

WHITE PAPER

MenaQ7®

NATURAL VITAMIN K2 AS MK-7

The Natural Clinically Proven Vitamin K2 as MK-7 Backed by Two Decades of Clinical Evidence

Established Benefits for Bone and Cardiovascular Health with Expanding Scientific
Evidence in Emerging Areas



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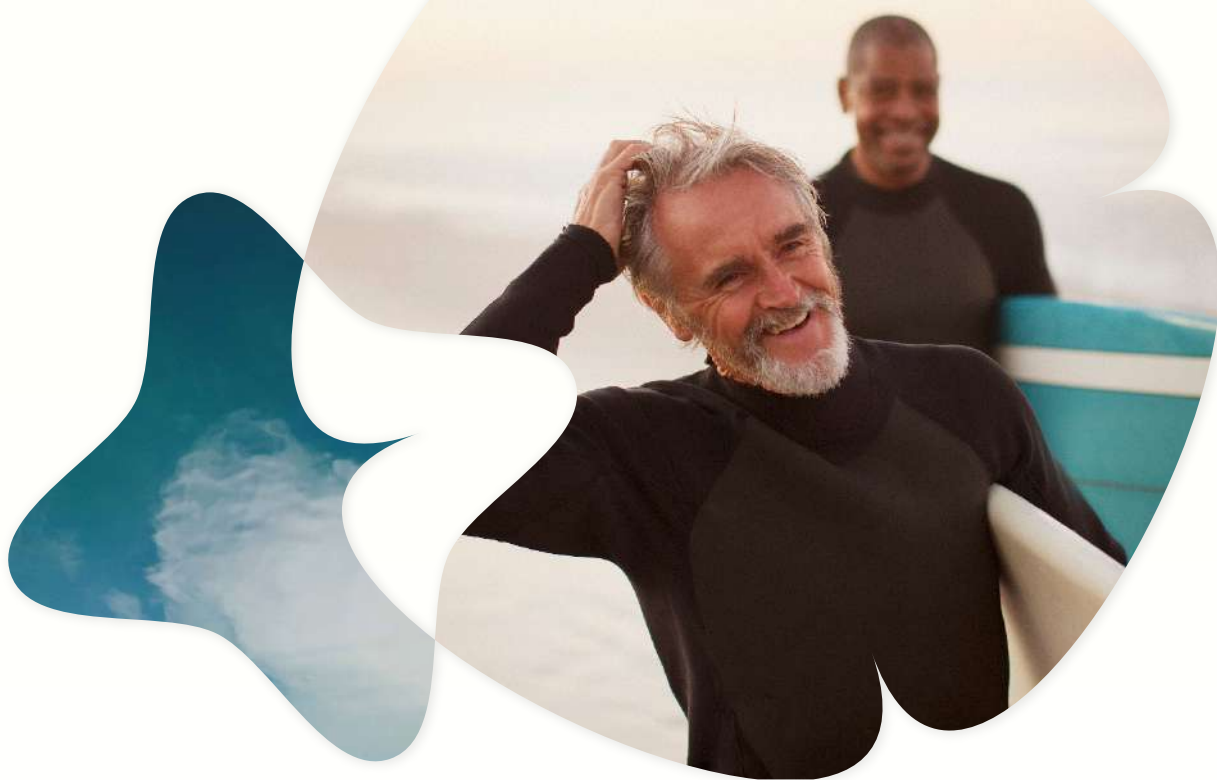


Executive Summary

Vitamin K refers to a group of fat-soluble compounds that play an essential role in normal blood coagulation and in the regulation of calcium metabolism through the activation of vitamin K-dependent proteins in bones, blood vessels, and other soft tissues. Among the different forms of vitamin K, menaquinone-7 (MK-7), the form used in MenaQ7[®], has favorable pharmacokinetic properties, including suitable bioavailability and a longer half-life compared with other vitamin K forms.

Research shows that suboptimal vitamin K status, characterized by elevated levels of under-carboxylated vitamin K-dependent proteins, is associated with poor bone health, increased fracture risk, and elevated cardiovascular disease risk. Multiple intervention studies demonstrate that MenaQ7[®] supplementation improves vitamin K status in both healthy adults and children at nutritional dosages. The effect of MenaQ7[®] has been demonstrated in multiple formulations, including dairy matrices.

Health claims related to bone health have been approved by regulatory authorities in Europe and Indonesia, underscoring the recognized importance of vitamin K for skeletal health. Consistent with these approvals, multiple meta-analyses indicate that the strongest clinical evidence for vitamin K2 relates to bone health. Clinical studies with MenaQ7[®] further support these findings: in a three-year, randomized, placebo-controlled trial, a nutritional dose of 180 µg/day significantly attenuated age-related bone loss in postmenopausal women. Supplementation with MenaQ7[®] has also been shown to support bone strength and quality. Emerging evidence suggests that vitamin K2 as MenaQ7[®] may also contribute to skeletal development and normal growth in children, highlighting the importance of adequate vitamin K2 intake across the lifespan.



While the strongest clinical evidence for vitamin K2 relates to bone health, growing evidence also supports an important role in cardiovascular health. Through its involvement in calcium metabolism, vitamin K2 activates matrix Gla protein (MGP), a key inhibitor of soft tissue calcification, supporting vasculature elasticity. Consistent with this mechanism, clinical studies have shown that MenaQ7® supplementation improves vitamin K-dependent MGP activation and supports the maintenance of arterial elasticity. Additional clinical study findings indicate that MenaQ7® may also support healthy blood pressure in specific populations and limit the progression rate of coronary artery calcification, a major risk factor for cardiovascular morbidity and mortality. Further research in this area is expected in the coming years. Additionally, emerging research is exploring the potential involvement of vitamin K2 in metabolic processes and nervous system.

Vitamin K2 acts in synergy with other nutrients involved in calcium metabolism, particularly vitamin D and magnesium. Vitamin D stimulates the synthesis of vitamin K-dependent proteins, such as osteocalcin and MGP, while vitamin K2 enables their biological activity through γ -carboxylation. Magnesium contributes to this interaction by serving as a cofactor for enzymes involved in vitamin D metabolism and activation. Adequate intake of these nutrients together supports optimal calcium utilization and distribution in the body.

While vitamin K, including K2 as MK-7, has no established tolerable upper intake level it has a demonstrated safety profile across a wide range of intakes. Extensive use worldwide, with millions of doses consumed annually, further supports its safety as a nutritional ingredient.

Overall, the available evidence supports MenaQ7® as a well-absorbed, biologically active, and safe form of vitamin K2, contributing to the maintenance of normal bones and cardiovascular health, with promising emerging research in metabolic health and nervous system.



