# Personalized Vitamin DNA Report (Sample)

Name: Welala Test

Kit ID: xxxxxxxxxxxxx

Report Date: Sep 26, 2022

Make more informed decisions
about your food choices
and dietary supplements

# Table of contents



# What is a Vitamin DNA Test?

"Do I need vitamin supplements?"

Most people do not need vitamin supplements, as they can get all essential micronutrients by eating a healthy and balanced diet. But supplements can be useful for filling in gaps in your diet.

However, certain groups of people could benefit from taking supplements e.g. folic acid supplement in pregnancy or vitamin B12 supplement in vegan.

In addition, people with specific genetic variants are at greater risk of vitamin and mineral deficiencies, due to inefficient metabolism processes. Thus, taking supplements help make sure they get enough essential nutrients to maintain or improve their health.

That's what the Welala Vitamin DNA Test can help you find out, whether you have certain specific DNA that puts you at higher risk of developing vitamin deficiencies. Our report also provides recommendations, based on your genetic results, about changing your diet or choosing specific supplements to get adequate micronutrients and improve your health.

# How is it different from a normal vitamin blood test in a hospital?

The vitamin blood test in a clinic or hospital measures specific micronutrient levels in your blood at a certain time to identify if there is any deficiency and doctors would recommend dietary changes or supplements to correct your nutritional status.

Welala Vitamin DNA Test works differently, it predicts the likelihood of vitamin deficiency, based on your genetic information. Your genes determine how your body reacts to each nutrient, for instance, absorption, metabolism and excretion, all which contribute to vitamin level in our body.

The result of the Vitamin DNA Test could guide you, or even your doctor to make specific recommendations on nutrition and choose the right form and dosage of supplements.

Welala Vitamin DNA Test cannot replace a blood test, instead it is intended to give you and your doctor additional information about your needs of specific vitamins and minerals.

# How do we analyze your DNA?

Between any two humans, the genetic difference is only about 0.1 percent. That miniscule difference makes up our unique body, we call it “polymorphisms”. The most common genetic variation is single nucleotide polymorphisms, frequently called SNPs (pronounced “snips”).

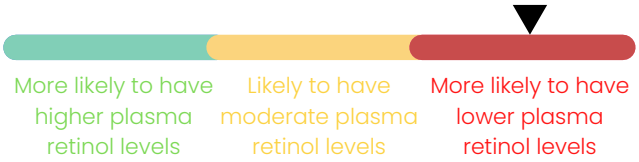
We obtain these SNPs data through DNA chips of the global leading applied genomics technology company, utilizing GWAS analysis. The data is then processed via a specific algorithm co-developed by biomedical engineers, medical geneticists and software engineers to analyze the genetic data and provide recommendations.

The genetic code information obtained is compared with the data from numerous certified international genetic databases. These databases collect the history of clinical data and the DNA mutations associated with the development of various diseases within different populations.

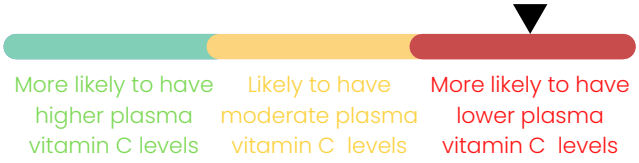
# Summary Report

# Immune System

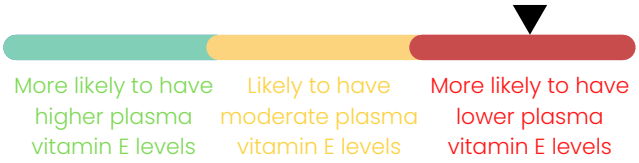
## Vitamin A



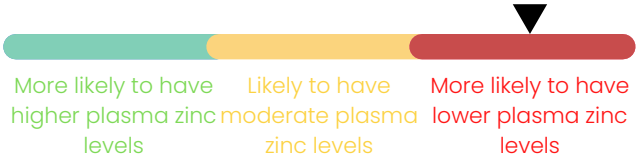

## Vitamin C



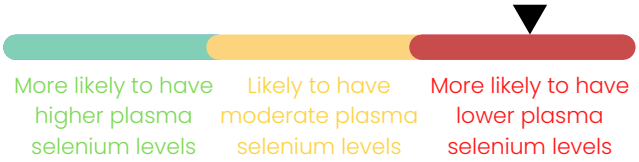

## Vitamin E



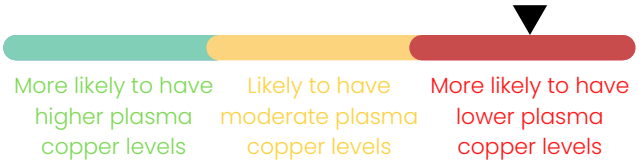

## Zinc




## Selenium

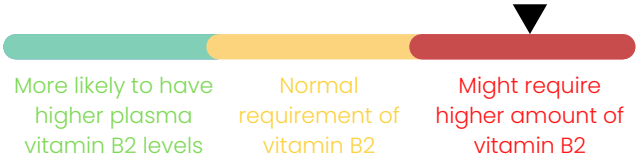



## Copper

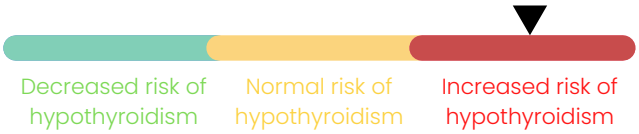


# Metabolism

## Vitamin B2

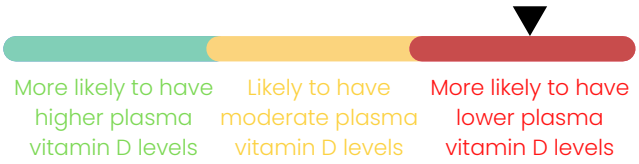



## Iodine

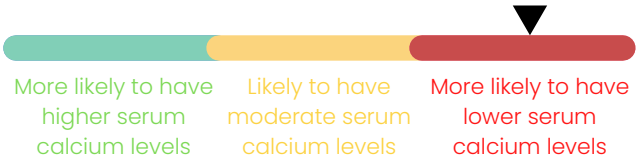


# Bone & Muscle

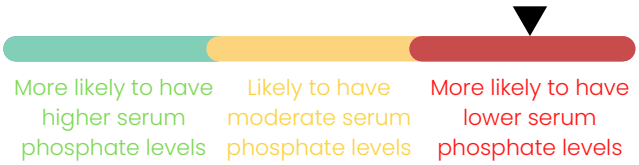
## Vitamin D



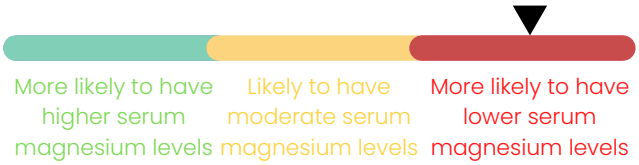

## Calcium



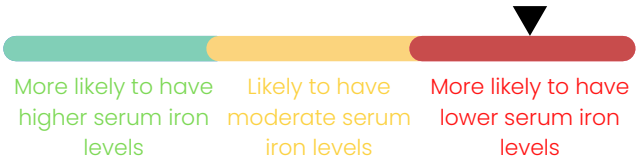

## Phosphorus




## Magnesium

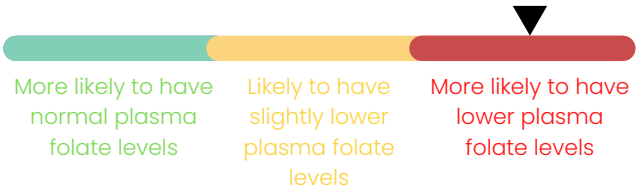



## Iron

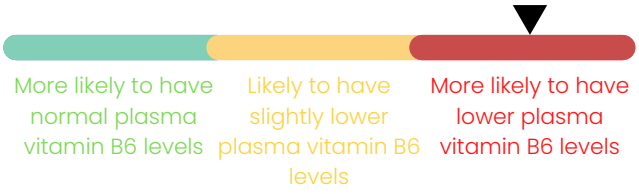


# Brain & Heart

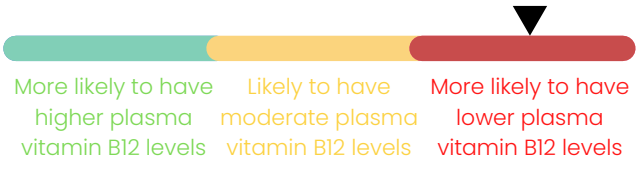
## Folate



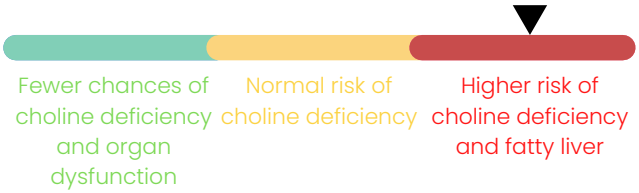

## Vitamin B6



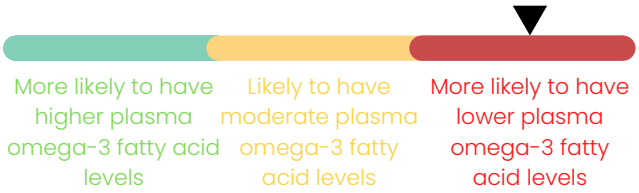

## Vitamin B12




## Choline




## Omega-3



# Understand your report

**Scale** 

The scale indicates whether you are likely to have lower, moderate or higher plasma vitamin levels based on your DNA result.

**Gene**

The name of the gene that can affect your plasma vitamin level, based on genome-wide association studies (GWAS).

**rsID**

rsID number is a unique label used by researchers and databases to identify specific SNPs (Single Nucleotide Polymorphisms).

**Genotype**

A person's genotype is their unique sequence of DNA. More specifically, this term is used to refer to the two alleles a person has inherited for a particular gene.

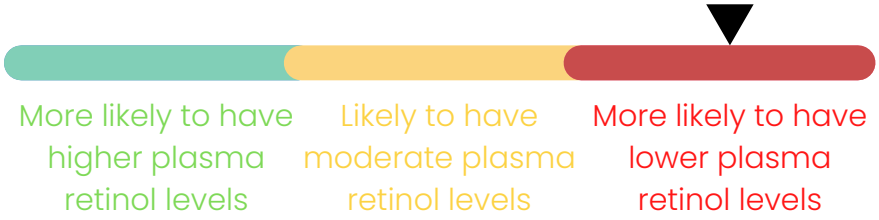
**Phenotype**

An individual's phenotype is the detectable expression of genotype, the combination of their observable characteristics or traits.

# Your Vitamin DNA Report

# Immune System

# Vitamin A




| Gene | rsID | Genotype |
|---|---|---|
| BCO1 gene | rs12934922 | TT |
| BCO1 gene | rs750133 | TT |

| Phenotype |
|---|
| More likely to have lower plasma retinol levels |

**Know your gene:**

The Beta Carotene Oxygenase 1 (BCO1) gene is associated with the synthesis of beta carotene oxygenase 1, an enzyme that converts precursor vitamin A into active retinol. People with certain variants of the gene were found to convert beta carotene 69% less efficiently than people without this variant.

Provitamin A carotenoids found in fruits, vegetables, and other plant-based products are turned into vitamin A by your body, having variation in BCO1 gene could result in lower plasma retinol levels.

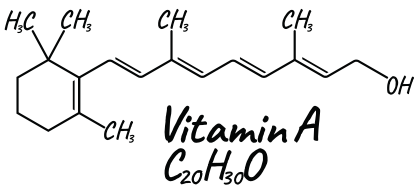
**Interpretation:**

Your gene indicates you have lower BCO1 enzyme activity. Your body cannot efficiently convert provitamin A (beta-carotene) into active vitamin A (retinol).

**Recommendation:**

You should focus on getting enough vitamin A in the form of preformed vitamin A which is found in fish, organ meats (such as liver), dairy products, and eggs because your body cannot efficiently convert provitamin A (beta-carotene) from plant sources into active retinol.
If you need to take vitamin A supplementation, selecting preformed vitamin A, usually in the form of retinyl acetate or retinyl palmitate, would be more beneficial than plant provitamin A to combat vitamin A deficiency.

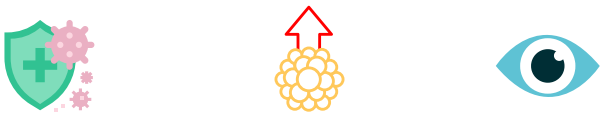
# Vitamin A




**What is vitamin A?**

Vitamin A, also known as retinol, is a fat-soluble vitamin that is naturally present in many foods. Vitamin A is important for several important functions which include:

- helping your body's natural defense against illness and infection (the immune system) work properly
- helping vision in dim light
- keeping skin and the lining of some parts of the body, such as the nose, healthy




**Sources:**

There are two different sources for vitamin A:

- Preformed vitamin A (active vitamin A or retinol) is found in fish, organ meats (such as liver), dairy products, and eggs.
- Provitamin A carotenoids are turned into vitamin A by your body. They are found in fruits, vegetables, and other plant-based products. The most common provitamin A carotenoid in foods and dietary supplements is beta-carotene.

Most multivitamin-mineral supplements contain vitamin A. Dietary supplements that contain only vitamin A are also available in both preformed vitamin A (usually in the form of retinyl acetate or retinyl palmitate) and provitamin A, or in combination.

