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Vitamins K and A Aid Brain Health

Analysis by Dr. Joseph Mercola | September 04, 2026

STORY AT-A-GLANCE

- Researchers created vitamin K analogues that cross the blood-brain barrier more effectively, which eventually turn into the bioactive form, menaquinone-4 (MK-4)
- Higher levels of MK-4 in brain tissue correlate with 17% to 20% lower dementia risk and reduced Alzheimer's-related brain damage
- Vitamin A's active form, retinoic acid, enhances synaptic plasticity and memory formation, with deficiencies linked to cognitive impairment and neuropsychiatric disorders
- Both vitamin K and retinoic acid signaling naturally decrease with aging, contributing to reduced neurogenesis and weakened memory circuits in older adults
- Consume K2-rich fermented foods, pair with healthy fats for absorption, combine with vitamin D3 and magnesium, and include vitamin A sources like leafy greens

Rates of neurological diseases continue to increase in America. For example, over 7 million people are currently diagnosed with Alzheimer's disease, and this number is estimated to rise to almost 13 million by 2050.[1]

Treatment for neurological disease greatly varies, but medications are often the first line of strategy. However, these are riddled with side effects. In an effort to break new ground when it comes to preserving and boosting cognitive health, researchers are tapping into the power of nutrients found in food, namely vitamins K and A.

Vitamin K Analogue Shows Neuron-Boosting Power

In a study published in ACS Chemical Neuroscience, researchers explored how modifying vitamin K's chemical structure can benefit brain health. The team designed 12 vitamin K analogues by attaching a retinoic acid-like side chain to them. For context, retinoic acid is the biologically active form of vitamin A, and is known for regulating cell growth and differentiation.[2]

The goal was to see if this newly synthesized form of vitamin K would be better at helping immature brain cells develop into fully functioning neurons. The experiments were carried out using neural precursor cells and mice models. These analogues were tested for their ability to pass through the blood-brain barrier, activate key receptors inside the brain, and trigger neuron development.

- **One analogue stood out —** Compound 7 not only reached the brain after oral administration but also transformed into menaquinone-4 (MK-4), the primary form of vitamin K stored in brain tissue.

  Here, the blood-brain barrier acts like a high-security checkpoint, preventing most substances from entering. Many drugs fail here, which is why brain-related treatments are difficult to design. That said, compound 7 not only got through but was also converted into MK-4 once inside the brain, showing it was both bioavailable and metabolically useful.

- **Compound 7 showed stronger effects in promoting neuronal differentiation compared to regular vitamin K —** For context, differentiation means that the cells stopped behaving like generic, immature cells and instead took on the specialized shape and function of neurons. This process is like flipping the switch from "blank slate" cells into brain cells that can send signals, connect with other neurons, and contribute to learning and memory.

- **Compound 7 activated several nuclear receptors —** These are proteins inside cells that act like master switches for gene activity. Among them were retinoic acid receptors (RARs) and the steroid and xenobiotic receptor (SXR). By turning on these

receptors, compound 7 influenced the expression of genes that drive neuron growth and survival.

- **Another mechanism involved the metabotropic glutamate receptor 1 (mGluR1) —** This receptor helps regulate synaptic signaling — the way neurons talk to each other. Computer modeling showed that compound 7 bonded more strongly to this receptor compared to regular vitamin K, suggesting it had a stronger effect on brain communication pathways. In other words, the analogue not only helped create more neurons, but also supported the chemical "language" used to exchange information.

- **The benefits were not limited to test tubes —** In mice, oral administration of compound 7 worked its way into the brain and eventually converted into MK-4. This shows the compound is not only theoretically effective but also practically deliverable through diet or supplementation in a living organism.

- **Future implications —** While this study focused on laboratory and animal models, it lays the groundwork for modifying existing nutrients that could open doors to new therapies. If regular vitamin K supports brain health, then new analogues like compound 7 could amplify those effects many times over.