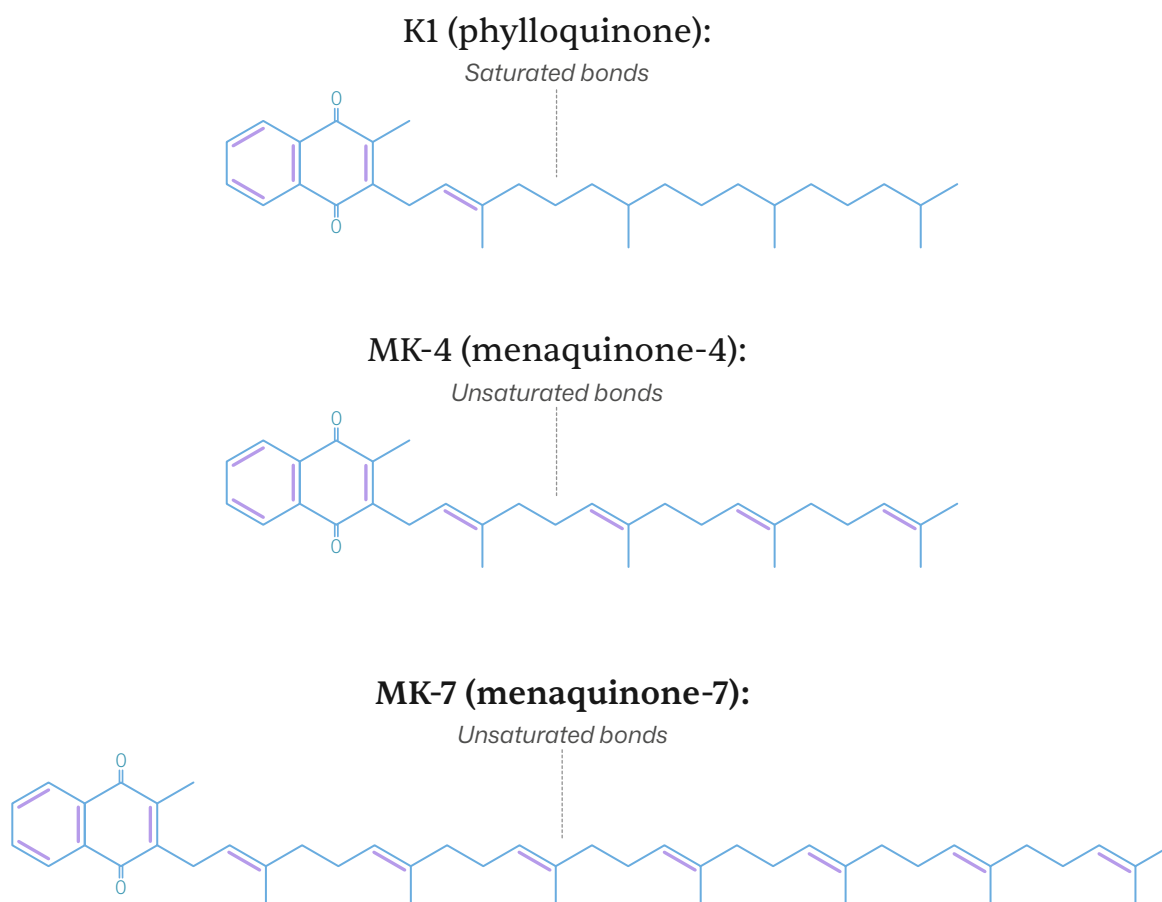
Background

The Vitamin K Family

Vitamin K is a group of fat-soluble vitamins that play a crucial role in normal blood coagulation and the regulation of calcium homeostasis, particularly in bones, arteries, and soft tissues. This family is traditionally divided into two main forms: vitamin K1 (phylloquinone), a single molecule, and vitamin K2, which comprises a group of related molecules known as menaquinones.

All vitamin K forms share a common 2-methyl-1,4-naphthoquinone ring structure, but they differ in the length and saturation of their side chains, called isoprenoid residues.¹ (Figure 1). The number of isoprenoid units in the side chain is reflected in the nomenclature of each menaquinone. For example, menaquinone 4 (MK-4) contains four isoprenoid units, while menaquinone 7 (MK-7) contains seven.

Figure 1 The chemical structures of vitamin K1 and vitamin K2 forms MK-4 and MK-7, highlighting differences in side-chain length and degree of unsaturation.



Vitamin K: Uptake and Distribution

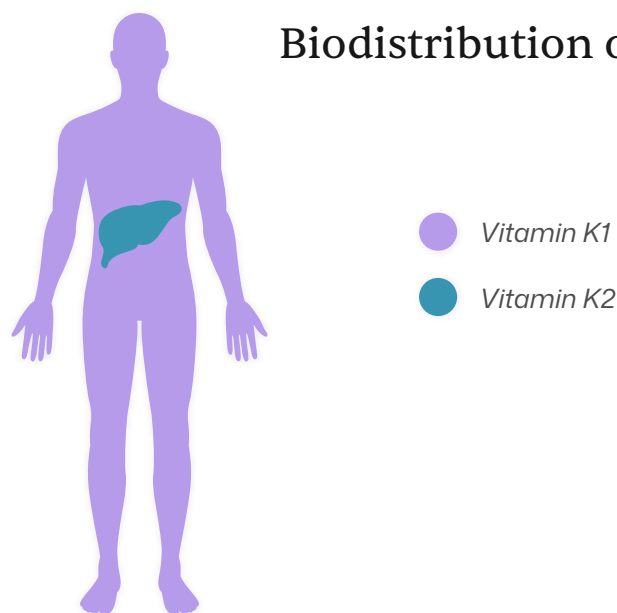
The length and saturation of the side chain in different vitamin K forms influences their biological activity and bioavailability. Longer-chain menaquinones, such as MK-7, are better able to reach tissues outside the liver, making them more effective in extra-hepatic tissues.²

All forms of vitamin K are absorbed in the intestine and incorporated into chylomicrons for transport via the lymphatic system into the bloodstream. Chylomicron remnants are subsequently taken up by the liver. Phylloquinone is relatively rapidly cleared from the circulation, with metabolites appearing in urine and bile. It is preferentially retained in the liver, where it supports the γ -carboxylation of blood clotting factors, and is less effectively maintained in the circulation compared with vitamin K2 forms.

In contrast, vitamin K2, particularly the longer-chain menaquinones, is more extensively redistributed from the liver to the systemic circulation via lipoproteins. This allows MK-7 to remain available for uptake and utilization by extrahepatic tissues such as bone and the vasculature.^{3, 4} (Figure 2).

Figure 2 Bioavailability and biodistribution of vitamin K.

While vitamin K1 is retained and exerts its function in the liver, vitamin K2 is redistributed to the circulation and (extra-)hepatic tissues.



Based on the figure published by Halder et al. Health and Disease. Int J Mol Sci. 2019

Sources of Vitamin K

Vitamin K1 is the predominant form in most diets and is found primarily in green leafy vegetables such as spinach, broccoli, and cabbage, as well as in smaller amounts in green fruits and vegetable oils. Although leafy vegetables contain substantial amounts of vitamin K1, absorption from plant sources is relatively low, with only about 10-20% entering the circulation.

Menaquinones, the forms of vitamin K2, are mainly, but not exclusively, of bacterial origin. Consequently, vitamin K2 is predominantly found in foods produced through bacterial fermentation or in animal-derived products. Fermented foods, particularly dairy products, represent the most important dietary sources of vitamin K2. In Western diets, hard and aged cheeses contain the highest levels of menaquinones, although vitamin K2 content can vary substantially depending on fermentation conditions and the bacterial strains involved.

In addition, menaquinone-4 can also be synthesized endogenously in mammalian and avian tissues through the conversion of vitamin K1. As a result, MK-4 is present in foods such as eggs and meat. The single richest natural source of vitamin K2 is natto, a traditional Japanese food made from fermented soybeans. Natto provides exceptionally high levels of menaquinone-7, and regular consumption has been associated with improved vitamin K status (higher level of activation (carboxylation) of vitamin K-dependent proteins in the body) and bone health.⁵ However, its strong odor, sticky texture, and distinctive taste limit its acceptance in Western diets.

In conclusion, obtaining sufficient vitamin K2 from diet alone can be difficult, as relatively large portions of K2-containing foods are needed to reach an intake of 45 µg/day. (Figure 3) For example, this would correspond to approximately 4 kg of beef, 5 L of milk, 140 g of egg yolk, 80 g of soft cheese, 59 g of hard cheese, or 5 L of yogurt per day.

Figure 3 Amounts of selected foods required to obtain 45 µg of vitamin K2 from the diet.

To obtain 45 µg of Vitamin K2, we should eat daily:



Vitamin K Intake Recommendations and Health Claims

Substantial regional differences exist in adult vitamin K intake recommendations and in the scope of permitted health claims. An Adequate Intake (AI) is used instead of a Recommended Daily Intake (RDI)⁶ because available data are insufficient to establish an average requirement and intake distribution needed to derive an RDI.

In Europe, the AI for adults is set at approximately 70 µg/day, corresponding to about 1 µg/kg body weight per day, and is derived primarily from requirements to maintain normal blood coagulation.⁷ Accordingly, EFSA has authorized two health claims for vitamin K, stating that it contributes to normal blood clotting and contributes to the maintenance of normal bones. More recently, in 2025, Indonesia established health claims related to bone health.⁸ These claims do not differentiate between vitamin K forms.

In the United States, recommended intakes are higher and sex-specific: 90 µg/day for adult women and 120 µg/day for adult men.⁹ The U.S. regulatory framework permits a broad range of structure/function claims, including claims addressing bone health (e.g. support of bone mineral density, bone mineral content, bone strength, and osteocalcin activity), cardiovascular health (arterial health, flexibility, and elasticity), and metabolic function.

Notably, Japan has established the highest adult vitamin K intake recommendations worldwide, with an AI of approximately 150 µg/day for adults.¹⁰ Japanese dietary reference intakes include both vitamin K1 and two menaquinones, MK-4 and MK-7, reflecting recognition of vitamin K's role in bone health and calcium regulation beyond coagulation.