**How much do I need?**

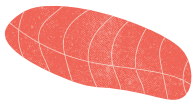
- Adult males: 900 mcg RAE (3,000 IU)
- Adult females: 700 mcg RAE (2,300 IU)
- Pregnant and breastfeeding adults: 1,200 - 1,300 mcg RAE (4,000 - 4,300 IU)

1 mcg RAE is equivalent to 1 mcg retinol, 2 mcg supplemental beta-carotene, 12 mcg dietary beta-carotene, or 24 mcg dietary alpha-carotene or beta-cryptoxanthin

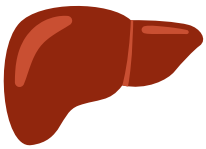
- 1 IU retinol = 0.3 mcg RAE
- 1 IU supplemental beta-carotene = 0.3 mcg RAE
- 1 IU dietary beta-carotene = 0.05 mcg RAE

## Sources *Nutrition value of 100 grams

### Preformed Vitamin A



Tuna - 757 mcg



Beef liver - 6,582 mcg

1 Large egg - 75 mcg

1 Cup milk (244 ml) - 149 mcg

Cheddar - 330 mcg

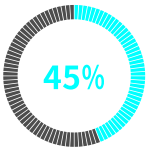
### Provitamin A (Beta-carotene)

Carrot - 852 mcg

Spinach - 469 mcg

Cantaloupe - 169 mcg

**Vitamin A deficiency:**




**Do you know ? About 45% of people carry a genetic mutation that significantly reduces their ability to convert provitamin A into vitamin A**

The most common sign of vitamin A deficiency is an eye condition called xerophthalmia. Xerophthalmia is the inability to see in low light, and it can lead to blindness if it isn't treated.

A long-term deficiency of vitamin A can also lead to a higher risk of respiratory diseases (such as pneumonia) and infections (such as measles and diarrhea). It can also cause anemia (a condition in which the red blood cells do not supply enough oxygen to the body). In severe cases, not getting enough vitamin A can increase your chances of dying.

**Vitamin A toxicity:**

**In adults 19 years and older, total vitamin A intakes from all sources—food, beverages, and supplements— should not exceed 3,000 mcg.**

Getting too much preformed vitamin A (usually from supplements or certain medicines) can cause severe headache, blurred vision, nausea, dizziness, muscle aches, and problems with coordination. In severe cases, getting too much preformed vitamin A can even lead to coma and death.

If you take too much preformed vitamin A while pregnant, it can cause birth defects in your baby, including abnormal eyes, skull, lungs, and heart. If you are or might be pregnant or breastfeeding, you should not take high-dose supplements of preformed vitamin A.

High intakes of beta-carotene do not cause the same problems as preformed vitamin A. Consuming high amounts of beta-carotene can turn the skin yellow-orange, but this condition is harmless and goes away when you eat less of it. However, several studies have shown that smokers, former smokers, and people exposed to asbestos who take high-dose beta-carotene supplements have a higher risk of lung cancer and death.

To avoid excessive amounts, don't eat liver (or limit it to not more than once per week) or take fish liver oils. Avoid large amounts of other vitamin A-rich foods such as whole milk, eggs, and meat. If you take multivitamins and other supplements, don't take more than 100% of the daily value for vitamin A (3,000 IU or 900 mcg for men)

**References:**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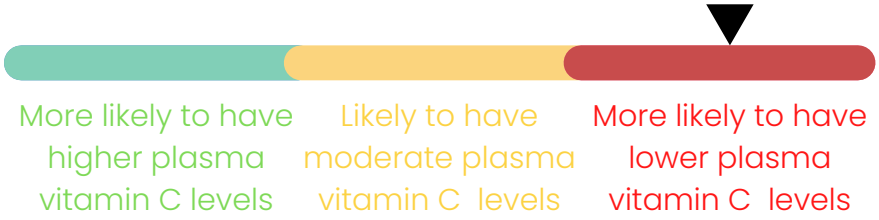
## Vitamin C




| Gene | rsID | Genotype |
|---|---|---|
| SLC23A1 | rs33972313 | AA |

| Phenotype |
|---|
| More likely to have lower plasma vitamin C (L-ascorbic acid) levels |

**Know your gene:**

The Solute Carrier Family 23 Member 1 (SLC23A1) gene is associated with the synthesis of Solute Carrier Family 23 Member 1(SLC23A1) protein. This gene encodes one of the two transporters associated with the absorption of vitamin C, specifically sodium L-ascorbic acid (vitamin C) co-transporters (SVCTs).

Genetic variations in SLC23A1 can effect your plasma concentrations of vitamin C, specifically L-ascorbic acid. Certain variant is associated with lower circulating levels of L-ascorbic acid, while another variant is correlated with higher levels.

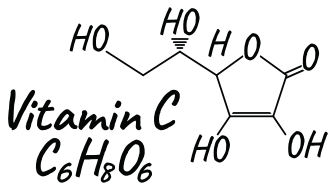
**Interpretation:**

Your gene indicates that you are likely to have lower plasma vitamin C levels, due to a genetic variant of vitamin C transporter which associated with vitamin C absorption.

**Recommendation:**

You should include vitamin C rich foods (citrus fruits, strawberries, broccoli, potato, kiwis, tomatoes) in your diet. Try getting higher vitamin C than recommended amount, especially if you smoke.

# Vitamin C




**What is vitamin C?**

Vitamin C, also known as ascorbic acid, is a water-soluble nutrient found in some foods. Vitamin C is important for serveral functions which include:

- Acts as an antioxidant, helping to protect cells from the damage caused by free radicals
- Makes collagen, a protein required to help wounds heal
- Improves the absorption of iron from plant-based foods and helps the immune system work properly to protect the body from disease


Immune


Collagen


Antioxidant

**Sources:**

Vitamin C is found in a wide variety of fruit and vegetables. You can get recommended amounts of vitamin C by eating a variety of foods including the following:

- Citrus fruits (such as oranges and grapefruit) and their juices
- Other fruits and vegetables-such as strawberries, broccoli, potatoes, kiwis and tomatoes, as well as red and green pepper
- Certain foods and beverages that are fortified with vitamin C.

Most multivitamins contain vitamin C. Vitamin C is also available alone as a dietary supplement or combined with other nutrients. Ascorbic acid is the most common form of vitamin C supplements, but there are also other forms, such as sodium ascorbate, calcium ascorbate, and ascorbic acid with bioflavonoids. Research has not shown that any form of vitamin C is better than the other forms.

**How much do I need?**

- Adult men 90 mg
- Adult women 75 mg
- Pregnant women 85 mg
- Breastfeeding women 120 mg

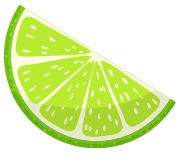
Individuals who smoke require 35 mg/day more vitamin C than nonsmokers. (Tobacco smoke contains many toxic, carcinogenic and mutagenic chemicals, as well as stable and unstable free radicals)

## Sources

*Nutrition value of 100 grams

Orange - 53.2 mg

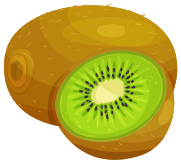
Grapefruit - 31.2 mg



Lime - 29.1 mg

Strawberry - 58.8 mg

Broccoli - 89.2 mg



Kiwi - 92.7 mg

Potato - 19.7 mg

Tomato - 13.7 mg

Bell pepper - 80.4 mg

**Vitamin C deficiency:**

Vitamin C deficiency leads to scurvy. Scurvy can cause the following signs and symptoms:

- Feel very tired and weak all the time (fatigue)
- Feel irritable and sad all the time (depression)
- Have severe joint or leg pain - Have swollen, bleeding gums (sometimes teeth can fall out)
- Develop red or blue spots on the skin, usually on your shins
- Have skin that bruises easily
- Have poor wound healing
- Sometimes scurvy can lead to anemia (low number of red blood cells)

Although scurvy is rare, it could be fatal if it is left untreated.


According to Centers for Disease Control and Prevention (CDC), only around 10% of adults met fruit and vegetable intake recommendations and that might put them at risk of vitamin C deficiency.

**Vitamin C toxicity:**

Vitamin C has low toxicity and is not believed to cause serious adverse effects at high intakes. However, taking too much vitamin C can cause diarrhea, nausea, and stomach cramps. In people with a condition called hemochromatosis, which causes the body to store too much iron, high doses of vitamin C could worsen iron overload and damage body tissues.

**The daily upper limits for vitamin C include intakes from all sources—food, beverages, and supplements—should not exceed 2,000 mg.**

**References:**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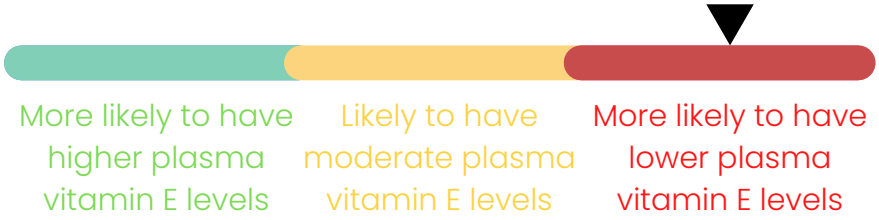
# Vitamin E




| Gene | rsID | Genotype |
|---|---|---|
| CYP4F2 | rs33972313 | CC |
| APOA5 | rs3135506 | GG |
| SCARB1 | rs11057830 | GG |
| TTPA | rs6994076 | AA |

| Phenotype |
|---|
| More likely to have lower plasma vitamin E levels |

**Know your gene:**

There are multiple genes which are associated with plasma vitamin E levels. Genetic variants that affect the digestion, absorption and transportation of fat-soluble nutrients may affect vitamin E levels.

A certain variant of CYP4F2 gene that reduces the activity of the CYP4F2 enzyme that is involved in breaking down vitamin E is associated with higher levels of the vitamin.

APOA5 gene is responsible for producing apolipoprotein, which is involved in the transportation of lipids including vitamin E, is associated with vitamin E levels.

Polymorphisms of the scavenger receptor class B member 1 (SCARB1) involved in transporting vitamin E across the intestinal lining is associated with circulating vitamin E levels.

Variants of The Alpha-Tocopherol Transfer Protein (TTPA) gene are associated with an increase or decrease in the level of Alpha-Tocopherol Transfer Protein, which corresponds to an increase or decrease in the level of vitamin E in the body.

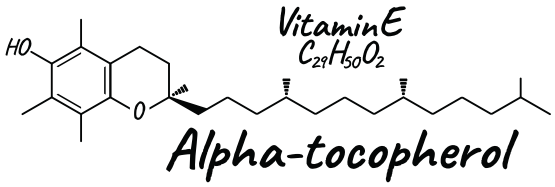
**Interpretation:**

Your genes indicate that you are likely to have lower plasma vitamin E levels, due to overall genetic variants which affect vitamin E digestion, absorption and transportation.

**Recommendation:**

You should get enough vitamin E from eating a variety of foods especially from vegetable oils (sunflower, safflower, flaxseed, canola, corn and soybean oils), nuts and seeds (peanuts, hazelnuts, almonds, sunflower seeds)..

# Vitamin E




**What is vitamin E?**

Vitamin E is a fat-soluble nutrient found in many foods. It acts as an antioxidant, helping to protect cells from the damage caused by free radicals. In addition to its activities as an antioxidant, vitamin E is involved in the followings:

- Strengthens the body's natural defense against illness and infection (the immune system)
- Helps to widen blood vessels and keep blood from clotting within them
- Helps maintain healthy skin and eyes

Immune

Prevent Blood Clot

Skin

**Sources:**

Vitamin E is found naturally in foods and is added to some fortified foods. You can get recommended amounts of vitamin E by eating a variety of foods including the following:

- Vegetable oils like sunflower, safflower, flaxseed, canola, corn and soybean oils
- Nuts (such as peanuts, hazelnuts, and, especially, almonds) and seeds (like sunflower seeds)
- Wheat germ
- Green vegetables, such as spinach and broccoli, also provide some vitamin E
- Fortified foods and drinks e.g. breakfast cereals and spreads

Vitamin E supplements come in different amounts and forms. Most multivitamin-mineral supplements provide approximately 13.5 mg of vitamin E which is similar to the recommended daily intake. There are eight forms of vitamin E. Supplements of vitamin E typically provide only alpha-tocopherol, but it could also mixed with other tocopherols or tocotrienols. Each form has a different potency, or level of activity in the body.

**How much do I need?**

- Adults 15 mg
- Breastfeeding women 19 mg

**International Units and Milligrams**

1 mg of alpha-tocopherol is equivalent to 1.49 IU of the natural form or 2.22 IU of the synthetic form. To convert from IU to mg:

- 1 IU of the natural form is equivalent to 0.67 mg of alpha-tocopherol.
- 1 IU of the synthetic form is equivalent to 0.45 mg of alpha-tocopherol.

## Sources

*Nutrition value of 100 grams

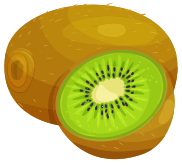
Sunflower oil - 41 mg

Almond - 26 mg

Wheat germ oil - 149 mg

Spinach - 2 mg

Broccoli - 1.5 mg



Kiwi - 1.5 mg

**Vitamin E deficiency:**

Vitamin E deficiency can cause nerve and muscle damage that results in loss of feeling in the arms and legs, loss of body movement control, muscle weakness, and vision problems. Another sign of deficiency is a weakened immune system.

**Vitamin E toxicity:**

Vitamin E that is naturally present in food and beverages is not harmful and does not need to be limited. However, high doses of vitamin E supplement might increase the risk of bleeding, whether from minor cuts or severe bleeding in the brain (hemorrhagic stroke).

