

Vitamin K2 – A New Hope for Osteoarthritis Relief

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STORY AT-A-GLANCE

- › Osteoarthritis results from cartilage deterioration due to genetic, metabolic and inflammatory factors, causing bone friction, pain, stiffness, and bone spur formation that impair joint function
- › Research suggests that vitamin K can support joint health by helping regulate calcium metabolism. Animal and lab studies indicate vitamin K2 may reduce inflammation, support cartilage integrity, and activate proteins like GPX4 that protect cartilage cells from damage
- › Elevated levels of vitamin K-dependent proteins like Gla-rich protein (GRP) and matrix Gla protein (MGP) in osteoarthritic joints suggest a possible protective role against harmful calcium deposits and potential use as diagnostic markers
- › Insufficient vitamin K may impair the activation of these proteins, and low vitamin K status has been linked in observational studies to more cartilage damage, joint degeneration, and worse osteoarthritis symptoms
- › Getting enough vitamin K2 through foods, supplements where your diet falls short, and healthy lifestyle changes is one way to support joint health – though human trials testing whether vitamin K2 slows osteoarthritis are still needed

Osteoarthritis is a condition that primarily affects older adults. It develops when cartilage, the cushion between bones, deteriorates due to genetic, metabolic or inflammatory factors. This causes bones to rub together, leading to pain, stiffness and

changes in the underlying bone structure, such as osteophytes (bone spurs), which further limit joint function.

Genetic predisposition plays a significant role in the development of osteoarthritis, as certain individuals are more susceptible to it due to inherited traits. Metabolic factors such as obesity contribute to increased stress on joints, accelerating cartilage wear and tear. Inflammatory processes within the joint also exacerbate cartilage degradation.

Conventional treatments, like pain relievers and physical therapy, often focus on managing the symptoms rather than addressing the root causes. While they can provide temporary relief, they generally don't stop the progression of joint damage. Some medications also have side effects, including gastrointestinal issues and increased cardiovascular risks.

Instead of relying solely on these treatments, it's worth looking at approaches that address the underlying factors linked to osteoarthritis. Nutrients like vitamin K — both K1 (phylloquinone) and K2 (menaquinones) — have shown promise in research on joint health and cartilage integrity. This makes your vitamin K status worth paying attention to as part of a broader approach to protecting your joints and mobility.

What's the Role of Gla-Rich Protein and Matrix Gla Protein in Osteoarthritis?

A small, cross-sectional study published in the *Journal of Clinical Medicine*¹ investigated the role of two vitamin K-dependent proteins — Gla-rich protein (GRP) and matrix Gla protein (MGP) — in the development of osteoarthritis. Researchers compared the levels of these proteins in the joint fluid of patients with and without osteoarthritis.

- **GRP levels are significantly higher in osteoarthritis** — The researchers selected 26 patients with advanced (grade 4) osteoarthritis who were undergoing knee replacement surgery and 31 individuals without osteoarthritis undergoing knee-related procedures for non-cartilage-related issues.

Their analysis revealed that GRP levels were significantly higher in the osteoarthritic group, with a mean of 419.61 ng/mL, compared to 382.18 ng/mL in the non-osteoarthritic group. The osteoarthritis group was also older on average (about 62 versus 48 years), which matters when interpreting these differences.

- **MGP levels are also elevated in osteoarthritic joints** — The study also found that MGP levels were elevated in osteoarthritic patients, with averages of 67.76 ng/mL versus 53.49 ng/mL in the controls. Calcium ion levels were also notably higher in those with osteoarthritis, suggesting a possible link between calcium metabolism and joint degeneration.
- **Age influences MGP but not GRP** — Interestingly, the study identified a positive correlation between MGP levels and age, reducing its specificity as an osteoarthritis biomarker. In contrast, GRP levels showed no significant age-related variation, which the authors said makes GRP a potentially more specific marker of this condition.
- **GRP and MGP may help limit calcium buildup** — The authors proposed that GRP and MGP rise in response to high calcium levels in the joint fluid and bind that calcium to help limit unwanted mineral deposits in the joints, which may contribute to further cartilage damage.
- **Vitamin K is essential for GRP and MGP function** — Vitamins K1 and K2 are needed for these proteins to function properly (vitamin K2 is thought to be especially relevant for these proteins in tissues outside the liver), as vitamin K enables them to bind calcium effectively. Without adequate vitamin K, the ability of GRP and MGP to limit calcium buildup may be compromised — a process researchers suspect could contribute to osteoarthritis. This featured study did not measure vitamin K levels, however.