Table 1 adequate intake (AI)- regional differences

Region	Adult Women (µg/day)	Adult Men (µg/day)
Europe (EFSA)	60-65	70-80
United States (IOM/NAM)	90	120
Japan (MHLW)	150	150

Collectively, these findings highlight the variability in vitamin K intake recommendations across different countries and suggest that it may be time to re-evaluate existing recommendations in light of newer scientific evidence.

MenaQ7®

The Natural Clinically Proven Vitamin K2 as MK-7

MenaQ7® is the most clinically proven natural vitamin K2 as MK-7, supported by numerous proprietary clinical studies covering all life stages. Manufactured in a GMP facility, it delivers proven efficacy and superior quality, empowering customers with formulation flexibility to develop innovative products for Performance & Mobility, Heart, Brain, and Women's Health.

MenaQ7® is produced through a controlled natural fermentation process using non-GMO Bacillus strains grown on an allergen-free substrate. During fermentation, microorganisms naturally synthesize vitamin K2, after which the biomass is concentrated to separate liquids from solids and recover the K2-rich fraction. The compound is then gently extracted and purified using food-grade bioethanol. This process results in a highly pure vitamin K2 with a general purity exceeding 97% and an isomeric purity of 99.8% in the bioactive all-trans MK-7 form. Thanks to this fermentation-based process, MenaQ7® provides a natural, clean vitamin K2 ingredient with minimal residues and consistent quality for nutritional formulations.





Pharmacokinetics and Biological Functions of Vitamin K2

Bioavailability and Bioactivity

Dietary supplements currently provide vitamin K in three main forms: vitamin K1, vitamin K2 as MK-4, and vitamin K2 as MK-7. Comparative studies, including extensive research conducted at the University of Maastricht, have evaluated these forms with respect to their absorption characteristics, pharmacokinetics, and biological efficacy.^{11,12}

Vitamin K1, vitamins K2 as MK-4, and MK-7 are all absorbed efficiently after oral intake, with peak serum concentrations typically reached approximately 4 hours post-ingestion. However, pronounced differences exist in their circulation time. (Figure 4) Vitamin K1¹³ and MK-4¹⁴ are rapidly cleared from plasma, exhibiting short half-lives and limited persistence in the bloodstream. In contrast, MK-7 exhibits a substantially longer half-life, resulting in more stable serum concentrations and significant accumulation during prolonged supplementation, reaching levels seven- to eight-fold higher than those observed with Vitamin K1.¹⁵ This prolonged presence in circulation underlies the greater efficacy of MK-7, resulting in more effective carboxylation of extra-hepatic vitamin K-dependent proteins than vitamin K1 and MK4.

Clinical studies, including MenaQ7®, show that vitamin K2 MK-7 exerts beneficial effects at nutritional doses.¹⁶ Daily intakes of approximately 90 µg significantly improve vitamin K status, reflecting the long half-life of MK-7 and its ability to maintain stable serum concentrations and accumulate during prolonged intake. In contrast, MK-4 has a short plasma half-life and therefore requires higher intake levels to achieve biological effects. A dose-finding study indicates that intakes of ≥600 µg/day¹⁷ may be relevant for bone health, while most clinical intervention trials have used pharmacological doses up to 45 mg/day.

Vitamin K1 has been evaluated at doses ranging from several hundred micrograms to milligram levels (0.2–2 mg/day). However, phylloquinone supplementation at diet-achievable doses (e.g., 500 µg/day) has not demonstrated additional benefits for bone health when combined with adequate calcium and vitamin D intake.¹⁸

Collectively, these findings indicate that MK-7 is remarkably more effective in maintaining higher vitamin K serum levels than both vitamin K1 and MK-4.

Figure 4 Serum concentration–time profiles of different vitamin K forms following oral ingestion.

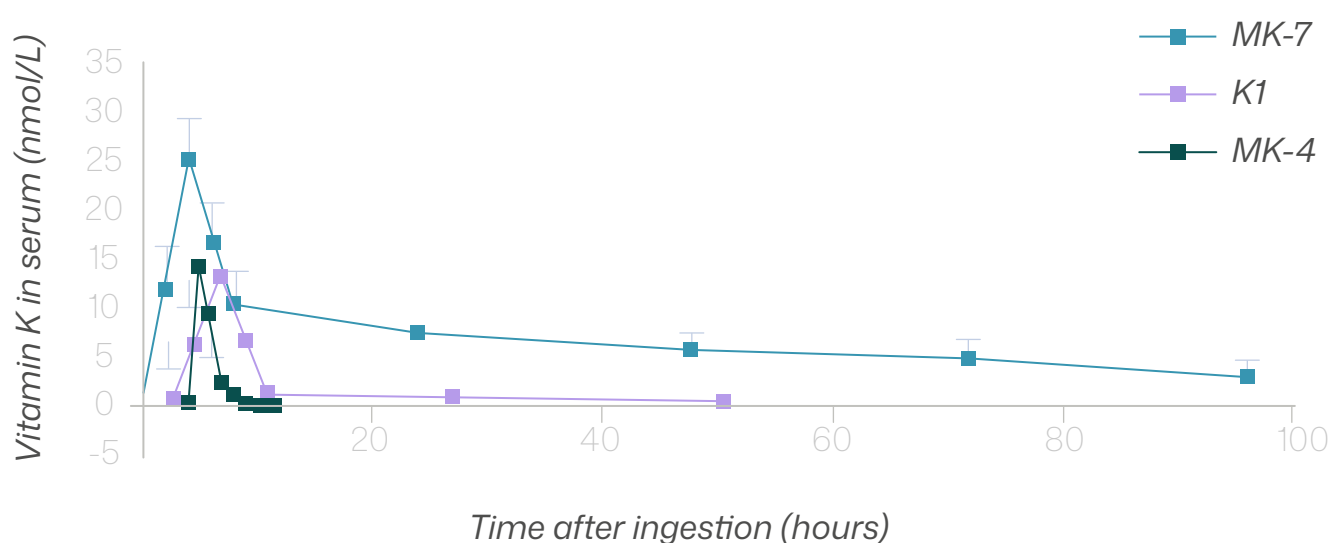


Figure adapted from WholeFoods Magazine, "New Discoveries About the Role of Vitamin K in Health, Part 3. 2014"

Mechanism of Action

Vitamin K has long been recognized for its essential role in blood coagulation through the activation of vitamin K-dependent proteins (VKDPs) in the liver. However, research over the past decades has shown that the function of vitamin K extends well beyond coagulation and involves a broader group of VKDPs present throughout the body. To date, approximately 17 distinct VKDPs have been identified in humans,¹⁹ all of which require vitamin K for activation.

Vitamin K serves as a cofactor for the enzyme γ -glutamyl carboxylase, which enables VKDPs to undergo carboxylation. (Figure 5) This biochemical modification allows these proteins to bind calcium and perform their biological functions. In the absence of sufficient vitamin K, VKDPs remain undercarboxylated and inactive.

While hepatic VKDPs are essential for maintaining normal hemostasis, several extra-hepatic VKDPs play important roles in tissues outside the liver. Among these, osteocalcin and MGP are particularly relevant.

Osteocalcin is produced by osteoblasts and is involved in the regulation of bone mineralization.²⁰ Its activity depends on vitamin K-mediated carboxylation, which supports calcium incorporation into the bone matrix. Matrix Gla protein is expressed primarily in vascular smooth muscle cells and cartilage and is considered a key inhibitor of calcium deposition in the arterial wall and other soft tissues. Only the carboxylated (active) form of MGP can exert this protective effect.