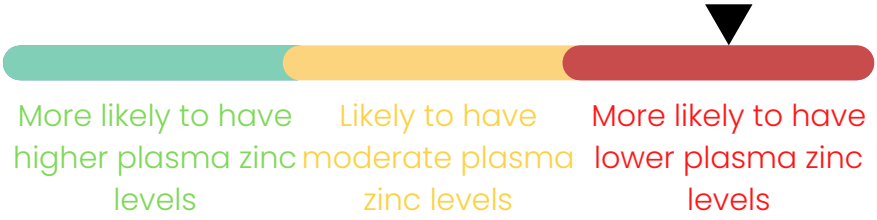
Because of this risk, **Adults should not take more than 1,000 mg/day for supplements of either natural or synthetic vitamin E. This is equal to 1,500 IU/day for natural vitamin E supplements and 1,100 IU/day for synthetic vitamin E supplements.**

Taking too much of vitamin E supplements can increase risk of bleeding, including bleeding in the brain.

**References:**


- Major JM, et a;. Genome-wide association study identifies common variants associated with circulating vitamin E levels. Hum Mol Genet. 2011 Oct 1;20(19):3876-83. doi: 10.1093/hmg/ddr296. Epub 2011 Jul 5. PMID: 21729881; PMCID: PMC3168288.
- Zanon-Moreno V, et al. Effects of polymorphisms in vitamin E-, vitamin C-, and glutathione peroxidase-related genes on serum biomarkers and associations with glaucoma. Mol Vis. 2013;19:231-42. Epub 2013 Feb 3. PMID: 23401652; PMCID: PMC3566896.
- Vitamin E [Internet]. Nih.gov. [cited 2022 Sep 22]. Available from: https://ods.od.nih.gov/factsheets/VitaminE-HealthProfessional/

## Zinc




| Gene | rsID | Genotype |
|---|---|---|
| CA1 | rs1532423 | GG |
| PPCDC | rs2120019 | CC |
| NBDY | rs4826508 | CC |

| Phenotype |
|---|
| More likely to have lower plasma zinc levels |

**Know your gene:**

CA1 gene encodes carbonic anhydrase 1 enzyme, which participates in a variety of biological processes. Carbonic anhydrase 1 is a zinc metalloenzyme, an enzyme which required zinc in order to function efficiently.

PPCDC gene encodes phosphopantothenoylcysteine decarboxylase enzyme. It is essential in biosynthesis of coenzyme A (CoA), a molecule which plays a major role in human metabolism, from pantothenic acid (vitamin B5). PPCDC might affect zinc status through effects on vitamin B5 (pantothenate) metabolism.

NBDY (Negative Regulator Of P-Body Association) is involved in mRNA processing, an important step of protein synthesis. It was associated with plasma zinc levels in a European population.

**Interpretation:**

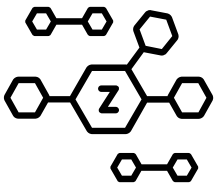
Your genes indicate that you are likely to have lower plasma vitamin zinc levels, due to overall genetic variants which can affect zinc status.

**Recommendation:**

Your should include food sources which are rich in zinc include meat, fish, and seafood to ensure that you get enough zinc.

If you follow vegetarian or vegan diets which exclude meat, which provides significant amount of zinc, you might be at risk of zinc deficiency. You should try eat a lot of beans, nuts and whole grains which provide some zinc. However, beans and grains contain phytates that interfere with zinc absorption, so you might benefit from taking zinc supplements.

# Zinc




**What is Zinc?**

Zinc, an essential mineral, is naturally present in some foods, added to others, and available as a dietary supplement. Zinc is found in cells throughout the body and has many functions:

- Helps your immune system fight off invading bacteria and viruses
- Plays a role in cell division, cell growth, wound healing, and the breakdown of carbohydrates
- Makes DNA (the genetic material in cells) and proteins

Immune

Cell Growth

DNA

**Sources:**

The richest food sources of zinc include meat, fish, and seafood. You can get recommended amounts of zinc by eating a variety of foods, including the following:

- Oysters (contain more zinc per serving than any other food)
- Meat, fish, poultry, seafood - Zinc fortified breakfast cereals
- Beans, nuts, whole grains, eggs, and dairy products (provide some zinc)

Almost all multivitamin/mineral dietary supplements contain zinc. Dietary supplements can have several different forms of zinc, such as zinc sulfate, zinc acetate, and zinc gluconate. It's not clear whether one form is better than the others.

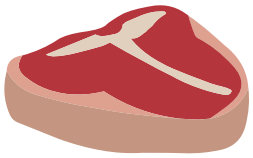
**How much do I need?**

- Adult men 11 mg
- Adult women 8 mg
- Pregnant women 11 mg
- Breastfeeding women 12 mg

## Sources

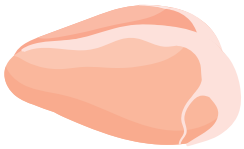
*Nutrition value of 100 grams

Oyster - 16 mg



Beef - 4.5 mg

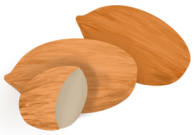
Pork chop - 3.1 mg



Chicken breast - 1 mg

Pumpkin seed - 10 mg

Cashew nut - 6 mg



Almond - 3.5 mg

1 Large egg - 0.5 mg

1 Cup milk (244 ml) - 1 mg

**Zinc deficiency:**

Zinc has many functions throughout the body, zinc deficiency affects many different tissues and organs, for instance, skin, bones, digestive, reproductive, central nervous, and immune systems.

Zinc deficiency has different manifestations, depends on age. In young children, diarrhea is the most common sign. Delayed growth, loss of hair and frequent infections are more common in older children. Children with zinc deficiency might have reproductive problems when they reach adulthood.

At any age, zinc deficiency can interfere with senses of smell and taste. In older adults, zinc deficiency can cause poor wound healing and problems with cognitive functions (for example, memory, thinking, reasoning)

**Zinc toxicity:**

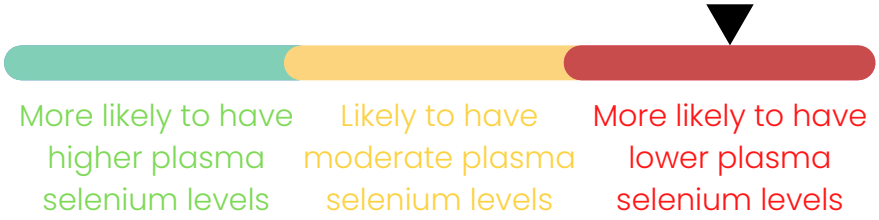
Too much zinc can be harmful. High zinc intakes can cause nausea, dizziness, headaches, gastric distress, vomiting, and loss of appetite. Long-term excessive zinc could lead to poor immune function, low HDL (good cholesterol) level and copper deficiency (as zinc can interfere with copper absorption). Very high doses of zinc from supplements might also reduce magnesium absorption.

**In adults 19 years and older, total zinc intakes from all sources—food, beverages, supplements and medications— should not exceed 40 mg.**

**References:**


- Evans DM, et al. Genome-wide association study identifies loci affecting blood copper, selenium and zinc. Hum Mol Genet. 2013 Oct 1;22(19):3998-4006. doi: 10.1093/hmg/ddt239. Epub 2013 May 29. PMID: 23720494; PMCID: PMC3766178.
- da Rocha TJ, Korb C, Schuch JB, Bamberg DP, de Andrade FM, Fiegenbaum M. SLC30A3 and SEP15 gene polymorphisms influence the serum concentrations of zinc and selenium in mature adults. Nutr Res. 2014 Sep;34(9):742-8. doi: 10.1016/j.nutres.2014.08.009. Epub 2014 Aug 28. PMID: 25249019.
- Zinc [Internet]. Nih.gov. [cited 2022 Sep 24]. Available from: https://ods.od.nih.gov/factsheets/Zinc-HealthProfessional/

# Selenium




| Gene | rsID | Genotype |
|---|---|---|
| DMGDH | rs921943 | CC |

| Phenotype |
|---|
| More likely to have lower plasma selenium levels |

**Know your gene:**

DMGDH (Dimethylglycine Dehydrogenase) is a Protein Coding gene which encodes an enzyme implicated in homocysteine metabolism, and there is a connection between selenium exposure and the homocysteine metabolic pathways, thus polymorphisms of DMGDH are associated with selenium levels.

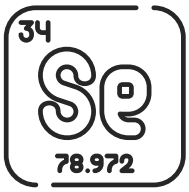
**Interpretation:**

Your genes indicate that you are likely to have lower plasma selenium levels, due to a genetic variant which might affect homocysteine metabolic pathway.

**Recommendation:**

Ensuring adequate intake of selenium by eating a variety of foods, especially meat products which contain high amount of selenium.

# Selenium




**What is selenium?**

Selenium is a trace element that is naturally present in many foods, added to others, and available as a dietary supplement. Selenium plays a vital role in many functions of the body:

- Acts as an antioxidant, helping to protect cells from the damage caused by free radicals
- Works together with iodine to activate thyroid hormone, which is essential for normal growth, development, and metabolism
- Helps maintain DNA (the genetic material in cells) synthesis
- Helps with growth and development of sperm (male fertility)


Immune


Thyroid hormone


DNA


Male fertility

**Sources:**

Selenium can be found in various foods. The amount of selenium in plant foods depends on the amount of selenium in the soil where they were grown. The amount of selenium in animal products depends on the selenium content of the foods that the animals consumed. You can get recommended amounts of selenium by eating a variety of foods, including the following:

- Seafood
- Meat, poultry, eggs, and dairy products
- Breads, cereals, and other grain products

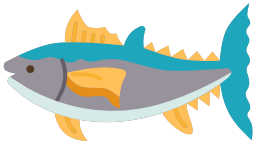
Selenium is available in multivitamin/multimineral supplements and also available alone as dietary supplements. Selenium supplements often come in the forms of selenomethionine, or as sodium selenite or sodium selenate. Selenium bioavailability (how well you body can absorb selenium) is greatest for selenomethionine and lowest for selenite.

**How much do I need?**

- Adults 55 mcg
- Pregnant women 60 mcg
- Breastfeeding women 70 mcg

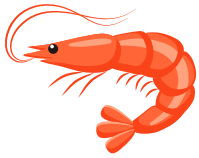
## Sources

*Nutrition value of 100 grams



Yellowfin tuna - 92 mcg

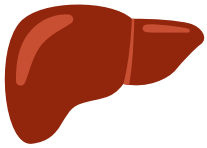
Sardine - 45 mcg



Shrimp - 40 mcg

Ham - 42 mcg

1 Large egg - 15 mcg



Beef liver - 28 mcg

Chicken - 22 mcg

Pork - 30 mcg

1 Cup milk (244 ml) - 8 mcg

**Selenium deficiency:**

Selenium deficiency can cause Keshan disease (a type of heart disease) and male infertility. It might also cause Kashin-Beck disease, a type of arthritis that produces pain, swelling, and loss of motion in your joints.

Although selenium deficiency is very rare, certain population might be at risk of selenium deficiency:

- People living in an area with soil low in selenium (certain part of China)
- People undergoing kidney dialysis
- People living with HIV
- People having a digestive disorder, such as Crohn's disease

**Selenium toxicity:**

Too much selenium can be harmful to your body. Signs and symptoms of excessive selenium are of the followings:

- Garlic breath
- Nausea
- Diarrhea
- Skin rashes
- Irritability
- Metallic taste in the mouth
- Brittle hair or nails
- Loss of hair or nails
- Discolored teeth
- Nervous system problems

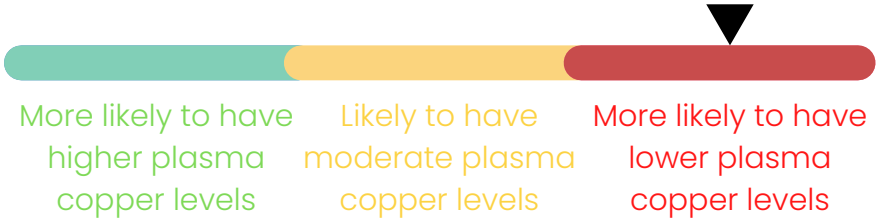
Extremely high intakes of selenium can cause severe problems, including difficulty breathing, tremors, kidney failure, heart attacks, and heart failure.

**In adults 19 years and older, total zinc intakes from all sources—food, beverages, and supplements— should not exceed 400 mcg.**

**References:**


- Evans DM, et al. Genome-wide association study identifies loci affecting blood copper, selenium and zinc. Hum Mol Genet. 2013 Oct 1;22(19):3998-4006. doi: 10.1093/hmg/ddt239. Epub 2013 May 29. PMID: 23720494; PMCID: PMC3766178.
- Cornelis MC, et al. Genome-wide association study of selenium concentrations. Hum Mol Genet. 2015 Mar 1;24(5):1469-77. doi: 10.1093/hmg/ddu546. Epub 2014 Oct 24. PMID: 25343990; PMCID: PMC4321444.
- Selenium [Internet]. Nih.gov. [cited 2022 Sep 25]. Available from: https://ods.od.nih.gov/factsheets/Selenium-HealthProfessional/

## Copper




| Gene | rsID | Genotype |
|---|---|---|
| SELENBP1 | rs2769264 | TT |
| SMIM1 | rs1175550 | AA |

| Phenotype |
|---|
| More likely to have lower plasma copper levels |

**Know your gene:**

SELENBP1 gene encodes a member of the selenium-binding protein family. This protein has majorly been studied only for its tumor suppressant activities, however, a 2013 study found a significant association between SELENBP1 and copper levels.