Overall, the findings point to GRP and MGP as potential markers of osteoarthritis. Because everyone in the osteoarthritis group had advanced disease, and vitamin K itself wasn't measured, it remains to be seen whether these proteins can help with early

diagnosis or how strongly vitamin K status influences them.²

What Does Research Say About Vitamin K and Osteoarthritis?

A 2020 review published in *Nutrients*³ examined the existing body of research — mostly observational studies, plus one clinical trial — on vitamin K and osteoarthritis, particularly whether vitamin K status is related to the risk and severity of this condition through its influence on cartilage calcification and joint inflammation. Key findings for each include:

- **Vitamin K1 is lower in osteoarthritis patients** — In small case-control studies, individuals with osteoarthritis had lower serum K1 levels than healthy controls.
- **Low plasma K1 is linked to mobility limitations** — In a large study of older adults, people with plasma K1 levels below 0.5 nmol/L were more likely to develop mobility limitations and disability than those at 1 nmol/L or higher. In another study, higher plasma K1 was linked to less hand osteoarthritis up to about 1 nmol/L, with no added benefit seen above that level.*
- **A K1 supplementation trial showed mixed results** — In a three-year randomized clinical trial on hand osteoarthritis, 500 micrograms of K1 per day did not change the overall occurrence of hand osteoarthritis, joint space narrowing, or bone spurs. However, among participants who had insufficient vitamin K at the start and reached sufficient levels during the trial, joint space narrowing occurred 47% less often.*
- **Higher dietary vitamin K intake is linked to less severe osteoarthritis** — Observational studies found a correlation between higher vitamin K intake and less severe osteoarthritis.*
- **Vitamin K2 is unevenly distributed in osteoarthritis joints** — In osteoarthritis patients, higher K2 levels were found in the outer part of the knee joint compared to the inner part. However, only one included study specifically examined K2

distribution in knee joints.*

**These findings are from research conducted in clinical settings. Results may not apply to all individuals.*

To better understand the unique functions of vitamin K1 and K2, read "[Vitamin K1 vs. K2 — Understanding Their Distinct Roles in Your Health.](#)"

How Are Low K1 Levels Linked to Osteoarthritis Severity?

The review published in *Nutrients* also noted that, across the observational studies it examined, adequate vitamin K status was associated with a lower risk of osteoarthritis and fewer signs of joint damage compared to vitamin K deficiency.⁴

- **Lower vitamin K1 levels are linked to more severe osteoarthritis** — A small study⁵ found that 40 people with early knee osteoarthritis had lower plasma phylloquinone levels than 20 healthy controls, and over 12 months, those who were deficient were about twice as likely to show progression on ultrasound.

"Increased plasma phylloquinone level was linked to increased medial cartilage thickness," the *Nutrients* review noted in summarizing this study. "Subjects with vitamin K deficiency was found to have higher scores of Western Ontario McMaster Scale (WOMAC), which reflects an increased severity of the disease."

- **Vitamin K helps regulate calcification in joint cartilage** — Vitamin K acts as a cofactor for γ -glutamyl carboxylase, an enzyme that activates γ -carboxyglutamate (Gla)-containing proteins, which regulate calcification. By activating these proteins, vitamin K may help limit the inappropriate buildup of calcium in joint cartilage, which is thought to contribute to cartilage degradation and joint pain, both hallmarks of osteoarthritis.
- **Vitamin K supports MGP function** — Vitamin K activates MGP, which acts as an inhibitor of bone morphogenetic protein-mediated cartilage calcification. Through this role, adequate vitamin K is thought to help preserve the structural integrity of

cartilage by limiting a calcification process that has been linked to osteoarthritis.

"Gla-rich proteins also inhibit inflammatory cascade in monocytic cell lines, but this function might be independent of vitamin K-carboxylation," the authors added.⁶

- **Higher vitamin K1 intake correlates with healthier joints** — The researchers also found a notable correlation between higher vitamin K1 intake and healthier joints, with individuals showing fewer signs of joint degeneration, such as better-preserved joint space width — although in that research, vitamin K intake was not linked to bone spur (osteophyte) area overall. Because these findings are associations, they show a relationship with joint structure rather than proof that vitamin K improves it.
- **Low vitamin K status is linked to more joint damage** — Additionally, the findings revealed that low vitamin K status, as indicated by higher plasma levels of inactive MGP, was linked to a higher likelihood of structural joint changes seen in osteoarthritis, such as meniscus damage, osteophytes, and bone marrow lesions (though not knee pain). This suggests that inadequate vitamin K may prevent the proper activation of MGP, potentially allowing calcification to progress.
- **Even subclinical vitamin K deficiency is associated with osteoarthritis** — The research concluded that even subclinical vitamin K deficiency was associated with the development of radiographic knee osteoarthritis and cartilage lesions, suggesting the nutrient plays a role in cartilage health. Based on this observational evidence, the review's author suggested that maintaining an adequate vitamin K intake is a reasonable recommendation for older adults, while noting that evidence from clinical trials is still limited.⁷

To learn more about how vitamin K supports bone health, check out "[Vitamin K 101 — Essential Basics for Bone and Heart Health](#)."