Nutrient science is moving beyond simple supplementation and into precision-designed molecules tailored for specific effects. These findings demonstrate that vitamin K is not just useful for blood clotting or strengthening bones — it has the capacity, when optimized, to trigger the growth and development of neurons.

Brain Vitamin K Levels Predict Lower Dementia Risk

Digging deeper into the link between brain function and vitamin K, a study published in Alzheimer's & Dementia: Translational Research & Clinical Interventions analyzed vitamin levels in the brains of older adults and linked the results to dementia outcomes.[3]

The population studied included 325 participants who agreed to annual cognitive testing during life and brain donation after death. The average age at death was 91, making this group especially relevant for understanding late-life cognitive decline.

- **Higher brain concentrations of menaquinone-4 (MK-4) lowered risk of dementia —** Specifically, the findings showed a 17% to 20% reduction of having dementia or mild cognitive impairment at the time of death. In simple terms, more MK-4 in the brain helped reduce memory loss, confusion, and disorientation in later years.

  Digging into the specifics, those with higher MK-4 also showed less Alzheimer's-type brain damage. Neuropathologists found fewer neurofibrillary tangles, which are twisted fibers of the tau protein that clog brain cells and disrupt communication. They also observed less overall Alzheimer's pathology across multiple brain regions. These findings suggest vitamin K is not just a marker, but a meaningful agent that helps slow down disease progression.

- **Comparing the odds of dementia across different vitamin K levels —** Participants with more MK-4 in their brains had significantly reduced odds of advanced Braak stage, which is a way of rating how far Alzheimer's pathology has spread. Specifically, the reduction ranged from 14% to 16% depending on the brain region studied.

- **Duration of vitamin K intake matters —** Because participants underwent annual cognitive testing for years before death, the researchers could compare brain vitamin levels with how thinking ability changed over time. Specifically, those with more MK-4 retained their cognitive function longer and declined more slowly.

- **The strongest associations were observed in the midfrontal cortex —** This part is involved in decision-making and executive function. People with higher MK-4 in this area were less likely to meet criteria for dementia at death. That means vitamin K presence was most protective in the part of the brain that helps you plan, organize, and think critically.

- **Vitamin K is important for brain function —** Comparing vitamin K to other variables, the effect was independent of age, gender, education level, and even total calorie intake. This suggests that the observed benefits were not simply the result of healthier overall lifestyles but had a specific link to vitamin K status. In other words, two people of the same age and educational background could still show different dementia outcomes depending on the vitamin K stored in their brain.

- **The benefit lies in vitamin K's multiple roles beyond blood clotting —** The researchers theorize that MK-4 in the brain influences sphingolipid metabolism, a process important for the structure and stability of brain cell membranes. Thus, healthy membranes support efficient communication between neurons.

  Vitamin K also regulates proteins that protect against oxidative stress and inflammation,[4] both of which accelerate Alzheimer's pathology. By acting on these cellular pathways, higher MK-4 levels translate into stronger resilience against neurodegeneration.

The takeaway here is straightforward — higher levels of MK-4 align with better cognitive outcomes and less Alzheimer's-related damage. Unlike studies that stop at blood markers, this one directly ties brain tissue vitamin K to dementia, making its implications especially powerful for those concerned about aging and memory loss.

Retinoic Acid Impacts Learning and Memory

In a related study published in the Annual Review of Nutrition journal, researchers examined how vitamin A and its active form, retinoic acid, influence cognition and neurological disease. The focus was not only on aging brains, but also on how disruptions in retinoic acid signaling contribute to conditions like Alzheimer's, depression, and schizophrenia.[5]

- **Deficiency can affect anyone's brain function —** The review highlighted that vitamin A deficiencies or impairments in retinoic acid metabolism are not limited to malnourished populations. Even in developed countries, subtle deficiencies or

signaling breakdowns appear in adults with cognitive impairment and neuropsychiatric disorders. That said, the authors emphasized that restoring proper retinoic acid pathways could help maintain memory, learning, and emotional regulation.