SMIM1 gene encodes a small, conserved protein that participates in red blood cell formation. There is an association between a genetic variant of SMIM1 and serum copper levels.

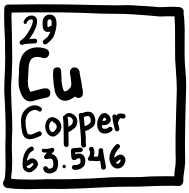
**Interpretation:**

Your gene indicates that you are likely to have lower plasma copper levels, due to a genetic variant which affects copper metabolism.

**Recommendation:**

To avoid a copper deficiency, be sure to include a variety of foods which provide high amount of copper, such as organ meats, oysters, leafy greens, nuts and seeds.

# Copper




**What is copper?**

Copper, an essential trace element, is naturally present in some foods and is available as a dietary supplement. Your body needs copper in order to carry out many important functions including:

- Maintains healthy nervous and immune system
- Plays a role in making red blood cells
- Acts as an antioxidant, helping to protect cells from the damage caused by free radicals
- Helps form collagen, which is important for healthy connective tissues and bones


Immune


Red blood cells


Collagen


Antioxidant

**Sources:**

Copper can be found in many foods. You can get recommended amounts of copper by eating a variety of foods, including the following:

- Organ meats, shellfish and fish
- Nuts (cashews) and seeds (sunflower, sesame seeds)
- Whole grains and chocolate
- Potatoes, chickpeas, mushrooms and spinach

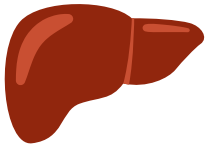
Copper is available in many multivitamin/multimineral supplements and also available alone as dietary supplements. Copper in dietary supplements is often in the forms of cupric oxide, cupric sulfate, copper amino acid chelates, and copper gluconate. It is not known whether one form of copper is better than another.

**How much do I need?**

- Adults 900 mcg (0.9 mg)
- Pregnant women 1,000 mcg (1 mg)
- Breastfeeding women 1,300 mcg (1.3 mg)

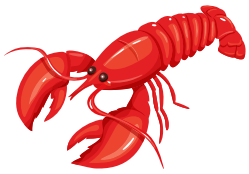
## Sources

*Nutrition value of 100 grams



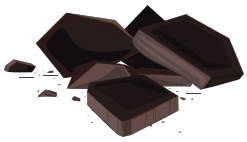
Beef liver - 14 mg

Oyster - 4.4 mg



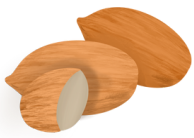
Lobster - 1.5 mg

Cashew nut - 2.2 mg



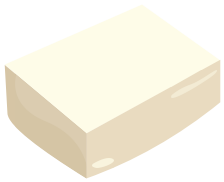
Dark Chocolate - 1.8 mg

Shitake - 0.9 mg



Almond - 1 mg

Sesame Seeds - 2.5 mg



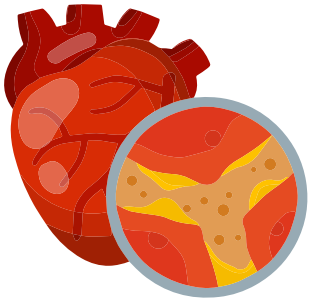
Tofu - 0.4 mg

**Copper deficiency:**

Common signs and symptoms of copper deficiency include

- Fatigue and weakness
- Getting sick easily or frequently
- Weak and brittle bones
- Skin sores and unexplained muscle soreness
- Pale skin and easy bruising
- Increased cold sensitivity
- Premature gray hair and vision loss.

Zinc supplementation is also a common cause of copper deficiency, because zinc and copper compete for absorption in the stomach.



Several studies have shown that copper deficiency is associated with elevated level of serum cholesterol and ischemic heart diseases.

**Copper toxicity:**

Getting too much copper on a regular basis can result in liver damage and gastrointestinal symptoms (e.g., abdominal pain, cramps, nausea, diarrhea, and vomiting). Copper toxicity is rare in healthy individuals. But it can occur in people with Wilson's disease, a rare genetic disorder, which have defective copper clearance. People with this disease can develop neurologic and liver damage that can result in cirrhosis.

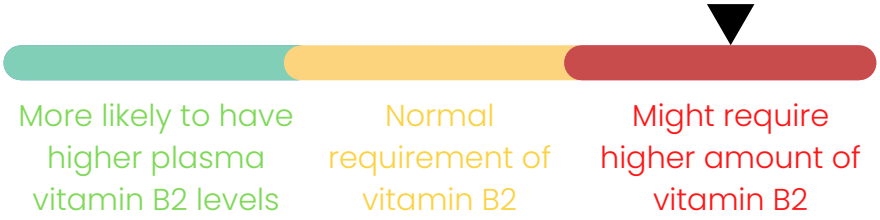
**In adults 19 years and older, total copper intakes from all sources—food, beverages, supplements—should not exceed 10,000 mcg (10 mg).**

**References:**


- Evans DM, et al. Genome-wide association study identifies loci affecting blood copper, selenium and zinc. Hum Mol Genet. 2013 Oct 1;22(19):3998-4006. doi: 10.1093/hmg/ddt239. Epub 2013 May 29. PMID: 23720494; PMCID: PMC3766178.
- Institute of Medicine. Food and Nutrition Board. Dietary Reference Intakes: Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline. Washington, DC: National Academy Press; 1998.
- Copper [Internet]. Nih.gov. [cited 2022 Sep 28]. Available from: https://ods.od.nih.gov/factsheets/Copper-HealthProfessional/

# Metabolism

# Vitamin B2 (Riboflavin)




| Gene | rsID | Genotype |
|---|---|---|
| MTHFR | rs1801133 | AA |

| Phenotype |
|---|
| Might require higher amount of vitamin B2 |

**Know your gene:**

The MTHFR gene provides instructions for making an enzyme called methylenetetrahydrofolate reductase, which converts folate to methyl folate, a key component in the methylation cycle. Methyl folate is needed for the conversion of homocysteine to methionine.

Vitamin B2 (riboflavin) is involved in the metabolism of homocysteine along with folate and vitamin B12.

A certain genetic variant of MTHFR gene decreases enzyme activity, hence decreases efficiency in folate processing and leads to high levels of of homocysteine in the body (high homocysteine increases heart disease risk), by increasing riboflavin could decrease homocysteine level.

**Interpretation:**

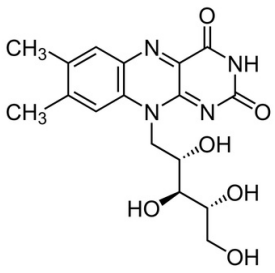
Your gene indicates that your MTHFR efficiency is about 10-20 percent in processing folic acid, which subsequently leads to high homocysteine, low B12 and folate levels. By increasing riboflavin in your body could decrease homocysteine level.

**Recommendation:**

You should include food sources which are rich in riboflavin, especially eggs, organ meats , lean meats, and milk.

You should discuss with your doctor regarding vitamin B2 supplement if you have high plasma homocysteine level.

# Vitamin B2 (Riboflavin)




**What is riboflavin?**

Riboflavin (also known as vitamin B2) is a water-soluble vitamin which is naturally present in some foods, added to some food products, and available as a dietary supplement. Vitamin B2 plays many important roles in the body including:

- Helps helps break down proteins, fats, and carbohydrates
- Plays a vital role in maintaining the body's energy supply
- Involves in cell growth and development
- Helps your body build red blood cells and support other cellular functions


Metabolism


Energy


Cell Growth


Red blood cells

**Sources:**

Riboflavin is found naturally in some foods and is added to many fortified foods. You can get recommended amounts of riboflavin by eating a variety of foods, including the following:

- Eggs, organ meats , lean meats, and milk (high amount)
- Fortified foods, such as cereals, bread, and grain products

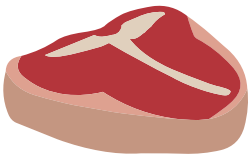
Riboflavin is found in multivitamin/multimineral supplements, in B-complex dietary supplements, and available alone as dietary supplements. If you take vitamin B supplements you might have noticed a dark yellow tinge to your urine.

**How much do I need?**

- Adult men 1.3 mg
- Adult women 1.1 mg
- Pregnant women 1.4 mg
- Breastfeeding women 1.6 mg

## Sources

*Nutrition value of 100 grams



Beef - 0.9 mg

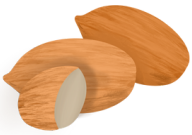
1 Large egg - 0.25 mg

Salmon - 0.5 mg

White button mushroom - 0.5 mg

Mussels - 0.4 mg

Pork chop - 0.3 mg



Almond - 1.1 mg

Spinach - 0.2 mg

1 Cup milk (244 ml) - 0.5 mg

**Riboflavin deficiency:**

Riboflavin deficiency can cause wide ranges of signs and symptoms including:

- Sores at the corners of your mouth (angular stomatitis)
- Swollen and cracked lips (cheilosis)
- Skin disorders
- Hair loss

Severe long-term riboflavin deficiency can lead to anemia (shortage of red blood cells) which could make you fatigue, and also cataracts (clouding of lens in your eyes) which affects your visual acuity.

**Riboflavin toxicity:**

Vitamin B2 is considered safe. An overdose is unlikely, as the body can absorb up to around 27 milligrams riboflavin at a time. Any excess amounts of riboflavin is excreted in the urine.

Some studies show that high dose riboflavin (400 mg/day) might help prevent migraine headache. Because riboflavin has very few side effects and generally considered safe, some medical experts recommend trying riboflavin, under the guidance of a healthcare provider, for preventing migraines.

**References:**


- Hustad S, Schneede J, Ueland PM. Riboflavin and Methylenetetrahydrofolate Reductase. In: Madame Curie Bioscience Database [Internet]. Austin (TX): Landes Bioscience; 2000-2013. Available from: https://www.ncbi.nlm.nih.gov/books/NBK6145/
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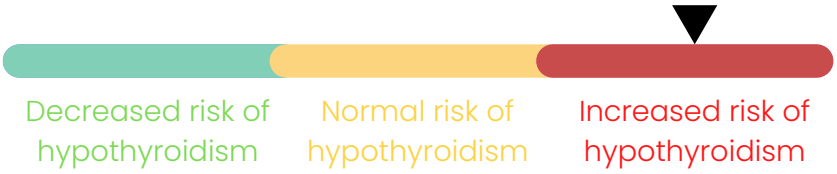
- Abhinand PA, et al. Insights on the structural perturbations in human MTHFR Ala222Val mutant by protein modeling and molecular dynamics. J Biomol Struct Dyn. 2016;34(4):892-905. doi: 10.1080/07391102.2015.1057866. Epub 2015 Aug 14. PMID: 26273990.
- Namazi N, Heshmati J, Tarighat-Esfanjani A. Supplementation with Riboflavin (Vitamin B2) for Migraine Prophylaxis in Adults and Children: A Review. Int J Vitam Nutr Res. 2015;85(1-2):79-87. doi: 10.1024/0300-9831/a000225. PMID: 26780280.
- Institute of Medicine. Food and Nutrition Board. Dietary Reference Intakes: Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline.external link disclaimer Washington, DC: National Academy Press; 1998.
- Riboflavin [Internet]. Nih.gov. [cited 2022 Sep 30]. Available from: https://ods.od.nih.gov/factsheets/Riboflavin-HealthProfessional/

# Iodine




| Gene | rsID | Genotype |
|---|---|---|
| PDE8B | rs4704397 | AA |

| Phenotype |
|---|
| Increased risk of hypothyroidism |

**Know your gene:**

The PDE8B gene encodes the protein Cyclic Nucleotide Phospho-diesterase 8B, which is abundant in the thyroid. Certain variants of PDE8B gene put an individual at higher risk of hypothyroidism.

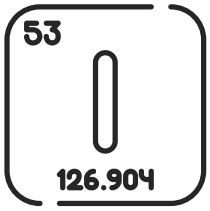
**Interpretation:**

Your gene indicates that you might have higher chance of developing hypothyroidism. Ensuring adequate iodine intake is important, as iodine deficiency can also lead to hypothyroidism.

**Recommendation:**

You should be able to get the recommended amount of iodine by eating wide variety of foods including seafood, eggs, dairy products. You should also use iodized salts, which is normally used as table salts, for cooking.

# Iodine




**What is iodine?**

Iodine is an essential trace mineral that is naturally present in certain foods, is added to some types of salt, and is available as a dietary supplement. The body needs iodine to make thyroid hormones which regulate the metabolism and many other important functions. Thyroid hormone is also important for growth and development, especially for bone and brain. Therefore, getting adequate amount of iodine is very important in infants and women who are pregnant.

Metabolism

Thyroid hormone

Cell Growth

**Sources:**

Iodine is found naturally in some foods and is also added to salt that is labeled as “iodized”. You can get recommended amounts of iodine by eating a variety of foods, including the following:

- Fish, seaweed, shrimp, and other seafood
- Dairy products and eggs
- "Iodized" salts (Special salts, such as sea salt, kosher salt and Himalayan salt, are not usually iodized)

Iodine is available in dietary supplements, usually in the form of potassium iodide or sodium iodide. Many multivitamin-mineral supplements contain iodine. Dietary supplements of iodine-containing kelp (a seaweed) are also available.

Pregnant women require almost 50% higher requirement of iodine than other women, so they might be at risk of iodine deficiency which is very important for infants' growth and development.