What Does Animal and Lab Research Show About Vitamin K2?

While the featured research above focused on vitamin K1, a June 2024 animal and laboratory study published in *Biomedicine and Pharmacotherapy*⁸ investigated whether vitamin K2 could slow the progression of osteoarthritis in rats. The researchers focused on two main areas – preventing the death of cartilage cells and stopping the breakdown of the cartilage matrix, which is essential for healthy joints.

- **Vitamin K2 improved bone and cartilage measures and reduced joint pain in animal subjects** – In rats with surgically induced knee osteoarthritis, vitamin K2 was injected directly into the knee joint, at doses of 50 and 100 milligrams per kilogram of body weight twice a week, to observe its effects on joint health.

In parallel, rat cartilage cells were treated with vitamin K2 in a controlled lab environment to determine its direct impact on these cells. In the rats, vitamin K2 increased bone mass and cartilage thickness in the treated knee, and reduced pain responses and structural damage.⁹

- **Vitamin K2 helped protect cartilage cells from ferroptosis** – The results showed that vitamin K2 increased the expression of GPX4, a protein that protects cells from ferroptosis, a type of programmed cell death that contributes to cartilage degradation in osteoarthritis. By boosting GPX4 levels, vitamin K2 helped keep the cartilage cells alive and functioning in these experiments.
- **Vitamin K2 reduced inflammation-driven cartilage damage** – Vitamin K2 protected the cartilage from excessive breakdown by inhibiting the MAPK/NFκB signaling pathway, which promotes inflammation and further cartilage damage in osteoarthritis.^{10*}
- **Vitamin K2's effects were dose-dependent** – In these experiments, higher doses led to greater increases in GPX4 expression and larger reductions in markers of cartilage degradation.¹¹
- **In cartilage cells, vitamin K2 reduced oxidative stress and cellular damage** – The research showed that vitamin K2 treatment improved cartilage cell viability, keeping more cells healthy and active, as well as reduced the levels of reactive oxygen

species (ROS), which are harmful molecules that cause oxidative stress and damage to cells.

Moreover, vitamin K2 lowered the levels of intracellular malondialdehyde (MDA), a marker of lipid peroxidation, a process that damages cell membranes.¹²

Egg Yolks Are Your Best Dietary Source of Vitamin K2 as MK-4

Egg yolks are among the highest dietary sources of Menaquinone-4 (MK-4), a vital form of vitamin K2 that plays an important role in bone health, cardiovascular function and calcium regulation. Including egg yolks in your diet significantly contributes to your MK-4 intake, supporting various aspects of your health.

- **Choose eggs from properly fed chickens** — Most commercial egg sources — even free-range organic — have high PUFA levels as they are fed grains like soy and corn. Ideally chickens should be fed rice, barley and split peas.
- **Eggs from low-PUFA-fed chickens are superior** — I personally eat six egg yolks a day from chickens fed this diet, which have 80% less linoleic acid than regular chickens.
- **How egg yolks compare as a leading MK-4 source** — Below is a comprehensive overview of egg yolks as a top source of MK-4, along with additional dietary sources and considerations.

To ensure you're choosing the highest-quality eggs for optimal nutrition, read "[How to Decode Egg Carton Codes](#)."

Five Ways to Increase Your Vitamin K Intake for Healthier Joints

Getting enough vitamin K1 and K2 through a nutritious diet, supplementation where your diet falls short, and other healthy habits is one way to support healthy cartilage and joint function. In addition to eating more egg yolks, here are five ways to increase your

vitamin K intake and support your joints:

- 1. Eat more leafy greens** — Vitamin K1 (phylloquinone) is found in all photosynthetic plants, with green leafy vegetables being the primary dietary source.
- 2. Add vitamin K2-rich foods into your diet** — Prioritize foods naturally rich in vitamin K2, especially the MK-7 form, which is more bioavailable and remains active in the body longer. Fermented foods like natto are the most potent source, delivering approximately 11 micrograms (mcg) of K2 MK-7 per gram of serving.