Vitamin K2 as M-K7 has been shown to be particularly effective in activating both osteocalcin and MGP.²¹

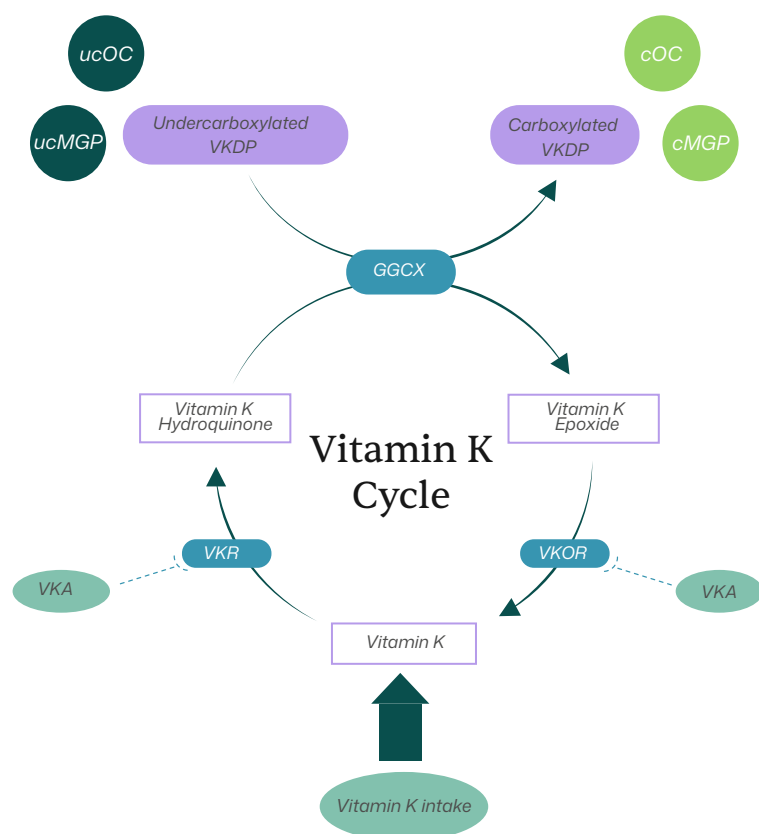


Figure 5 The vitamin K cycle.

Vitamin K is converted into its active form, vitamin K hydroquinone. During γ -carboxylation of vitamin K-dependent proteins (VKDPs) by γ -glutamyl carboxylase (GGCX), it is oxidized to vitamin K epoxide, which is recycled back to hydroquinone by vitamin K epoxide reductase (VKOR) and vitamin K reductase (VKR). Vitamin K antagonists inhibit VKOR, reducing vitamin K recycling. Only carboxylated VKDPs – such as osteocalcin (cOC) and matrix Gla-protein (cMGP) – are biologically active. Their undercarboxylated forms are denoted as ucOC and ucMGP.

Based on the figure published by Piscoer et al J Clin Med. 2023



Understanding the Calcium Paradox:

The Interplay of Vitamin K2, Vitamin D, and Magnesium

The calcium paradox refers to the simultaneous occurrence of inadequate calcium deposition in bone and excessive calcium accumulation in soft tissues, particularly the arterial wall. This concept was clearly presented in the book "Vitamin K2 and the Calcium Paradox" by Dr. Kate Rheaume-Bleue.²² The paradox offers a mechanistic explanation for the frequent coexistence of osteoporosis and vascular calcification, even in populations with sufficient calcium intake. (Figure 6)

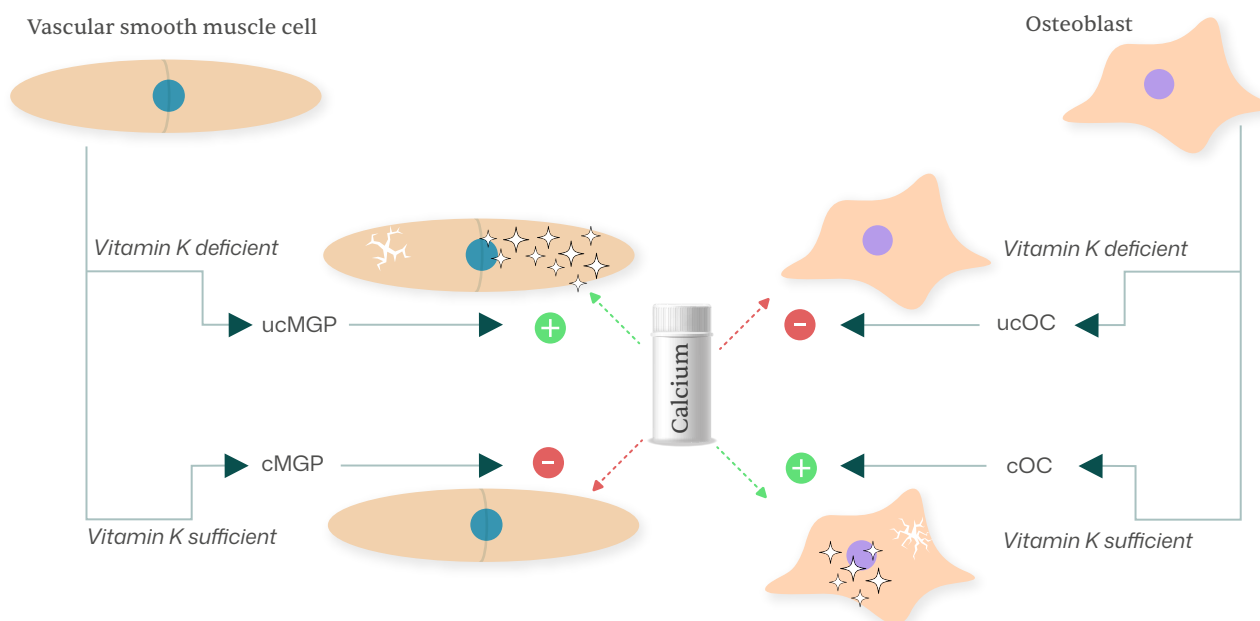
At the biochemical level, the calcium paradox reflects dysregulation in calcium distribution rather than calcium bioavailability. Vitamin D enhances intestinal calcium absorption and upregulates the expression of vitamin K-dependent proteins, including osteocalcin and MGP. However, these proteins require vitamin K-dependent γ -carboxylation to become biologically active. In the absence of adequate vitamin K, increased calcium absorption – particularly under vitamin D supplementation – may promote ectopic calcification instead of improving bone mineralization.²³

Vitamin K2 activates osteocalcin, enabling proper incorporation of calcium into the bone matrix, while simultaneously activating MGP, a key inhibitor of vascular and soft tissue calcification. Thus, vitamin K2 functions as a critical regulator that directs calcium away from arteries and toward skeletal tissue.

Figure 6 Understanding the calcium paradox:²⁴

the role of vitamin K in directing calcium to bone and away from arteries

Vascular smooth muscle cells (VSMCs) and osteoblasts synthesize Matrix-Gla-Protein (MGP) and osteocalcin (OC), respectively. In the presence of vitamin K2, these proteins undergo carboxylation, forming cMGP and cOC. Carboxylated MGP prevents calcification of VSMCs, while carboxylated osteocalcin promotes mineralization of the osteoblast matrix.



Based on the figure published by Wasilewski et al. Front. Cardiovasc. Med. 2019

Magnesium is an indispensable cofactor in this system. It is required for enzymatic activation of vitamin D and plays a direct role in bone crystal formation and parathyroid hormone regulation.²⁵ Approximately 31% of the global population has inadequate magnesium intake²⁶ and its subsequent deficiency can therefore induce functional vitamin D insufficiency and further exacerbate calcium mislocalization.

In conclusion, the calcium paradox should be considered within the context of overall nutrient intake. Adequate and balanced intake of vitamin D, vitamin K2, and magnesium is essential to ensure proper calcium homeostasis, supporting skeletal health while preventing pathological vascular calcification.



Benefits of MenaQ7®

Improvement of Vitamin K Status: Evidence from Healthy Adults and Children

There is growing concern that current dietary recommendations for vitamin K intake may be sufficient to maintain normal coagulation but may be inadequate to ensure optimal vitamin K status including the proper activation (carboxylation) of extra-hepatic vitamin K-dependent proteins,²⁷ which is essential for their optimal function. While prothrombin is essentially fully carboxylated under habitual dietary conditions, approximately 10–40% of circulating osteocalcin and matrix Gla-protein remains undercarboxylated in healthy individuals, indicating suboptimal extra-hepatic vitamin K status despite normal hemostasis.^{28, 29} Multiple clinical studies have shown that MenaQ7® is well absorbed and effective in improving extrahepatic vitamin K status.