**How much do I need?**

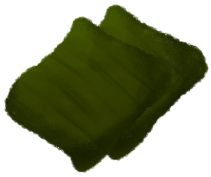
- Adults 150 mcg
- Pregnant women 220 mcg
- Breastfeeding women 290 mcg

## Sources

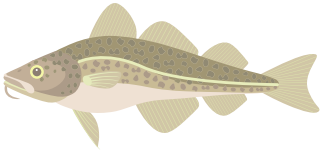
*Nutrition value of 100 grams

Kombu (1 gram) - 2,984 mcg

Wakame (1 gram) - 66 mcg



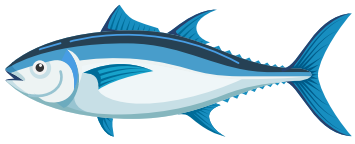
Nori (1 gram) - 16 mcg



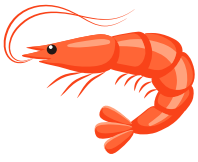
Cod - 158 mcg

Oyster - 93 mcg

1 Large egg - 26 mcg



Tuna - 17 mcg

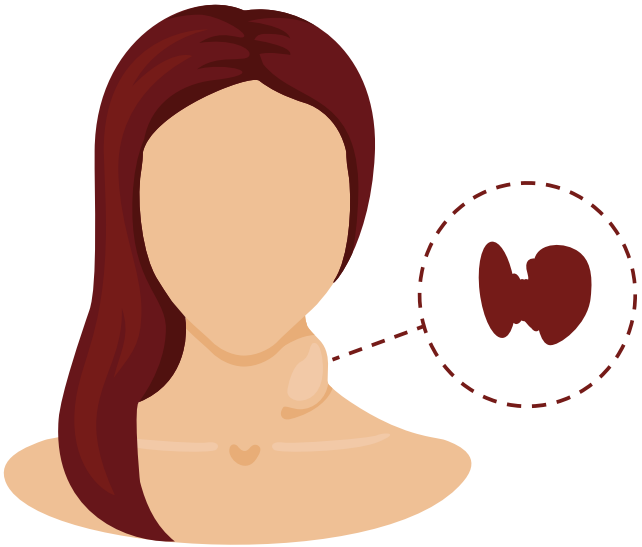


Shrimp - 35 mcg

1 Cup milk (244 ml) - 85 mcg

**Iodine deficiency:**

Iodine deficiency can lead to hypothyroidism (as the body uses iodine to synthesize thyroid hormone). Hypothyroidism can cause many problems. In pregnant women, severe iodine deficiency can cause impaired growth, intelletual disability and delayed sexual development of the fetus. Hypothyroidism from iodine deficiency usually accompanied by goiter (an enlarged thyroid gland).



Goiter (an enlarged thyroid gland).

**Iodine toxicity:**

Getting too much iodine can cause some of the same symptoms as iodine deficiency, including goiter (an enlarged thyroid gland). and hypothyroidism. Excessive iodine intake could also lead to thyroiditis (inflammation of thyroid gland) and thyroid cancer.

**In adults 19 years and older, total iodine intakes from all sources—food, beverages, and supplements—should not exceed 1,100 mcg.**

**References:**


- Beverley M. Shields, et al. Phosphodiesterase 8B Gene Polymorphism Is Associated with Subclinical Hypothyroidism in Pregnancy, The Journal of Clinical Endocrinology & Metabolism, Volume 94, Issue 11, 1 November 2009, Pages 4608–4612, https://doi.org/10.1210/jc.2009-1298
- Eriksson N, Tung JY, Kiefer AK, Hinds DA, Francke U, Mountain JL, Do CB. Novel associations for hypothyroidism include known autoimmune risk loci. PLoS One. 2012;7(4):e34442. doi: 10.1371/journal.pone.0034442. Epub 2012 Apr 6. PMID: 22493691; PMCID: PMC3321023.
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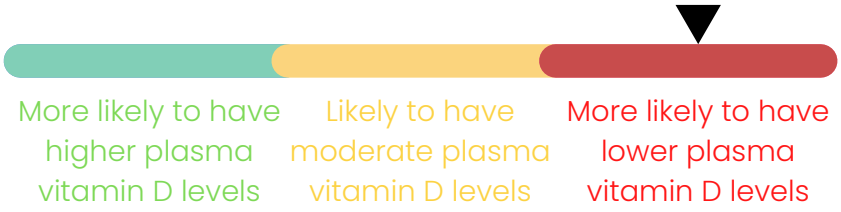
# Bone & Muscle

# Vitamin D




| Gene | rsID | Genotype |
|---|---|---|
| GC | rs2282679 | CC |
| CYP2R1 | rs2060793 | AA |

| Phenotype |
|---|
| More likely to have lower plasma vitamin D levels |

**Know your gene:**

GC (GC Vitamin D Binding Protein) gene encodes vitamin D-binding protein (DBP), a multifunctional protein found in plasma, ascitic fluid, cerebrospinal fluid and on the surface of many cell types. It binds to vitamin D and its plasma metabolites and transports them to target tissues. Polymorphisms of GC are associated with circulating vitamin D levels.

CYP2R1 (Cytochrome P450 Family 2 Subfamily R Member 1) encodes a member of the cytochrome P450 superfamily of enzymes, involved in drug metabolism and synthesis of cholesterol, steroids and other lipids. This gene also provides instructions for making an enzyme called 25-hydroxylase. This enzyme carries out the first of two reactions to convert vitamin D to its active form. Polymorphisms of CYP2R1 result in variance of vitamin D levels.

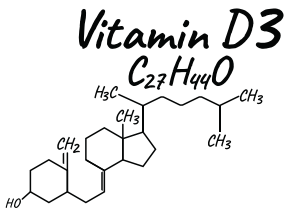
**Interpretation:**

Your gene indicate that you are likely to have lower plasma vitamin D levels, due to a genetic variant which affect vitamin D metabolism.

**Recommendation:**

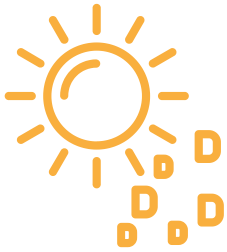
You should include foods like fatty fish, fish oil, and liver which contain vitamin D. If you don't spend much time in the sun and rarely eat fatty fish, you might be at risk of vitamin D deficiency, consider supplementing by discussing with your healthcare provider.

# Vitamin D




**What is vitamin D?**

Vitamin D (calciferol) is a fat-soluble vitamin that is naturally present in a some foods and available as a dietary supplement. Our body can also produces vitamin D when ultraviolet (UV) rays from sunlight hit the skin and trigger vitamin D synthesis. Despite all these methods to get vitamin D, vitamin D deficiency is a common worldwide problem.




Vitamin D plays an important role in many functions throughout our body, including the following:

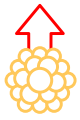
- Helps your body absorb calcium, which help maintain healthy bones and teeth and prevent osteoporosis
- Modulates cell growth, neuromuscular and immune function
- Involves many gene expression regulating cell proliferation, differentiation, and apoptosis

There are two forms of vitamin D in supplements which are D2 (ergocalciferol) and D3 (cholecalciferol). Both forms can increase vitamin D in your blood, but D3 might raise it higher and for longer than D2.

Bone

Muscle

Immune



Cell Growth

**Sources:**

Very few foods provide vitamin D. Most of the vitamin D in the diets comes from fortified food. Check the nutrition facts label to find out the amount of vitamin D in certain foods and beverages.

- Fatty fish (salmon, tuna, mackerel) and fish liver oils are the best natural sources of vitamin D
- Most milk is fortified with vitamin D, but other dairy products (cheese or ice cream) usually are not fortified
- Vitamin D is added to many breakfast cereals and other food products
- Beef liver, egg yolks, and cheese have small amounts of vitamin D
- Mushrooms provides little vitamin D

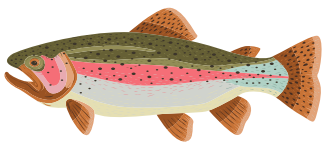
Vitamin D is found in multivitamin/multimineral supplements. It is also available in dietary supplements containing only vitamin D or vitamin D combined with a few other nutrients, usually calcium. The two forms of vitamin D in supplements are D2 (ergocalciferol) and D3 (cholecalciferol).

Vitamin D is fat-soluble, it is best absorbed when taken with a meal or snack that includes some fat.

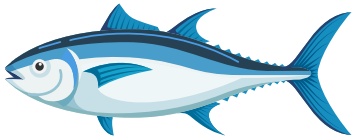
## Sources *Nutrition value of 100 grams

Salmon - 570 IU

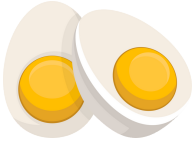
Cod liver oil - 1360 IU (1 tbsp)



Trout - 645 IU



Tuna - 82 IU



1 Large egg - 44 IU

1 Cup milk (237 ml) - 115 IU

**How much do I need?**

- Adults 19–70 years 15 mcg (600 IU)
- Adults 71 years and older 20 mcg (800 IU)
- Pregnant and breastfeeding women 15 mcg (600 IU)

One way to know if you're getting enough is a blood test that measures a form of vitamin D known as 25-hydroxyvitamin D in your blood:

- Levels of 50 nmol/L (20 ng/mL) or above are adequate for most people for bone and overall health.
- Levels below 30 nmol/L (12 ng/mL) are too low and might weaken your bones and affect your health.
- Levels above 125 nmol/L (50 ng/mL) are too high and might cause health problems.

**Vitamin D deficiency:**

Vitamin D deficiency is quite common worldwide. In Thai population, almost 50% has vitamin D insufficiency, defined by serum 25(OH)D level < 30 ng/mL (<75 nmol/L).

Vitamin D deficiency normally occurs when usual intakes inadequate for a period of time, exposure to sunlight is limited, the kidneys cannot convert vitamin D its active form, or there is an issue with absorption of vitamin D from the gut.

In children, vitamin D deficiency causes rickets, a disease in children that causes irreversible soft and weak bones. In teens and adults, vitamin D deficiency causes osteomalacia, a disorder that causes weak bones.

Vitamin D deficiency is also associated with many chronic diseases including depression, anxiety, type 2 diabete mellitus, heart disease, multiple sclerosis and some cancers.

**Vitamin D toxicity:**

Excess level of vitamin D in your blood (greater than 375 nmol/L or 150 ng/mL) can cause nausea, vomiting, muscle weakness, confusion, pain, loss of appetite, dehydration, excessive urination and thirst, and kidney stones. In extreme cases, vitamin D toxicity causes renal failure, calcification of soft tissues throughout the body, cardiac arrhythmias, and even death. High levels of vitamin D are almost always caused by consuming excessive amounts of vitamin D from dietary supplements. You cannot get too much vitamin D from sunshine because your skin limits the amount of vitamin D it makes.

**In adults 19 years and older, total vitamin D intakes from all sources—food, beverages, and supplements—should not exceed 100 mcg (4,000 IU).**

**References:**


- Nissen J, et al. Common variants in CYP2R1 and GC genes predict vitamin D concentrations in healthy Danish children and adults. PLoS One. 2014 Feb 27;9(2):e89907. doi: 10.1371/journal.pone.0089907. PMID: 24587115; PMCID: PMC3937412.
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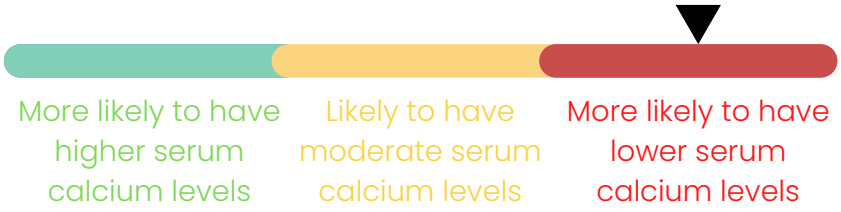
# Calcium




| Gene | rsID | Genotype |
|---|---|---|
| CASR | rs1801725 | GG |

| Phenotype |
|---|
| More likely to have lower serum calcium levels |

**Know your gene:**

The calcium sensing receptor (CASR) gene encodes a calcium-sensing receptor (CaSR), which binds to calcium present in the blood. CaSR found in abundance in parathyroid glands and is associated with parathyroid hormone regulation. This hormone transfers calcium between the bone and the blood, affecting plasma calcium levels. The CaSR also found in kidneys, involved in removal of calcium via kidneys. Certain polymorphisms of CASR contribute to variance in calcium levels.

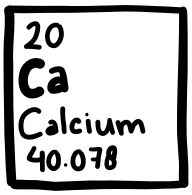
**Interpretation:**

Your gene indicate that you are likely to have lower serum calcium levels, due to a genetic variant which affect parathyroid hormone function.

**Recommendation:**

You should get the minimum recommended daily intake of calcium by eating a variety of foods, especially dairy products and fish with bones. Consider taking supplementation if you are a vegan or have certain health conditions, such as osteoporosis, by discussing with your healthcare provider.

# Calcium




**What is calcium?**

Calcium, the most abundant mineral in the body, is needed in our bodies to perform a variety of functions. Almost all calcium in the body is stored in bones and teeth, giving them structure and hardness. Your body needs to carry out many important functions including:

- Maintains strong bones and teeth
- Regulates muscular contraction and relaxation, including your heart muscle
- Helps with blood clotting process
- Mediates nerve transmission and hormone secretion


Bone


Muscle


Clotting process


Nerve transmission

**Sources:**

Calcium is found in many foods. You can get recommended amounts of calcium by eating a variety of foods, including the following:

- Dairy products (milk, yogurt, and cheese) are the main food sources of calcium
- Canned fish (sardine, mackerel, etc.) with bones contain calcium
- Certain leafy greens, such as kale, broccoli and brussel sprouts, also contain calcium

Calcium is found in many multivitamin-mineral supplements, sole calcium supplements and usually in combination with vitamin D.