- **How retinoic acid fine-tunes synaptic plasticity —** This refers to the ability of neurons to strengthen or weaken their connections based on activity. Long-term potentiation, the cellular process that underpins memory formation, is strongly influenced by retinoic acid signaling. When that pathway falters, memory consolidation suffers.

- **Retinoic acid signaling naturally decreases with age —** This decline coincides with reductions in hippocampal neurogenesis, which is the brain's ability to create new neurons.

  In healthy youth, retinoic acid helps replenish and remodel memory circuits. In older age, diminished activity means fewer new neurons and less flexible synapses, making it harder to adapt or recover from cognitive challenges.

- **Certain groups are vulnerable to disruption —** Alzheimer's patients often show reduced expression of retinoic acid receptors in brain regions like the hippocampus and cortex. This receptor loss correlates with the severity of their memory impairment.

  In other words, that part of the Alzheimer's disease pathology involves not only toxic proteins like amyloid and tau, but also a breakdown in nutrient signaling that normally sustains cognitive resilience.

- **Impact of retinoic acid on other pathways —** The authors also compared the effects of retinoic acid to other signaling molecules. They noted its strong interaction with neurotransmitters like acetylcholine, which is central to attention and memory.

When retinoic acid pathways are impaired, cholinergic signaling weakens, leading to the same deficits often targeted by current Alzheimer's drugs. But instead of offering short-lived symptomatic relief, supporting retinoic acid signaling can address the upstream regulatory system that keeps acetylcholine functioning well.

- **Why the benefits of retinoic acid are impactful —** It mainly works through nuclear receptors, which are proteins inside brain cells that regulate which genes get turned on or off. By binding to these receptors, retinoic acid activates gene networks involved in synaptic proteins, neurotransmitter systems, and structural remodeling of neurons. This is not just about single pathways but about broad control of the brain's adaptability.

  Another mechanism involved mTOR, a key pathway that balances growth, energy use, and plasticity. Retinoic acid influences mTOR activity in ways that optimize both neuron survival and flexibility. That connection is significant because mTOR dysfunction has been implicated in everything from aging to autism. With proper retinoic acid signaling, mTOR operates in a balanced way, supporting healthy brain plasticity rather than tipping into disease states.

- **How retinoic acid impacts mood and psychiatric health —** Deficiencies or signaling breakdowns were linked not only to memory problems but also to depression-like symptoms. Animal studies cited by the researchers showed that restoring retinoic acid reversed these issues, suggesting that vitamin A's role extends into strengthening emotional resilience as well.

Optimize Your Vitamin K and A Levels with These Strategies

Vitamin K continues to be an important nutrient for overall health. In a previous article, I noted how it serves as the body's master regulator for calcium distribution that promotes better skeletal integrity and cardiovascular health. Now, the studies I discussed in this article show how important it is for optimal brain health.

While the featured study researchers used an analogue, I believe that getting vitamin K naturally is just as good for your health. That said, here are tips on how to optimize your intake for best results:

1. **Eat natural sources of vitamin K2 —** Make a point of adding natto (fermented soybeans) and other vegetables fermented with K2-producing bacteria to your daily meals. These foods are excellent sources of the MK-7 form of vitamin K2, known for staying active in the body longer.

   Certain cheeses like Brie, Munster, and Gouda are also abundant in K2. In addition, grass fed organic animal products such as egg yolks, liver, butter, tallow, and dairy provide valuable amounts of this nutrient.

   Now, why vitamin K2? In another article, I explained how it significantly impacts bone and heart health, giving it system-wide importance. Moreover, it also has higher bioavailability compared to vitamin K1.