Evidence in Healthy Adults

In a randomized, placebo-controlled, dose-response study in healthy adults, 12-week vitamin K2 MK-7 (MenaQ7®) supplementation exhibited a dose-dependent increase in circulating MK-7 concentrations, with significant elevations observed from 90 µg/day, confirming bioavailability.³⁰ Additionally, MK-7 supplementation at doses around the adequate daily intake significantly improved the carboxylation of extra-hepatic vitamin K-dependent proteins. Compared with placebo, higher MK-7 intakes resulted in significant reductions in undercarboxylated osteocalcin (ucOC), desphospho-uncarboxylated matrix Gla-protein (dp-ucMGP), and the ucOC:cOC ratio, whereas doses ≤45 µg/day showed no significant effects. Consistent with these findings,³¹ MK-7 delivered via extra-virgin olive oil increased plasma MK-7 in a dose-dependent manner, with 90 µg/day, but not 45 µg/day, producing a significant improvement in osteocalcin carboxylation.

In two studies^{32,33}, daily intake from 6 to 12 weeks of MenaQ7® at nutritional dosages, delivered either through fortified dairy products or soft-gel capsules, significantly increased circulating MK-7 levels and reduced ucOC and dp-ucMGP in healthy adults.

These findings demonstrate that MenaQ7® is well absorbed, improves extrahepatic vitamin K status, and is effective across different delivery matrices, including food-based applications.





Evidence in Healthy Kids

Supplementation with 45 µg of MK-7 as MenaQ7® for 8 weeks in healthy, prepubertal children resulted in reduced circulating levels of ucOC and an improved ratio of ucOC to carboxylated osteocalcin (UCR), indicating enhanced vitamin K status.³⁴ In contrast, the placebo group did not experience any significant changes in ucOC, cOC, UCR, or MK-7 levels over the study period.

These findings demonstrate that a modest 45 µg dose of MenaQ7® can improve vitamin K status and osteocalcin carboxylation in healthy children.

The Role of Vitamin K2 in Maintaining Bone Health

Based on 2025 IOF data,³⁵ osteoporosis is recognized as a global "silent disease" affecting over 500 million people, with figures expected to rise significantly. It is characterized by porous bones, primarily causing fractures in 1 in 3 women and 1 in 5 men over the age of 50. Adequate nutrition, including essential vitamins and minerals, plays a fundamental role in maintaining bone health, with vitamin K2 emerging as an important and increasingly recognized factor in bone metabolism.

Vitamin K2 plays an important role in bone metabolism through the activation of vitamin K-dependent proteins, particularly osteocalcin, which is essential for proper calcium binding within the bone matrix. In addition, experimental evidence suggests that vitamin K2 may influence bone health by modulating osteoclast activity and supporting collagen synthesis,³⁶ further contributing to skeletal strength. Recent large-scale meta-analyses published between 2020 and 2025 encompassing several thousand participants consistently demonstrate that vitamin K2 plays a meaningful role in bone health.

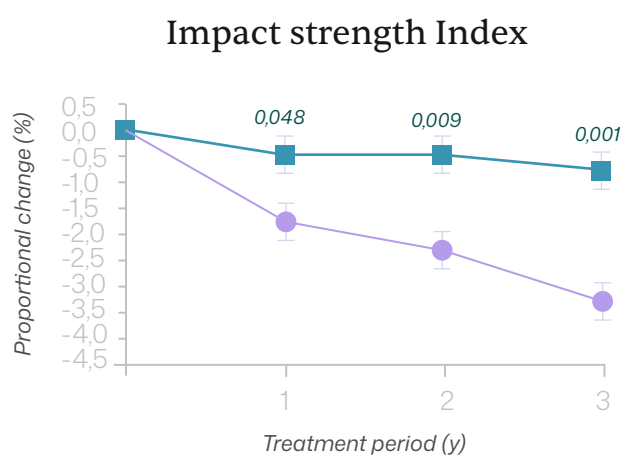
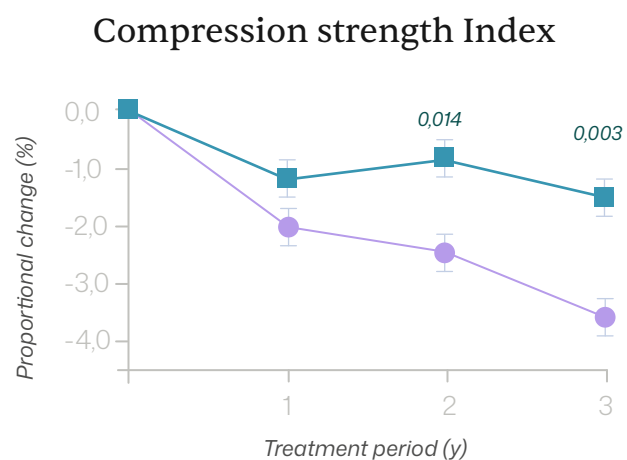
These analyses show that vitamin K2 supplementation supports bone turnover markers, contributes to osteocalcin activation, helps maintain bone mineral density and bone structure, and is associated with a reduced risk of fractures – both as a standalone intervention^{37, 38, 39, 40} and when combined with calcium⁴¹ and vitamin D.⁴²

MenaQ7® and Bone Health in Adults: Evidence from a Three-Year Clinical Study

In a randomized, placebo-controlled study, 244 healthy postmenopausal women who supplementation with MenaQ7® (vitamin K2 MK-7, 180 µg/day) for three years demonstrated significantly improved vitamin K status and attenuated age-related bone loss. Furthermore, MK-7 supplementation reduced declines in bone mineral density and bone mineral content at clinically relevant sites, including the lumbar spine and femoral neck, and favorably influenced indices of bone strength. (Figure 7) Additionally, MK-7 intake significantly decreased the loss of vertebral height in the lower thoracic spine.⁴³

Figure 7 Bone effects of MenaQ7® (180 µg/day) supplementation for three years.

Participants receiving MenaQ7® experienced significantly smaller declines in impact strength index and compression strength index compared with placebo, indicating better preservation of bone strength.



—●— Placebo —■— MenaQ7

Based on Osteoporos Int 2013

Importantly, these benefits were observed at nutritional intake levels in the microgram range, in contrast to earlier studies with vitamin K2 as MK-4 that used pharmacological doses in the milligram range,⁴⁴ although similar improvements in bone strength and hip geometry have also been reported with MK-4 supplementation.



Preclinical evidences

Bisphosphonate therapy with zoledronic acid is a commonly used treatment for osteoporosis and osteolytic bone diseases that works by inhibiting bone resorption, but it may be associated with side effects such as acute-phase reactions, impaired bone remodeling, and, in rare cases, osteonecrosis of the jaw. Preclinical research suggests that vitamin K2 as MK-7, when used alongside zoledronic acid therapy, may help attenuate zoledronic acid-related adverse effects through modulation of bone-forming gene expression.^{45,46}

Vitamin K2 and Bone Health in Kids

Children have a high requirement for vitamin K, as reflected by the relatively high levels of ucOC commonly observed in healthy children,⁴⁷ indicating suboptimal vitamin K status during growth. Vitamin K plays a crucial role in the proper development of the growing skeleton and vitamin K status is associated with childhood bone mineral content.⁴⁸ Elevated levels of ucOC are associated with lower bone mineral density and may indicate increased fracture risk in children.⁴⁹ During rapid growth phases, such as puberty, adequate vitamin K is essential for activating osteocalcin and facilitating calcium incorporation into the bone matrix. Without sufficient vitamin K availability, osteocalcin remains inactive, which may limit bone formation and peak bone mass. Promoting optimal vitamin K2 intake early in life can help peak bone mass and support bones in later life.

Benefits of MenaQ7® in Healthy Children

Supplementation with vitamin K2 MK-7 (MenaQ7®) improves vitamin K status in healthy prepubertal children. In a double-blind, placebo-controlled study, 55 children consumed either 45 µg of MenaQ7® or a placebo daily for 8 weeks.⁵⁰ Those in the MenaQ7® group experienced a significant reduction in circulating levels of ucOC and an improvement in ucOC:cOC, indicating enhanced vitamin K status. No significant changes in these markers were observed in the placebo group.

Furthermore, no increase in procoagulant activity was noted in the vitamin K2 MK-7 group, indicating that its supplementation is safe. The study represents the first randomized controlled trial using MenaQ7® and its effect on osteocalcin carboxylation in healthy children.



These findings suggest that prepubertal children may have a suboptimal vitamin K status, and that vitamin K2 supplementation can play a supportive role in bone metabolism during this critical growth phase.