The two main forms of calcium in dietary supplements are calcium carbonate and calcium citrate. Calcium carbonate is best absorbed when taken together with meals, while calcium citrate could be taken both with meals and on an empty stomach.

**How much do I need?**

Adult males

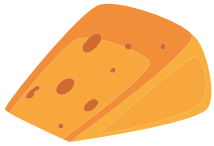
- 19-70 years old 1,000 mg
- 71 years and older 1,200 mg

Adult females

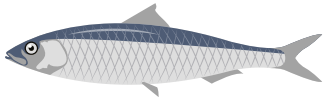
- 19-50 years old 1,000 mg
- Pregnant and breastfeeding 1,000 mg
- 51 years and older 1,200 mg

## Sources *Nutrition value of 100 grams


Greek yogurt - 110 mg



Cheddar cheese - 721 mg



Sardine - 325 mg

Spinach - 99 mg

Kale - 150 mg

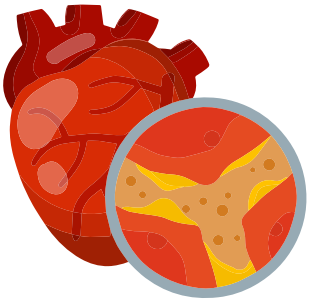
1 Cup milk (244 ml) - 276 mg

**Calcium deficiency:**

Getting not enough calcium can lead to many health conditions, including the following:

- Osteoporosis, a condition which causes weak, fragile bones and increases the risk of falling
- Osteomalacia, a condition which causes soft bones in children and adults
- Rickets, a disease in children that causes irreversible soft and weak bones

Many people get less than recommended amounts of calcium from food and supplements. Certain groups of people are more likely than others to have trouble getting enough calcium, mainly postmenopausal women and people who don't drink milk or eat other dairy products.



Calcium supplementation might cause arterial calcification, hence increase risk of cardiovascular diseases

**Calcium toxicity:**

High calcium intakes might increase the risk of heart disease and prostate cancer.

**In adults 19 years and older, total calcium intakes from all sources—food, beverages, and supplements—should not exceed 2,000 mg.**

Calcium supplements might cause gas, bloating, and constipation in some people, try spreading out the calcium dose throughout the day, taking the supplement with meals, or switching the form of calcium you take to ease the symptoms.

**References:**


- Kapur K, et al. Genome-wide meta-analysis for serum calcium identifies significantly associated SNPs near the calcium-sensing receptor (CASR) gene. PLoS Genet. 2010 Jul 22;6(7):e1001035. doi: 10.1371/journal.pgen.1001035. PMID: 20661308; PMCID: PMC2908705.
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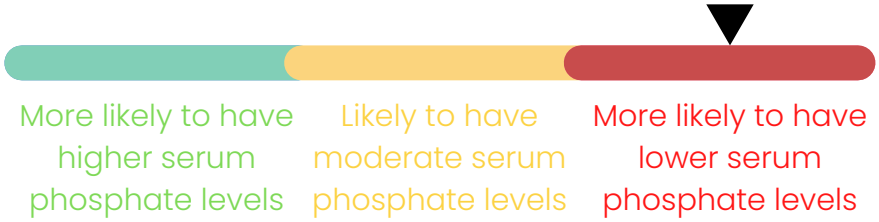
- Calcium [Internet]. Nih.gov. [cited 2022 Oct 5]. Available from: https://ods.od.nih.gov/factsheets/Calcium-HealthProfessional/

## Phosphorus




| Gene | rsID | Genotype |
|---|---|---|
| C12orf4 | rs2970818 | TT |
| ALPL | rs1697421 | TT |
| IP6K3 | rs9469578 | TT |
| PDE7B | rs947583 | TT |

| Phenotype |
|---|
| More likely to have lower serum phosphate levels |

**Know your gene:**

The SNP rs2970818 (Gene: C12orf4) is located within FGF6 and FGF23 (Fibroblast Growth Factor 6 and 23 gene). FGF23, is involved in the regulation of phosphorus balance, it binds to its receptor within the kidney to increase phosphorus excretion via urine.

ALPL gene provides instructions for making an enzyme called tissue-nonspecific alkaline phosphatase, which plays a key role in mineralizing the skeleton. Mutations in this gene have been linked to hypophosphatasia (low serum phosphorus level), a disorder that is characterized by hypercalcemia and skeletal defects.

IP6K3 encodes a protein that belongs to the inositol phosphokinase (IPK) family. Certain polymorphisms of IP6K3 is associated with lower serum phosphorus levels.

PDE7B (Phosphodiesterase 7B) is a protein coding gene encoding cAMP-specific phosphodiesterase which involves in many signaling pathway. Certain genetic variants associate with serum phosphorus concentration.

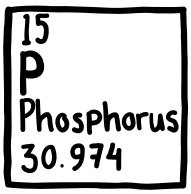
**Interpretation:**

Your genes indicate that you are likely to have lower serum phosphorus levels, due to genetic polymorphisms which affect phosphate metabolism.

**Recommendation:**

You should ensure adequate intake of phosphorus by eating a variety of foods which are rich in phosphorus, mainly meat, poultry, fish and dairy products.

# Phosphorus




**What is phosphorus?**

Phosphorus is an essential mineral which is a main component of bones, teeth, DNA and RNA. Phosphorus plays key roles in many important functions in our body including:

- Regulates of gene transcription
- Activates enzymes which involved in energy metabolism
- Maintains of normal pH (acid-base balance) in of the blood
- Involves in carrying out many important chemical processes

Bone

Energy

Acid-base balance

Gene transcription

**Sources:**

Phosphorus is naturally present in many foods. You can get recommended amounts of phosphorus by eating a variety of foods, including the following:

- Dairy products, such as milk, yogurt and cheese
- Meats, poultry, fish, and eggs
- Grain products
- Nuts, seeds and legumes
- Certain vegetables, such as potatoes and asparagus

Phosphorus is available in a few multivitamin/mineral supplements and some other dietary supplements. The most common forms of phophorus in supplements are dipotassium phosphate, disodium phosphate, phosphatidylcholine, or phosphatidylserine. Research hasn't shown that any form of supplemental phosphorus is better than the others.

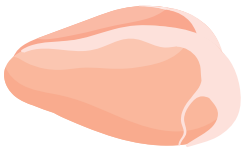
**How much do I need?**

- Adults 700 mg
- Pregnant and breastfeeding women 700 mg

## Sources

*Nutrition value of 100 grams

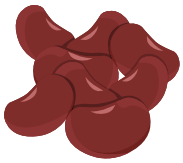
Salmon - 254 mg



Chicken breast - 214 mg

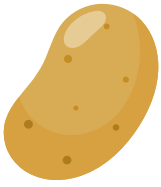
Pork - 235 mg

Cashew nut - 490 mg



Kidney bean - 406 mg

1 Large egg - 86 mg



Potato - 75 mg

Pea - 82 mg

1 Cup milk (244 ml) - 226 mg

**Phosphorus deficiency:**

Phosphorus deficiency is rare. But certain groups are most likely to have inadequate phosphorus status, especially people with genetic phosphate regulation disorders and people with severe malnutrition.

A phosphorus deficiency can cause wide range of problems including the following:

- Loss of appetite
- Anemia (low red blood cell counts)
- Muscle weakness
- Coordination problems
- Bone pain, soft and deformed bones
- A higher risk of infection
- A feeling of burning or prickling in the skin
- Confusion

**Phosphorus toxicity:**

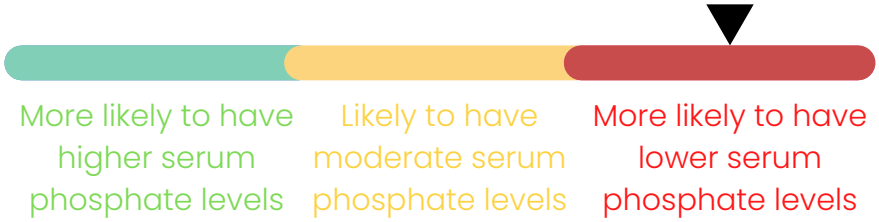
High phosphorus intakes rarely produce adverse effects in healthy people. But you shouldn't get more phosphorus than the upper limits as there some studies have found associations between high phosphorus intakes (1,000 mg/day or higher) and cardiovascular, kidney, and bone adverse effects as well as an increased risk of death.

**In adults 19 - 70 years old, total phosphorus intakes from all sources —food, beverages, and supplements—should not exceed 4,000 mg. Pregnant women should limit phosphorus to lower than 3,500 mg. Those who are older than 71 years old should limit to 3,000 mg.**

**References:**


- Kestenbaum B, Glazer NL, Köttgen A, et al. Common genetic variants associate with serum phosphorus concentration. Journal of the American Society of Nephrology : JASN. 2010 Jul;21(7):1223-1232. DOI: 10.1681/asn.2009111104. PMID: 20558539; PMCID: PMC3152230.
- Shin SY, et al. An atlas of genetic influences on human blood metabolites. Nat Genet. 2014 Jun;46(6):543-550. doi: 10.1038/ng.2982. Epub 2014 May 11. PMID: 24816252; PMCID: PMC4064254.
- Phosphorus [Internet]. Nih.gov. [cited 2022 Oct 6]. Available from: https://ods.od.nih.gov/factsheets/Phosphorus-HealthProfessional/

# Magnesium




| Gene | rsID | Genotype |
|---|---|---|
| TRPM6 | rs11144134 | TT |
| SHROOM3 | rs13146355 | GG |
| DCDC1 | rs3925584 | CC |
| MUC1 | rs4072037 | CC |
| ATP2B1 | rs7965584 | GG |

| Phenotype |
|---|
| More likely to have lower serum magnesium levels |

**Know your gene:**

TRPM6, predominantly expressed in the kidney and colon, is crucial for magnesium homeostasis, and plays an essential role in epithelial magnesium transport and in the active magnesium absorption in the gut and kidney. Mutations of this gene could lead to hypomagnesia (low level of magnesium in blood).

SHROOM3 gene product is expressed in kidneys and reported to play a role in epithelial cell shape regulation. SHROOM3 gene is associated with eGFR (kidney function) and also magnesium levels.

ATP2B1 encodes plasma-membrane calcium ATPase 1 (PMCA1), which is responsible for the removal of calcium ions from cells. The PMCA1 enzyme activity is dependent on magnesium ions. Variants in the ATP2B1 gene region are associated with magnesium levels.

**Interpretation:**

Your genes indicate that you are likely to have lower serum magnesium levels, due to genetic variants which lead to change in magnesium absorption and transportation.

**Recommendation:**

You should get recommended amounts of magnesium by eating a variety of foods, including nuts, seed, legumes, dairy products and other fortified magnesium products. If you have certain medical conditions or certain medications which put you at risk of magnesium deficiency, consider taking supplements by discussing with your healthcare provider.

# Magnesium


**What is magnesium?**

Magnesium, an essential mineral, is a cofactor in more than 300 enzyme systems that regulate diverse biochemical reactions in the body. Magnesium is important for many processes in the body, including:

- Regulates muscle and nerve function
- Regulates blood sugar levels and blood pressure
- Contributes to the structural development of bone
- Involves in synthesis of DNA, RNA, and the antioxidant glutathione


Bone


Muscle


Blood sugar

Blood pressure

**Sources:**

Magnesium is found naturally in many foods. You can get recommended amounts of magnesium by eating a variety of foods, including the following:

- Legumes, nuts, seeds, whole grains, and green leafy vegetables (such as spinach)
- Fortified breakfast cereals and other fortified foods
- Milk, yogurt, and some other milk products

Magnesium is available in multivitamin-mineral supplements and other dietary supplements. There are many forms of magnesium in dietary supplements. Forms which most easily absorbed by the body are magnesium aspartate, magnesium citrate, magnesium lactate, and magnesium chloride.

**How much do I need?**

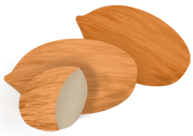
- Adult men 400-420 mg
- Adult women 310-320 mg
- Pregnant women 350-360 mg

## Sources

*Nutrition value of 1 ounce (28 grams)

Pumpkin seed - 156 mg

Chia seed - 111 mg

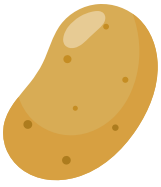


Almond - 80 mg

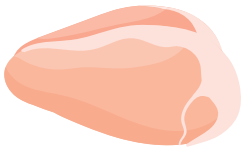
Cashew nut - 74 mg

1/2 Cup of boiled spinach - 78 mg

Peanut butter - 49 mg



Potato (100 g) - 43 mg



Chicken breast (100 g) - 22 mg

1 Cup milk (244 ml) - 25 mg

**Magnesium deficiency:**

Low magnesium intakes for a long period of time, some medical conditions and medications interfere with the body's ability to absorb magnesium can lead to magnesium deficiency. Magnesium deficiency include loss of appetite, nausea, vomiting, fatigue, and weakness. In severe cases, it could lead to numbness, tingling, muscle cramps, seizures, personality changes, and an abnormal heart rhythm.