Other good options include sauerkraut made with K2-producing bacteria and certain cheeses like Gouda, brie and Edam — ideally raw-milk versions made with animal rennet rather than commercially produced, pasteurized variants. Homemade fermented vegetables prepared with starter cultures designed to enhance K2 production provide up to 500 mcg of K2 per 2-ounce serving. Additionally, grass fed beef, butter and eggs are far superior to grain-fed options, offering significantly higher levels of this essential nutrient.

- 3. A vitamin K2 MK-7 supplement may be used if your diet falls short** — If you supplement, a general guideline is about 180 mcg of vitamin K2 for every 5,000 IUs of vitamin D3 you take. Vitamin K2 helps activate proteins that keep calcium from depositing in soft tissues, and the MK-7 form is well-absorbed and has a long half-life. For optimal absorption, consume it with a meal containing healthy fats. If you take a blood thinner such as warfarin, talk to your health care provider before adding vitamin K2, as vitamin K can interfere with these medications and make them less effective. People with conditions such as atrial fibrillation, mechanical heart valves, deep vein thrombosis, and several others, also need to work with their physicians to determine whether vitamin K2 supplementation is appropriate.
- 4. Combine vitamin K2 with vitamin D3 and magnesium** — Support healthy calcium metabolism by pairing vitamin K2 with vitamin D3 and magnesium glycinate or malate daily. This combination works synergistically — vitamin K2 directs calcium to bones instead of soft tissues, while vitamin D3 aids in its absorption.

To determine your ideal dosage for magnesium, take magnesium citrate first, gradually increasing your dose until you experience loose stools, then reduce it slightly – that's your ideal dose. Afterward, you can transition to magnesium glycinate or malate, which are less likely to cause loose stools than magnesium citrate.

- 5. Replace seed oils with healthy fats** — Remove seed oils (often sold as "vegetable oils") from your diet, as their high linoleic acid content is thought to promote inflammation that may contribute to joint damage; aim to keep your linoleic acid intake below 5 grams a day. Instead, choose nutrient-dense, anti-inflammatory alternatives such as tallow, ghee or grass fed butter.

Focus on consuming whole, unprocessed foods to further reduce inflammatory triggers and support your body's natural repair processes. This change supports your joints and your overall health, and complements the role vitamin K2 plays in calcium regulation and cartilage health.

Frequently Asked Questions (FAQs) About Osteoarthritis and Vitamin K

Q: What causes osteoarthritis?

A: Osteoarthritis develops when cartilage deteriorates due to genetic, metabolic or inflammatory factors. This leads to bones rubbing together, causing pain, stiffness and structural changes like bone spurs that impair joint function.

Q: How is vitamin K involved in joint health?

A: Vitamin K is needed to activate proteins, such as MGP and GRP, that help regulate calcium in cartilage. Research links adequate vitamin K status to fewer signs of joint

degeneration, although clinical trials testing vitamin K for osteoarthritis are limited.

Q: Can a vitamin K deficiency worsen osteoarthritis?

A: Observational studies suggest it may. Low vitamin K levels have been linked to more cartilage damage, joint pain, and reduced mobility. Without enough vitamin K, essential proteins like matrix Gla protein (MGP) can't be fully activated, which may weaken their ability to limit calcium buildup in joints.

Q: Should I take a vitamin K2 supplement for joint health?

A: If your diet doesn't provide enough vitamin K2, an MK-7 supplement is one option — a good guideline is about 180 mcg of K2 for every 5,000 IUs of vitamin D3 you take. Vitamin K2 helps activate proteins involved in calcium regulation. If you take a blood thinner,, talk to your health care provider first, as vitamin K2 can make vitamin K antagonists like warfarin less effective. People with conditions such as atrial fibrillation, mechanical heart valves, deep vein thrombosis, and several others, also need to work with their physicians to determine whether vitamin K2 supplementation is appropriate.

Q: What are the best ways to increase your vitamin K intake for joint health?

A: Increase your intake of vitamin K-rich foods, supplement with K2 if needed, pair it with vitamin D3 and magnesium, and eliminate inflammatory seed oils (often sold as vegetable oils) from your diet to support joint health.

This article is for informational purposes only and does not constitute medical advice. Consult a qualified healthcare provider before making changes to your health regimen.

Sources and References

- ^{1, 2} J Clin Med. 2024 Aug 30;13(17):5159
- ^{3, 4, 6, 7} Nutrients. 2020 Apr 25;12(5):1208
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