



Choline

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► Choline Food Sources ◀

Choline is found in a variety of foods. The richest sources are meat, fish, poultry, dairy, and eggs. Other sources of choline are:

- Beef, beef liver
- Egg yolks
- Chicken breast
- Fish
- Shiitake mushrooms
- Potatoes
- Legumes (beans, peanuts)
- Milk
- Yogurt
- Cruciferous vegetables (broccoli, cauliflower, Brussels sprouts, cabbage)
- Sunflower seeds

► Choline Deficiency ◀

Groups at higher risk of deficiency:

- Pregnant women: In addition to low average dietary intakes in the general public, prenatal supplements do not typically contain choline.
- Patients are dependent on intravenous nutrition: Total parenteral nutrition (TPN) is administered through a vein to people whose digestive tracts cannot tolerate solid food due to disease, surgery, or other digestive conditions.

Choline is not typically included in TPN formulas unless specified.

- People with specific genetic alterations
Choline deficiency can contribute to the following health conditions:
 - cardiovascular disease
- neurological conditions, such as Alzheimer's disease
 - nonalcoholic fatty liver disease
 - neural tube irregularities
 - muscle damage



► Choline and Health ◀

► Cardiovascular and peripheral artery disease: Some researchers have suggested that choline might protect cardiovascular health by reducing blood pressure, altering lipid profiles, and reducing plasma homocysteine levels.

► Neurological disorders:

People with Alzheimer's disease have lower levels of the enzyme that converts choline into acetylcholine in the brain.

► Nonalcoholic fatty liver disease

► Choline Toxicity ◀

High intakes of choline are associated with a fishy body odor, vomiting, excessive sweating and salivation, hypotension, and liver toxicity.

Choline consumption has been shown to increase the production of TMAO, a substance that has been linked to a higher risk of cardiovascular disease, in a dose-dependent manner in adults.

The Tolerable Upper Intake Level (UL) for choline for adults 19 years and older is 3,500 mg daily and is based on the amount that has been shown to produce these side effects.



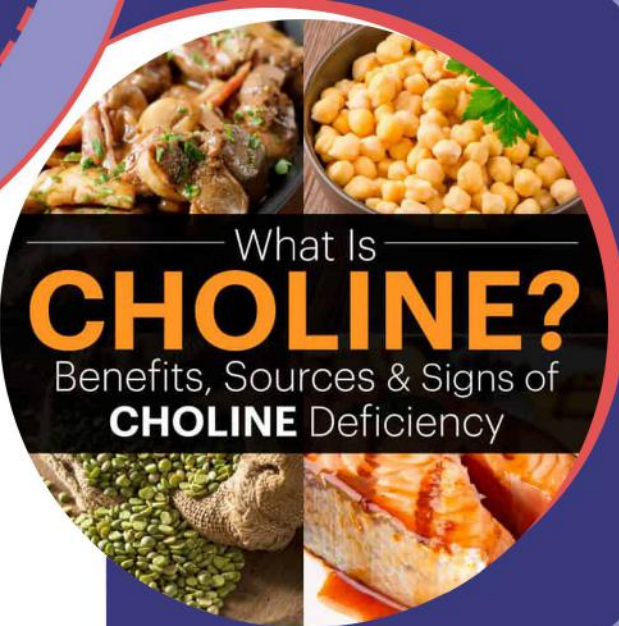
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Humans can produce choline endogenously in the liver, primarily as phosphatidylcholine, but the body naturally synthesizes it is insufficient to meet human needs. As a result, humans must obtain some choline from the diet.

Choline is a nutrient similar to B vitamins. It can be made in the liver. Choline is a source of methyl groups needed for many steps in metabolism. The body needs choline to synthesize phosphatidylcholine and sphingomyelin, two major phospholipids vital for cell membranes. Therefore, all plant and animal cells need choline to preserve their structural integrity. Also, choline is needed to produce acetylcholine, an essential neurotransmitter for memory, mood, muscle control, and other brain and nervous system functions. Choline also plays essential roles in modulating gene expression, cell membrane signaling, lipid transport and metabolism, and early brain development.



Choline supports numerous vital bodily functions, including:



- Cell maintenance: The body uses choline to produce fats that make up cellular membranes.
- DNA synthesis: Choline, along with other nutrients such as folate and vitamin B12, can affect gene expression.
- Metabolism: Choline helps metabolize fats.
- Nervous system functioning: The body converts choline into a neurotransmitter that affects the nerves and regulates automatic bodily functions, such as breathing and heart rate.