MenaQ7® and Vitamin D Supplementation in Children with Compromised Bone Health

Thalassemic osteopathy (TOSP) is a growing concern in children with thalassemia major, as improved transfusion and chelation therapies have increased their life expectancy. In a prospective pilot study, researchers investigated the effects of a dietary supplement containing MenaQ7® (50 µg) and vitamin D (5 µg calcitriol) on bone health in 20 children with TOSP. The results showed a significant improvement in bone mineral density and Z-scores at the lumbar spine, particularly in the prepubertal group, after 6 and 12 months of supplementation.⁵¹

While the researchers did not find a significant decrease in ucOC:cOC, the overall findings suggest a positive association between MenaQ7® and calcitriol supplementation and bone mineralization in children with thalassemic osteopathy.



Vitamin K2 and Linear Growth: Emerging Evidence from Vietnam and China

Recent studies from Vietnam, together with observational studies from China, provided data regarding the hypothesis that vitamin K2 MK-7 may play a supportive role in linear growth in children.

A longitudinal prospective cohort study of 945 children aged 1–14 years in the MIDU children's height assessment program (May 2022–July 2025) evaluated vitamin K2 as MK-7 (MenaQ7®) at 180–360 µg/day, given continuously or in ≥3-month cycles for up to 18 months. Despite limitations inherent to its real-world design, the study provides evidence of a positive association between continuous vitamin K2 intake and greater height gain. The effect was consistent across all age groups, with the strongest long-term improvements seen in preschool children and pubertal girls (11–14 years).

These findings are supported by a nationwide Vietnamese cross-sectional study of 43,505 school-aged children, in which daily vitamin K2-MK-7 intake was associated with 18% lower odds of impaired growth,⁵² suggesting a role for vitamin K2 in supporting childhood growth in populations at risk of nutritional insufficiency.

Additional evidence comes from another cross-sectional study⁵³ which examined the relationship between vitamin K2 status and growth. Children with short stature had significantly lower vitamin K2 levels than their healthy peers, and vitamin K2 deficiency was identified as an independent risk factor for short stature, with an increased likelihood of growth impairment of more than 50%.⁵⁴



These studies collectively associated vitamin K2 status and supplementation with favorable linear growth outcomes in children.

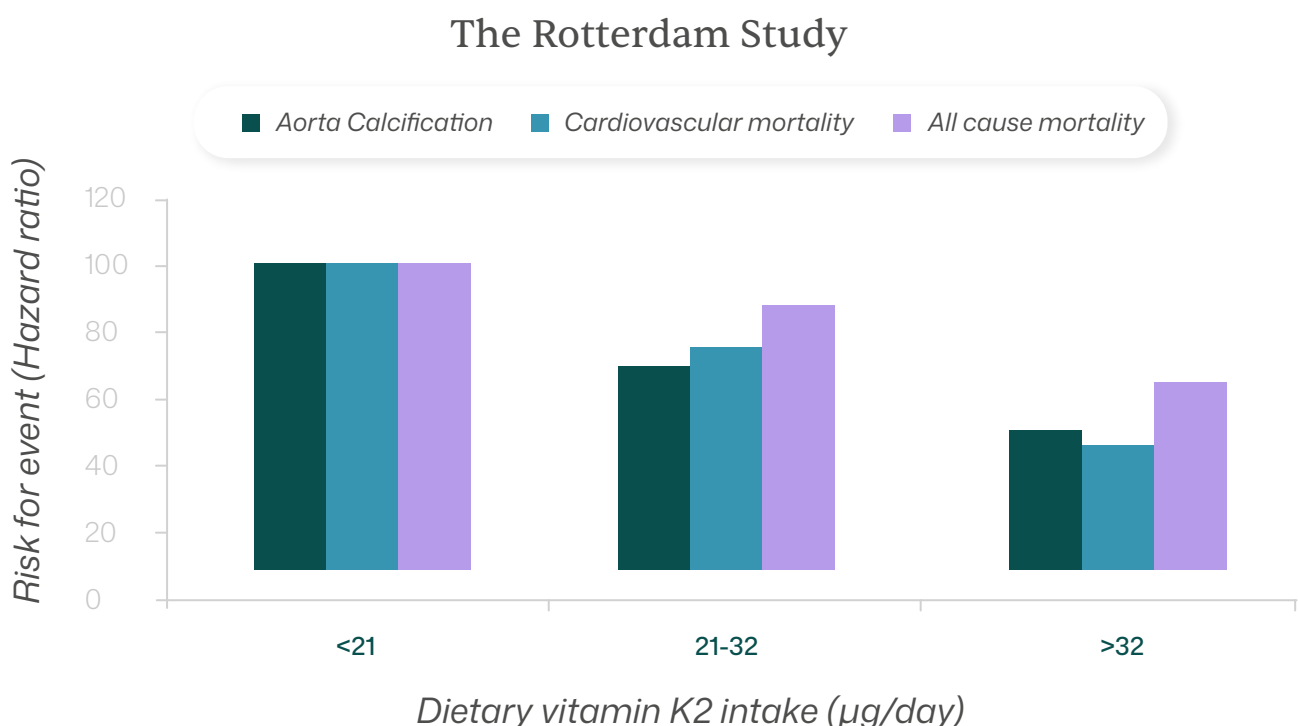


Cardiovascular Benefits

Clinicians from the Cleveland Clinic Foundation have highlighted an alarmingly high prevalence of suboptimal vitamin K intake across the U.S. population, alongside a growing body of evidence supporting the role of vitamin K2 in cardiovascular health.⁵⁵ This is particularly relevant given that cardiovascular disease remains the leading cause of death worldwide, accounting for approximately 20 million deaths annually. In this context, data from the Council for Responsible Nutrition's Supplements to Savings Report (2022) indicates that increased vitamin K2 use could reduce coronary artery disease events by 15.7% and generate an estimated \$9.48 billion in U.S. healthcare savings between 2022 and 2030.⁵⁶

Vitamin K2 helps regulate soft-tissue calcium balance through activation of MGP, a key inhibitor of vascular calcification. A recent review described the association between low vitamin K status, reflected by inactive MGP, and arterial stiffness, vascular and valvular calcification, heart failure, and increased cardiovascular mortality.⁵⁷ Higher dietary vitamin K2 intake has been associated with lower cardiovascular risk, with epidemiological data from the Rotterdam Study showing approximately a 50–60% reduction in coronary heart disease mortality, lower all-cause mortality, and significantly reduced odds of severe aortic calcification among individuals with higher menaquinone intake. (Figure 8) The associations were specific to vitamin K2, not vitamin K1.⁵⁸ Additionally, each additional 10 µg/day increase in dietary vitamin K2 (primarily long-chain menaquinones, MK-7 to MK-9) has been associated with an approximately 9% reduction in the risk of incident coronary heart disease.⁵⁹

Figure 8 Association Between Dietary Vitamin K2 Intake and Risk of Aortic Calcification and Mortality in the Rotterdam Study

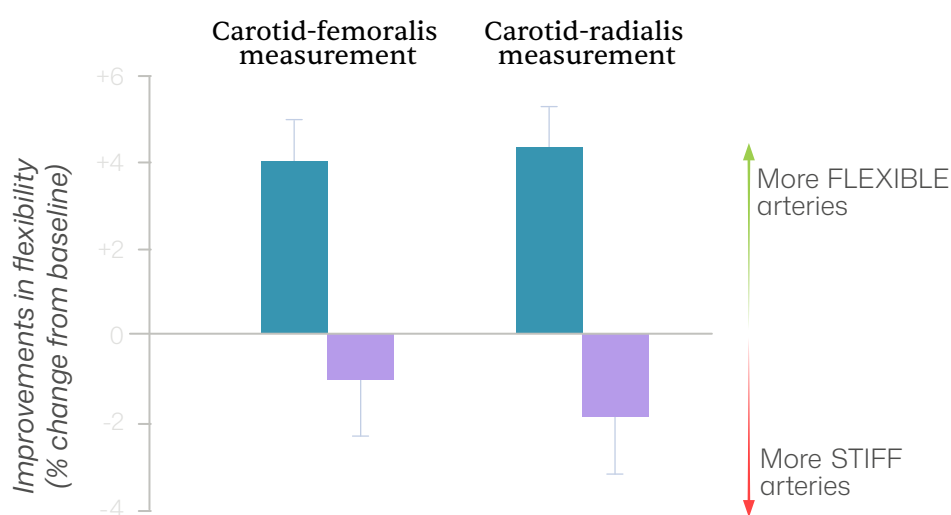


Impact of MenaQ7® Supplementation on Arterial Elasticity

Results from a double-blind, randomized, placebo-controlled clinical trial demonstrated that daily supplementation with vitamin K2 (MK-7) as MenaQ7® at a nutritional dose of 180 µg for three years improved measures of arterial stiffness in healthy postmenopausal women.