2. **Pair K2 with healthy fats —** Because vitamin K2 is fat-soluble, consuming it alongside healthy fats helps your body absorb it more effectively. Choices include grass fed butter, ghee, or tallow.

3. **Combine K2 with key cofactors —** Vitamin K2 works alongside other vital nutrients, particularly calcium, vitamin D3, and magnesium. When supplementing with vitamin D3, be sure to include K2 as well, since this helps guide calcium into your bones rather than your arteries. This balanced approach strengthens your skeletal system while safeguarding heart and brain health.

4. **Dosing recommendations —** The recommended daily intake of vitamin K for an adult ranges between 150 and 200 micrograms. If you're taking a supplement, keep this in mind. Again, for best absorption, take it alongside meals that contain healthy fats.

5. **Dietary sources of vitamin A —** This nutrient is found in vast sources of plant foods. Top examples include kale, spinach, broccoli, carrots, and sweet potatoes. It's also found in tomatoes, red bell pepper, eggs, and beef liver.[6]

   Just like vitamin K, vitamin A is also fat-soluble, which is why they work well together. However, take care not to go overboard with your consumption — toxicity is far more common than deficiency in America. Symptoms include blurry sight, dry skin, and bone pain.[7]

Frequently Asked Questions (FAQs) About Vitamins K and A for Brain Health

Q: Why are researchers focusing on vitamins K and A for brain health?

A: Rates of neurological diseases like Alzheimer's are steadily rising, and current treatments often have limited effectiveness with unwanted side effects. Researchers are now exploring nutrients such as vitamin K and vitamin A (in the form of retinoic acid) for their potential to preserve and boost cognitive function, improve neuron development, and reduce dementia risk.

Q: What did scientists discover about vitamin K analogues?

A: A study published in ACS Chemical Neuroscience created modified forms of vitamin K by linking them with a retinoic acid-like side chain. One compound, Compound 7, showed remarkable results. It crossed the blood-brain barrier, converted into MK-4 (the brain's primary form of vitamin K), promoted neuron growth and differentiation, activated receptors tied to brain signaling, and worked effectively in animal models.

Q: How does vitamin K in the brain influence dementia risk?

A: Research published in Alzheimer's & Dementia analyzed brain tissue from older adults and found that higher MK-4 levels were linked to a 17% to 20% lower risk of dementia. People with more MK-4 had less Alzheimer's-type brain damage, fewer tau tangles, slower cognitive decline, and stronger protection in critical brain areas like the midfrontal cortex.

Q: What role does vitamin A's active form, retinoic acid, play in cognition?

A: Retinoic acid regulates synaptic plasticity, neurogenesis, and memory circuits. Its signaling declines with age and is often disrupted in conditions like Alzheimer's, depression, and schizophrenia. Supporting retinoic acid pathways helps maintain learning, memory, mood regulation, and neuron survival by influencing gene networks, neurotransmitters like acetylcholine, and key pathways such as mTOR.

Q: How can people optimize vitamin K and A intake for brain health?

A: To support brain health with vitamins K and A, focus on nutrient-rich foods. Good sources of vitamin K2 include natto, fermented cheeses, and grass fed animal products like egg yolks and beef liver. Since K2 is fat-soluble, pair it with healthy fats and other cofactors such as vitamin D3, calcium, and magnesium for better absorption and balance. For vitamin A, leafy greens, carrots, sweet potatoes, tomatoes, eggs, and beef liver are excellent sources, but intake should be moderate to avoid toxicity.

Sources and References

- [1] Alzheimer's Association, "Alzheimer's Disease Facts and Figures"
- [2] ACS Chem. Neurosci. 2025, 16, 15, 2812-2828

- [3] Alzheimers Dement (N Y). 2022 Apr 20;8(1):e12255
- [4] Nutrients. 2024 Dec 16;16(24):4341
- [5] Annu Rev Nutr. 2020 Sep 23:40:247-272
- [6, 7] The Nutrition Source, “Vitamin A”