Certain group of people who are at risk of magnesium deficiency are of the following:

- People with gastrointestinal diseases, which might affect magnesium absorption
- People with type 2 diabetes
- People with alcoholism
- People with older age

**Magnesium toxicity:**

Magnesium that is naturally present in food and beverages is not harmful and does not need to be limited. In healthy people, the kidneys can get rid of any excess in the urine. However, high intakes of magnesium from dietary supplements and medications (such as laxatives or certain products that used to treat heartburns) can cause diarrhea, nausea, and abdominal cramping. Extremely excess magnesium intakes can even lead to abnormal heart rhythm and cardiac arrest.

**In adults 19 years and older, total magnesium intakes from supplements —should not exceed 350 mg. (no need to limit magnesium from natural sources.)**

**References:**


- Meyer TE, et al. Genome-wide association studies of serum magnesium, potassium, and sodium concentrations identify six Loci influencing serum magnesium levels. PLoS Genet. 2010 Aug 5;6(8):e1001045. doi: 10.1371/journal.pgen.1001045. PMID: 20700443; PMCID: PMC2916845.
- Mazzitelli LR, Adamo HP. The phosphatase activity of the plasma membrane Ca2+ pump. Activation by acidic lipids in the absence of Ca2+ increases the apparent affinity for Mg2+. Biochim Biophys Acta. 2007 Jul;1768(7):1777-83. doi: 10.1016/j.bbamem.2007.04.019. Epub 2007 May 3. PMID: 17540337.
- Magnesium [Internet]. Nih.gov. [cited 2022 Oct 7]. Available from: https://ods.od.nih.gov/factsheets/Magnesium-HealthProfessional/

# Iron


| Gene | rsID | Genotype |
|---|---|---|
| HFE | rs1800562 | GG |
| TF | rs8177240 | TT |
| TFR2 | rs7385804 | CC |
| TMPRSS6 | rs855791 | AA |
| TMPRSS6 | rs228916 | TT |

| Phenotype |
|---|
| More likely to have lower serum iron levels |

**Know your gene:**

HFE gene provides instructions for producing a protein (called hepcidin), located on the surface of cells, primarily liver and intestinal cells, which functions to regulate iron absorption. Certain variants of HFE can lead to higher levels of serum iron.

TF gene encodes transferrin, a protein which function is to transports iron through the blood to various tissues such as the liver, spleen, and bone marrow. Specific polymorphisms of TF decrease serum iron levels.

TFR2 gene encodes protein called transferrin receptor 2. The main function of this protein is to help iron enter liver cells. It also helps regulate iron storage levels in the body by controlling the levels of another protein called hepcidin. Certain variants of TFR2 result in higher levels of serum iron.

TMPRSS6 gene provides instructions for making a protein called matriptase-2. This protein is part of a signaling pathway that also controls the levels of hepcidin. Certain variants of TMPRSS6 are associated with lower serum iron levels.

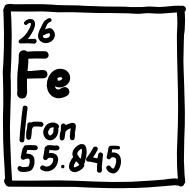
**Interpretation:**

Your genes indicate that you are more likely to have lower serum iron levels, due to genetic variants that affect absorption and transportation of iron.

**Recommendation:**

You can get the recommended amounts of iron by eating lean meat, seafood, poultry, iron-fortified foods, dark leafy greens and nuts. If you are at risk of iron deficiency (pregnant, having heavy period, frequent blood donor, certain GI disorders or vegan), considering iron supplement by talking to your healthcare provider.

# Iron




**What is iron?**

Iron is a vital mineral that is present in many natural foods, fortified food products, and available as a dietary supplement. Iron plays a vital role in many functions throughout the body including:

- Makes hemoglobin, a protein in red blood cells that carries oxygen from the lungs to all parts of the body
- Makes myoglobin, a protein that provides oxygen to muscles
- Supports muscle metabolism and healthy connective tissue
- Involves in physical growth, neurological development and synthesis of some hormones

Red blood cells

Muscle

Physical growth



Neurological development

**Sources:**

Iron is found naturally in many foods and is added to some fortified food products. You can get recommended amounts of iron by eating a variety of foods, including the following:

- Lean meat, seafood, and poultry.
- Iron-fortified breakfast cereals and breads
- White beans, lentils, spinach, kidney beans, peas and nuts

There are 2 forms of iron: heme iron and nonheme iron. Nonheme iron is found in plant foods and iron-fortified food products. Meat, seafood, and poultry have both heme and nonheme iron.

Your body can absorb only small amount of nonheme iron, however you can enhance nonheme iron absorption by eating it with meat, poultry, seafood, and foods that contain vitamin C, such as citrus fruits, strawberries, sweet peppers, tomatoes, and broccoli.

Iron is available in many multivitamin-mineral supplements and in supplements that contain only iron. Iron in supplements is often in the form of ferrous sulfate, ferrous gluconate, ferric citrate, or ferric sulfate.

Certain groups people are at higher risk of iron deficiency

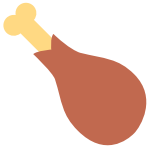
- Women with heavy periods
- Pregnant women
- Frequent blood donors
- People with cancer, gastrointestinal disorders, or heart failure

## Sources

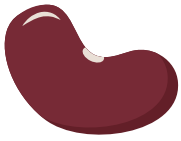
*Nutrition value of 100 grams

Pork - 0.9 mg

Ground beef - 2.6 mg



Chicken - 1.3 mg



Kidney bean (boiled) - 2.2 mg

Boiled spinach - 3.6 mg

Peanut butter - 1.9 mg

**How much do I need?**

- Adult men 19–50 years 8 mg
- Adult women 19–50 years 18 mg
- Adults 51 years and older 8 mg
- Pregnant women 27 mg
- Breastfeeding women 9 mg

**Iron deficiency:**

In the short term, getting to little iron won't cause any obvious symptoms, as the body can store iron in muscles, liver, spleen and bone marrow. But if your body has depleted iron storage, it would lead to iron deficiency anemia, a condition which red blood cells become smaller and contain less hemoglobin. As a result, blood carries less oxygen from the lungs throughout the body.

Symptoms of iron deficiency anemia include gastrointestinal upset, weakness, tiredness, lack of energy, problems with concentration and memory and poor immune functions.

**Iron toxicity:**

Too much iron is harmful. People who take high doses of iron supplements (especially on an empty stomach) can cause an upset stomach, constipation, nausea, abdominal pain, vomiting, and diarrhea. Large amount of iron might also cause inflammation of the stomach lining and ulcers. Extremely high doses of iron (in the hundreds or thousands of mg) can cause organ failure, coma, convulsions, and death.

People with hemochromatosis, a condition which toxic levels of iron to build up in their bodies, should avoid using iron supplements and vitamin C supplements (which can enhance body iron absorption).

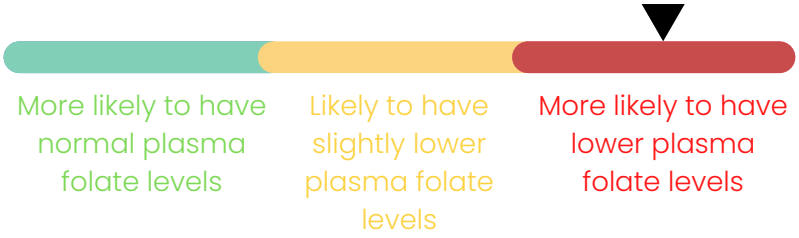
**In adults 19 years and older, total iron intakes from all sources—food, beverages, and supplements—should not exceed 45 mg.**

**References:**


- Benyamin B, et al. Novel loci affecting iron homeostasis and their effects in individuals at risk for hemochromatosis. Nat Commun. 2014 Oct 29;5:4926. doi: 10.1038/ncomms5926. Erratum in: Nat Commun. 2015;6:6542. Häldin, Jonas [corrected to Hälldin, Jonas]. PMID: 25352340; PMCID: PMC4215164.
- Iron [Internet]. Nih.gov. [cited 2022 Oct 10]. Available from: https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/

# Brain & Heart

## Folate




| Gene | rsID | Genotype |
|---|---|---|
| MTHFR | rs1801133 | AA |

| Phenotype |
|---|
| More likely to have lower plasma folate levels |

**Know your gene:**

The MTHFR gene provides instructions for making an enzyme called methylenetetrahydrofolate reductase, which converts folate to methylfolate, a key component in the methylation cycle. Methylfolate is needed for the conversion of homocysteine to methionine.

Mutations in the MTHFR gene can lead to lower methylene tetrahydrofolate reductase efficiency, hence reduction in ability to process folate. Certain genetic variants of MTHFR are associated with high homocysteine and low folate levels, both of which are harmful to the body.

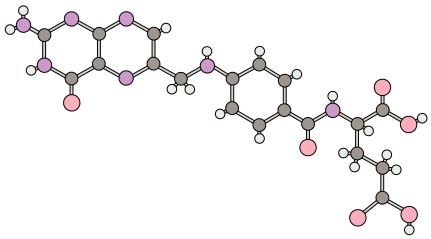
**Interpretation:**

Your gene indicates that your MTHFR efficiency is about 10-20 percent in processing folic acid, which subsequently leads to high homocysteine, low B12 and folate levels.

**Recommendation:**

You might need more than the recommended amounts of folate by eating by eating plenty of vegetables, fruit, nuts, beans and wholegrains. Considering taking folic acid supplements, especially if you are pregnant, by discussing with your healthcare provider.

# Folate



**What is folate?**

Folate is a water soluble B-vitamin that is naturally present in many foods. It's formerly known as “vitamin B9". Our body needs folate for many important functions including:

- Synthesizes DNA and RNA (genetic materials)
- Makes red blood cells
- Metabolizes certain amino acids, specifically homocysteine which is harmful to the body

Genetic materials

Red blood cells


Metabolize homocysteine

**Sources:**

Folate is naturally present in many foods and added to some foods (in the form of folic acid). You can get recommended amounts by eating a variety of foods, including the following:

- Beef liver
- Vegetables (especially asparagus, brussels sprouts, and dark green leafy vegetables such as spinach)
- Fruits and fruit juices
- Nuts, beans, and peas
- Fortified foods, such as bread, pasta, flour and cereal breakfast

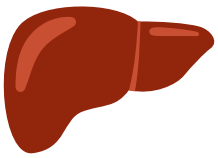
Folate is available in multivitamins, prenatal vitamins, B-complex dietary supplements and also available in dietary supplements containing only folate. Folate supplements are usually in the form of folic acid and methylfolate (5-methyl-THF). Methylfolate might be better than folic acid for individuals who have a certain mutation in a gene called MTHFR because their bodies can use this form more easily.

**How much do I need?**

- Adults 400 mcg
- Pregnant women 600 mcg
- Breastfeeding women 500 mcg

## Sources

*Nutrition value of 100 grams



Beef liver - 290 mcg

Spinach - 194 mcg

Asparagus - 175 mcg

Avocado - 81 mcg

Brussel sprout - 60 mcg

Broccoli - 57 mcg

1 Large egg - 22 mcg

Banana - 20 mcg

1 Cup milk (244 ml) - 12 mcg

**Folate deficiency:**

Folate deficiency can result in megaloblastic anemia, a blood disorder that causes weakness, fatigue, trouble concentrating, irritability, headache, heart palpitations, and shortness of breath. Folate deficiency can also cause open sores on the tongue and inside the mouth and changes in the color of the skin, hair, or fingernails.

Pregnant women who don't get enough folate are at risk of having babies with neural tube defects, such as spina bifida, especially myelomeningocele, or encephalocele. There's a high likelihood of nerve damage, which can cause paralysis and other issues. The nerve damage and loss of function that are present at birth are usually permanent.

**Folate toxicity:**

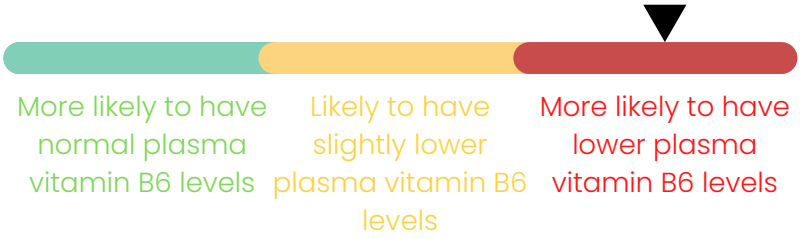
Folate that is naturally present in food and beverages is not harmful and does not need to be limited. However, taking large amounts of folate supplements might hide a vitamin B12 deficiency because these supplements can correct the anemia that the vitamin B12 deficiency causes, but not the nerve damage that the vitamin B12 deficiency also causes. High doses of folic acid might increase the risk of colorectal cancer and possibly other cancers in some people.

**In adults 19 years and older, total folate intakes from supplements and fortified foods—should not exceed 1,000 mcg. (no need to limit folate from natural sources.)**

**References:**


- Tanaka T, et al. Genome-wide association study of vitamin B6, vitamin B12, folate, and homocysteine blood concentrations. Am J Hum Genet. 2009 Apr;84(4):477-82. doi: 10.1016/j.ajhg.2009.02.011. Epub 2009 Mar 19. Erratum in: Am J Hum Genet. 2009 May;84(5):712. PMID: 19303062; PMCID: PMC2667971.
- Folate [Internet]. Nih.gov. [cited 2022 Oct 12]. Available from: https://ods.od.nih.gov/factsheets/Folate-HealthProfessional/

# Vitamin B6 (Pyridoxine)




| Gene | rsID | Genotype |
|---|---|---|
| NBPF3 | rs4654748 | CC |

| Phenotype |
|---|
| More likely to have lower plasma vitamin B6 levels |

**Know your gene:**

NBPF3 (Neuroblastoma breakpoint family member 3), found to be associated with the clearance of vitamin B6 from the body. Certain polymorphisms of the gene could lead to more efficient clearance of the vitamin, leading to lower level of vitamin B6.