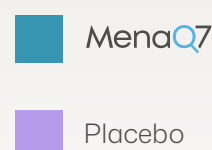
In this study, 244 Dutch women aged 55–65 years were randomly assigned to receive either MenaQ7® or placebo. (Figure 9) While the placebo group showed the expected age-related tendency toward increased arterial stiffness, MK-7 supplementation resulted in significant reductions in pulse wave velocity and improvements in ultrasound-based carotid stiffness parameters. The greatest benefits were observed in women with higher baseline arterial stiffness.⁶⁰

These findings provide long-term clinical evidence that MenaQ7® supplementation at nutritional intake levels can support arterial elasticity in postmenopausal women.



Based on *Thrombosis and Haemostasis*, 2015; 3-year endpoints

Figure 9 Cardiovascular effects of MenaQ7® (180 µg/day) supplementation for three years.



Additional clinical evidence comes from the KING trial, which evaluated the effects of MenaQ7® supplementation (360 µg/day) for eight weeks in renal transplant recipients, a population with a high prevalence of subclinical vitamin K deficiency and increased cardiovascular risk. Supplementation significantly improved vitamin K status, reflected by a marked reduction in dp-ucMGP, and was associated with a significant decrease in arterial stiffness, as measured by carotid-femoral pulse wave velocity. The greatest improvements were observed in patients with poorer vitamin K status at baseline.⁶¹ These findings suggest that vitamin K2 supplementation may help improve vascular health in populations at elevated cardiovascular risk.

Together, these clinical findings highlight a role for vitamin K2 in supporting arterial elasticity and vascular function across different populations. While effective intake levels have been established in healthy populations, optimal dosing in individuals with kidney disease remains under investigation; for example, the ongoing VIKIPEDIA study is evaluating a daily dose of 1000 µg vitamin K2.



Benefits of MenaQ7® in Adults with Poor Vitamin K Status

Low vitamin K status has been associated with increased arterial stiffness and vascular calcification, suggesting that individuals with poorer vitamin K status may benefit most from vitamin K2 supplementation.⁶²

A one-year randomized, placebo-controlled clinical trial evaluated whether vitamin K2 as MenaQ7® (180 µg/day) could improve vascular elasticity in adults with poor vitamin K status, defined by elevated levels of dp-ucMGP (>400 pmol/L). In 243 men and women aged 40–70 years, vitamin K2 MK-7 supplementation significantly reduced levels of dp-ucMGP, indicating improved vitamin K status. Vitamin K2 MK-7 also limited the increases in arterial stiffness, as measured by carotid–femoral pulse-wave velocity, with the most pronounced benefits observed in women.⁶³

A subsequent post hoc analysis of this one-year study concluded that MenaQ7® supplementation significantly attenuated vascular stiffening in postmenopausal women as shown by a markedly lower relative change in the Young's elasticity modulus. The effect was most pronounced in women with higher baseline arterial stiffness and included improvements in vascular compliance and distensibility, as well as favorable changes in brachial and carotid blood pressure compared with placebo.⁶⁴ These study results indicate that MenaQ7® supplementation may particularly benefit individuals with poorer vascular health by supporting arterial flexibility and blood pressure levels.



In conclusion, these findings suggest that MenaQ7® may provide vascular benefits within one year, particularly in individuals with low extrahepatic vitamin K status

Emerging Research

Benefits of Vitamin K2 on Metabolic health and Body Composition

Cohort studies have indicated an inverse association between dietary vitamin K2 intake levels and the risk of type 2 diabetes and metabolic syndrome.^{71, 72} In line with these findings, a case-control study showed that circulating vitamin K2 levels were significantly lower in individuals with type 2 diabetes compared to non-diabetic controls.⁷³ Furthermore, multiple randomized controlled trials have shown that vitamin K2 supplementation was associated with improved glycemic indices including lower fasting blood glucose, fasting insulin and homeostatic model assessment insulin resistance index compared to controls in patients with type 2 diabetes.^{74, 75, 76}

Additionally, Vitamin K2, particularly the MK-7 form, plays an emerging role in fat metabolism by potentially enhancing fat degradation, reducing visceral fat accumulation, and influencing key metabolic genes⁷⁷. MenaQ7® has also been linked to favorable body composition outcomes, with supplementation shown to support reductions in abdominal and visceral fat, which are key drivers of insulin resistance and metabolic risk.

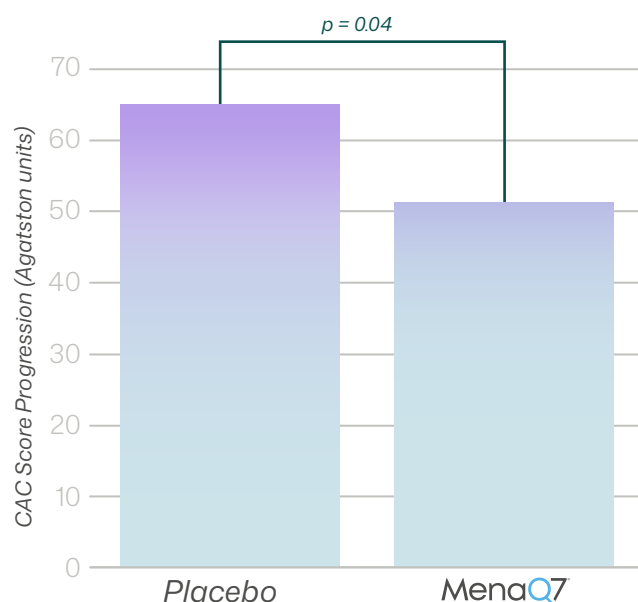
In a three-year randomized, placebo-controlled trial in 214 postmenopausal women, daily supplementation with 180 µg vitamin K2 (MK-7) as MenaQ7® significantly improved vitamin K status, as reflected by increased cOC.⁷⁸ While no overall effect on body composition was observed in the full cohort, women showing a strong response in osteocalcin carboxylation experienced higher adiponectin levels and significant reductions in abdominal and visceral fat compared with placebo and low responders. These study results suggest that high MenaQ7® intake was associated with favorable changes in fat distribution, particularly in individuals with a robust improvement in vitamin K status.

In a one-year intervention in adults with low vitamin K status, higher baseline dp-ucMGP was associated with higher BMI, fat mass, and visceral adipose tissue. Following daily supplementation with 180 µg MenaQ7®, modest reductions in BMI were observed overall, while participants with the greatest improvement in vitamin K status showed significant reductions in fat mass, waist-to-hip ratio, body weight, and visceral adiposity,⁷⁹ (Figure 11) supporting a link between improved vitamin K status and favorable body-composition outcomes.



Impact of MenaQ7® on Coronary Artery Calcification

Figure 10 Changes in coronary artery calcification over two years, comparing MenaQ7® treated group with control group.



Coronary artery calcification (CAC) is a well-established marker of cardiovascular risk, and there is currently no specific treatment available to reverse or effectively slow its progression.⁶⁵

A double-blind, randomized, placebo-controlled trial evaluated the effect of vitamin K2 as MenaQ7® (360 µg/day for two years) on the progression of CAC in 180 men and women with mild to moderate coronary artery disease.⁶⁶ In the participants who were followed up for two years, MenaQ7® supplementation significantly improved vitamin K status and slowed the rate of coronary artery calcification progression compared with placebo. (Figure 10) The slower progression was independent of blood pressure and occurred without significant adverse effects. These study results suggested that vitamin K2 may help slow the progression of coronary calcification, thus playing a role as a supporting nutrient for heart health.

