whether or not you're headed for osteoporosis and possibly heart disease.

Caution: people who take blood thinners such as Coumadin or heparin should not take vitamin K without consulting their doctor.

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Vitamin K Stressors

o Very high amounts of vitamin E can interfere with vitamin K. The oxidized form of E known as tocopherylquinone interferes with vitamin K's ability to carboxylate coagulation proteins. But, it takes thousands of IUs a day to create this effect. Supplemental vitamin E into the normal range of up to 1200 IU/day will not affect vitamin K or blood coagulation, unless vitamin K is perilously low.

o Antibiotics wipe out intestinal flora, which are the source of vitamin K2.

o Cholesterol-reducing drugs, low-fat diets, Olestra, and anything else that interferes with fat reduces vitamin K. Vitamin K is carted around the body by lipoproteins-the same proteins that carry cholesterol. In order for vitamin K to be absorbed, there must be some fat present.

o Mineral oil laxatives interfere with the absorption of vitamin K. BHT, the synthetic food preservative, interferes with the ability of vitamin K to function.

o Liver disease, gastrointestinal diseases, gallstones, synthetic estrogens and anything else that interferes with the gut or bile can cause vitamin K deficiency.

o Dietary restriction or dieting. Don't forget that dietary restriction only enhances longevity if all nutrients are maintained at high levels. And watch out for low-fat diets. It's the oil in the salad dressing that enables the vitamin K in your salad to be absorbed. Also be careful about diets such as high-protein meat diets that are devoid of green vegetables.

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