The coronary artery calcium scoring was evaluated with the Agatston score calculated based on lesion density and area measure by computed tomography. The yearly mean values were significantly lower in the MK-7 group compared with the control group

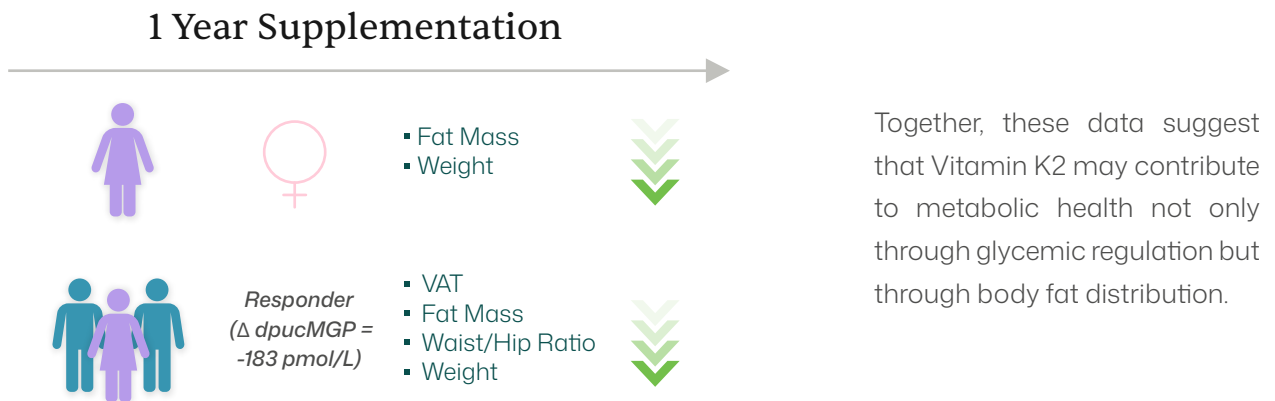
Statins and Vitamin K Status

Statins are first-line drugs in the prevention and treatment of atherosclerotic cardiovascular disease.⁶⁷ Paradoxically, intensive statin therapy has been associated in some studies with increased vascular calcification and faster progression⁶⁸ of coronary calcification. This phenomenon may involve interference with vitamin K-dependent proteins that regulate vascular calcification.

A 2021 study⁶⁹ including 98 participants with cardiovascular disease (CVD) and controls at moderate risk for CVD found that statin use was independently associated with higher coronary artery calcification scores. Statin users also showed higher levels of undercarboxylated osteocalcin (ucOC) and a higher ucOC:cOC, markers associated with poorer vitamin K status.

Experimental evidence further suggests that statins may reduce the conversion of dietary phylloquinone to MK-4.⁷⁰ In this context, vitamin K2 supplementation, such as MenaQ7®, may improve vitamin K status, although its benefit specifically in statin users remains to be established.

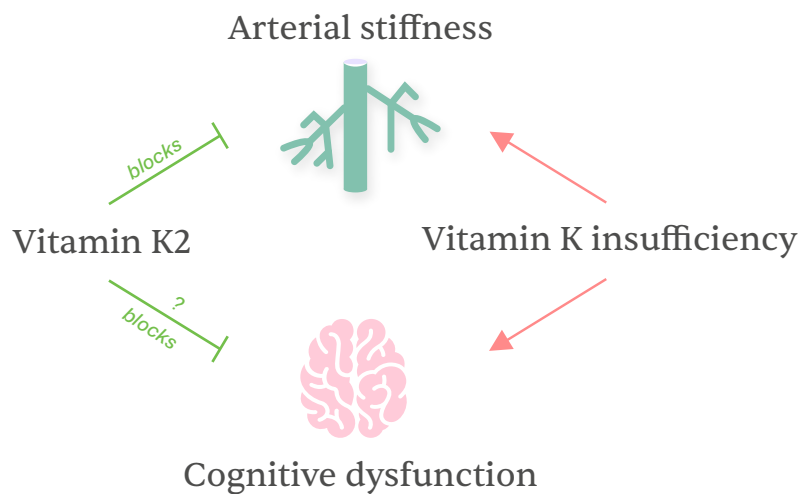
Figure 11 Effects of one-year supplementation with MenaQ7® on body composition in participants with low baseline extrahepatic vitamin K status.



Vitamin K2 and Brain Health: Emerging Links to Cognition and Neuroprotection

Figure 12 Emerging evidence linking vitamin K status, arterial stiffness, and cognitive function.

Vitamin K2 has emerged as a nutrient that may help maintain cognitive function in older adults by supporting vascular health including arterial elasticity, which is associated with age-related brain changes and cognitive decline.⁸⁰ (Figure 12)



Based on Front Aging Neurosci 2025

Although clinical evidence remains limited, observational studies have linked higher dietary vitamin K intake and greater brain levels of vitamin K2 to better cognitive performance.^{81, 82, 83} Additionally, emerging evidence suggests that vitamin K2 may influence brain health through epigenetic mechanisms, with animal studies showing that long-term vitamin K deficiency impairs hippocampal-dependent cognition, neurogenesis, and increases neuroinflammation⁸⁴.

In summary, an emerging field of research is investigating the potential role for vitamin K2 in supporting brain health during aging, warranting further clinical studies to clarify these effects.



Safety

Debunking Myths About Vitamin K2 And Coagulation

Vitamin K2 is considered a safe and well-tolerated nutrient with a safety profile supported by long history of use. So far, no adverse effects have been reported for individuals consuming high amounts of vitamin K, so no Tolerable Upper Intake Level (UL) has been established.⁸⁵

A common misconception is that vitamin K including K2 might increase the risk of blood clotting. In reality, vitamin K does not promote excessive coagulation. Its primary role is to ensure the activation of vitamin K-dependent proteins, including those involved in normal haemostasis.⁸⁶ Several studies have investigated the impact of vitamin K2 supplementation in coagulation parameters in healthy individuals, or in patients with different conditions including those treated with anticoagulant therapies without identifying specific concerns.^{87, 88, 89}



Key Clinical Studies With MenaQ7® Around Safety

Several well-designed human studies have established the safety profile of MenaQ7® across different populations and clinical settings.

In healthy adults, a randomized dose-response study⁹⁰ demonstrated that MenaQ7® supplementation improved extra-hepatic vitamin K status without affecting haemostasis. Importantly, no adverse effects on thrombin generation were observed, confirming that MK-7 does not increase coagulation risk in healthy individuals.

In healthy children, a double-blind, placebo-controlled trial⁹¹ showed that MenaQ7® supplementation improved osteocalcin carboxylation while coagulation parameters remained constant over time, supporting the haemostatic safety of MK-7 in the pediatric population.

In contrast, a study in patients receiving vitamin K antagonists (VKA).⁹² demonstrated that MenaQ7® supplementation at doses as low as 10 µg/day significantly influenced anticoagulation sensitivity in some individuals. This finding highlights that MK-7 supplements should be avoided in patients treated with coumarin-derived anticoagulants such as warfarin.

Finally, in patients with chronic kidney disease treated with non-vitamin K oral anticoagulant (NOAC) rivaroxaban⁹³ showed that MenaQ7® could be used without negatively affecting anticoagulation control, providing important evidence that vitamin K2 supplementation is compatible with modern anticoagulant therapies.

Taken together, these studies clearly distinguish the safety profile of MenaQ7® in healthy individuals and NOAC-treated patients from its clinically relevant interaction with vitamin K antagonists.





Conclusions

Almost Two Decades Of Clinical Research Support The Effects Of MenaQ7®

The most widely recognized clinical benefits relate to bone health across the lifespan. Supplementation with MenaQ7® has been shown to enhance the activation of osteocalcin, a key vitamin K-dependent protein in bone as well as bone quality. Clinical evidence shows that a nutritional dose of 180 µg/day significantly support bone and bone strength. Research continues to evolve across different age groups with emerging data around vitamin K2 in children's growth support, highlighting the importance of adequate vitamin K2 intake throughout life.

Cardiovascular health is an important and growing area of research. Clinical studies show that MenaQ7® enhances the activation of matrix Gla protein, a key inhibitor of vascular calcification, and thus supports arterial elasticity, while supporting slower progression of arterial calcification. Further clinical evidence in this area is expected in the coming years.

New research is also exploring the role of vitamin K2 in metabolic health, body composition, and brain health. Although these areas are still developing, they point to a broader role of vitamin K2 in long-term health.

Extensive clinical research confirms vitamin K2 as MenaQ7® is safe and well-tolerated with no established upper intake limit. Studies demonstrate no increased coagulation risk in healthy adults or children and compatibility with modern non-vitamin K anticoagulants. While generally safe, MenaQ7® should be avoided by individuals taking vitamin K antagonists like warfarin due to potential interactions.

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