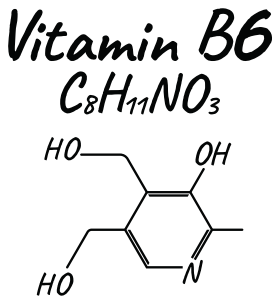
**Interpretation:**

Your gene indicates that your body vitamin B6 clearance is higher, leading to lower plasma vitamin B6 levels.

**Recommendation:**

You might need more than the recommended amounts of vitamin B6 by eating by wide range of animal products, starchy vegetables and fruit.

# Vitamin B6 (Pyridoxine)




**What is vitamin B6?**

Vitamin B6 is a water-soluble vitamin that is naturally present in many foods, and available as a dietary supplement.

Vitamin B6 is required in more than 100 enzyme reactions involved in metabolism. It is very important for a wide variety of functions in the body including:

Cognitive development


Metabolize homocysteine

Immune

Energy

- Plays a role in cognitive development during pregnancy and infancy
- Maintains normal levels of homocysteine, a harmful amino acid in the blood
- Strengthens the body's natural defense against illness and infection (the immune system)
- Activates enzymes which involved in energy metabolism

**Sources:**

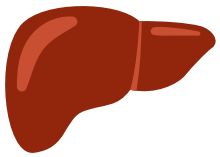
Vitamin B6 is found in a wide variety of foods. You can get recommended amounts by eating a variety of foods, including the following:

- Animal products, such as fish, beef liver and other organ meats, is the richest sources of vitamin B6
- Potatoes and other starchy vegetables
- Fruit (other than citrus)
- Fortified foods, such as breakfast cereal

Vitamin B6 is available in multivitamins, B-complex dietary supplements and also available in dietary supplements containing only vitamin B6, usually in the form of pyridoxine.

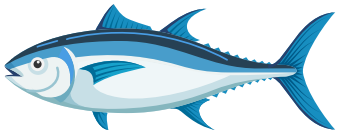
## Sources

*Nutrition value of 100 grams



Beef liver - 1 mg

chickpea - 0.5 mg



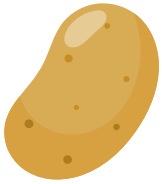
Tuna - 1 mg

Salmon - 0.6 mg

Chicken breast - 0.4 mg

Ground beef - 0.3 mg

Banana - 0.4 mg



Potato - 0.3 mg

Spinach - 0.2 mg

**How much do I need?**

- Adults 19–50 years 1.3 mg
- Adults 51+ years (men) 1.7 mg
- Adults 51+ years (women) 1.5 mg
- Pregnant women 1.9 mg
- Breastfeeding women 2.0 mg

**Vitamin B6 deficiency:**

Vitamin B6 deficiency can have a wide range of signs and symptoms, including anemia, itchy rashes, scaly skin on the lips, cracks at the corners of the mouth, and a swollen tongue. It could also lead to depression, confusion, and a weak immune system.

**Vitamin B6 toxicity:**

High intakes of vitamin B6 from food sources have not been reported to cause adverse effects. However, taking high levels of vitamin B6 (1–6 g oral pyridoxine per day) from supplements for a year or longer can cause severe nerve damage, leading people to lose control of their bodily movements. Excessive vitamin B6 intakes can also cause painful, unsightly skin patches, extreme sensitivity to sunlight, nausea, and heartburn.

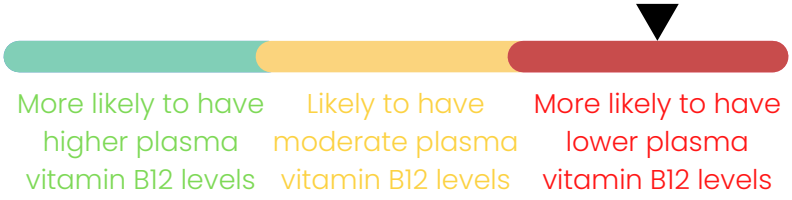
**In adults 19 years and older, total vitamin B6 intakes from all sources —food, beverages, and supplements—should not exceed 100 mg.**

Vitamin B6 is often prescribed for the treatment of nausea and vomiting of pregnancy (morning sickness), at much higher doses than initially recommended (could exceed 100 mg/day, under physician supervision

**References:**


- Tanaka T, et al. Genome-wide association study of vitamin B6, vitamin B12, folate, and homocysteine blood concentrations. Am J Hum Genet. 2009 Apr;84(4):477-82. doi: 10.1016/j.ajhg.2009.02.011. Epub 2009 Mar 19. Erratum in: Am J Hum Genet. 2009 May;84(5):712. PMID: 19303062; PMCID: PMC2667971.
- Vitamin B6 [Internet]. Nih.gov. [cited 2022 Oct 14]. Available from: https://ods.od.nih.gov/factsheets/VitaminB6-HealthProfessional/

# Vitamin B12 (Cobalamin)




| Gene | rsID | Genotype |
|---|---|---|
| CUBN | rs11254363 | AA |
| FUT2 | rs602662 | GG |
| TCN1 | rs526934 | GG |

| Phenotype |
|---|
| More likely to have lower plasma vitamin B12 levels |

**Know your gene:**

CUBN gene provides instructions for making a protein called cubilin. This protein is involved in the uptake of vitamin B12 (also called cobalamin) from food into the body. Certain genetic variants of CUBN can lead to lower plasma vitamin B12 levels.

FUT2 gene encodes the galactoside 2-L-fucosyltransferase enzyme, which is important for the final step in the soluble ABO blood group antigen synthesis pathway. It is also involved in cell-cell interaction, cell surface expression, and cell proliferation. Certain genetic variants of FUT2 lead to reduce activity of the FUT2 enzyme and decrease susceptibility to bacterial infection and indirectly lower the risk of vitamin B12 malabsorption, thereby resulting in higher vitamin B12 levels.

TCN1 encodes the vitamin B12-binding protein, transcobalamin 1. Certain mutation of TCN1 result in transcobalamin I deficiency, characterized by low vitamin B12.

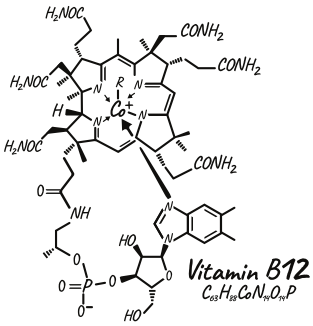
**Interpretation:**

Your genes indicate that you are likely to have lower plasma vitamin B12 levels, due to genetic variants that affect absorption and transportation of vitamin B12.

**Recommendation:**

You should get the recommended amount of vitamin B12 by eating a wide variety of animal products. Consider taking vitamin 12 supplements if you are older than 50 years old or you are a strict vegan / vegetarian.

# Vitamin B12 (Cobalamin)




**What is vitamin B12?**

Vitamin B12 is a water-soluble vitamin that is naturally present in some foods, added to fortified foods, available as a dietary supplement and a prescription medication.

Vitamin B12 is required for healthy nervous system functions, red blood cell formation and DNA (genetic material) synthesis.

Genetic materials

Red blood cells



Nervous system

**Sources:**

Vitamin B12 is mainly found in wide variety of animal foods, and some fortified foods. Plant foods have no vitamin B12 unless they are fortified. You can get recommended amounts of vitamin B12 by eating a variety of foods including the following:

- Animal products including fish, meat, poultry, eggs, milk, and other dairy products
- Some breakfast cereals, nutritional yeasts, and other food products are fortified with vitamin B12

Vitamin B12 is available in multivitamin/multimineral supplements, in B-complex supplements, and in supplements containing only vitamin B12. It is usually in a form called cyanocobalamin.

People who eat little or no animal foods, such as vegetarians and vegans, might not get enough vitamin B12 from their diets (as plant foods contain no vitamin B12). Therefore, they are at risk of vitamin B12 deficiency.

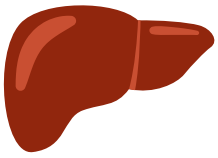
Many older adults don't have enough hydrochloric acid in their stomach to absorb the vitamin B12 that's naturally present in food. People over 50 should get most of their vitamin B12 from fortified foods or dietary supplements.

**How much do I need?**

- Adults 2.4 mcg
- Pregnant women 2.6 mcg
- Breastfeeding women 2.8 mcg

## Sources

*Nutrition value of 100 grams



Beef liver - 70 mcg

Tuna - 2.2 mcg

Ground beef - 2.1 mcg

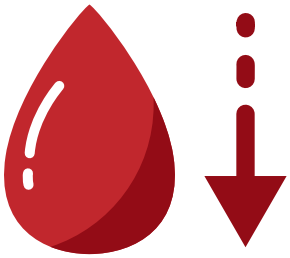
Salmon - 3.2 mcg

1 Large egg
- 0.5 mcg

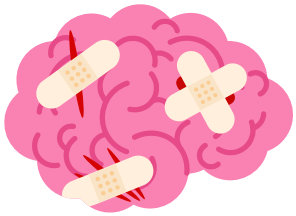
Chicken breast
- 0.3 mcg

**Vitamin B12 deficiency:**

Vitamin B12 deficiency can lead to megaloblastic anemia, you could experience fatigue, pale skin, heart palpitations, loss of appetite, weight loss, and infertility. Your hands and feet might become numb or tingly, as signs of nervous system impairment. Vitamin B12 deficiency could also lead to other neurological symptoms including: balance, depression, confusion, dementia, and poor memory.



Megaloblastic anemia is a type of vitamin deficiency anemia that happens when you don't get enough vitamin B12 and/or vitamin B9 (folate), characterized by a presence of large red blood cell.



Vitamin B12 deficiency cam result in wide range of neurological symptoms such as difficulty walking, tingling numbness in hands and feet, or even dementia.

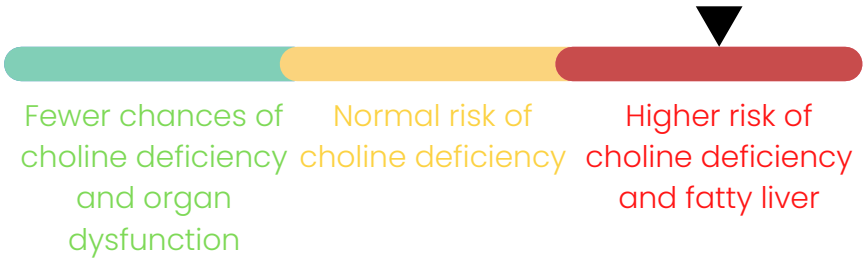
**Vitamin B12 toxicity:**

Vitamin B12 has not been shown to cause any harm, even at high doses. As your body can excrete the excess amout of vitamin B12 via urine.

**References:**


- Tanaka T, et al. Genome-wide association study of vitamin B6, vitamin B12, folate, and homocysteine blood concentrations. Am J Hum Genet. 2009 Apr;84(4):477-82. doi: 10.1016/j.ajhg.2009.02.011. Epub 2009 Mar 19. Erratum in: Am J Hum Genet. 2009 May;84(5):712. PMID: 19303062; PMCID: PMC2667971.
- Vitamin B12 [Internet]. Nih.gov. [cited 2022 Oct 17]. Available from: https://ods.od.nih.gov/factsheets/Vitamin B12-HealthProfessional/

# Choline




| Gene | rsID | Genotype |
|---|---|---|
| PEMT | rs12325817 | CG |

| Phenotype |
|---|
| Higher risk of choline deficiency and fatty liver |

**Know your gene:**

PEMT encodes an enzyme phosphatidylethanolamine N-methyltransferase, which produces phosphatidylcholine. A part of the choline requirement of the body can be satisfied by the synthesis of phosphatidylcholine. Polymorphisms in PEMT gene could alter choline requirements and might put individual at higher risk of choline deficiency, especially it one has a poor diet.

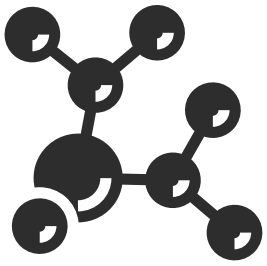
**Interpretation:**

Your gene indicates that you are more prone to organ dysfunction when on a low choline diet, fatty liver is usually the first clinical sign of choline deficiency.

**Recommendation:**

You should get the daily recommended amount of choline by eating a wide variety of foods, especially meat, eggs, fish and dairy products, which are the richest sources of choline.

# Choline



**What is choline?**

Choline is an essential nutrient that is naturally present in some foods and also available as a dietary supplement. The body needs choline to synthesize phosphatidylcholine and sphingomyelin, vital components of cell membrane. Therefore, cells need choline to preserve structural integrity.

In addition, choline is needed to produce acetylcholine, an important neurotransmitter for memory, mood, muscle control, and other brain and nervous system functions.

Your body can make a small amount of choline (from phosphatidylcholine) in your liver, but most of the choline in your body comes from the food you eat.

Structural integrity

Brain and nerve function

**Sources:**

Choline is naturally present in many foods. You can get recommended amounts of choline by eating a variety of foods, including the following:

- Meat, eggs, poultry, fish, and dairy products
- Potatoes and cruciferous vegetables such as brussels sprouts, broccoli, and cauliflower
- Some types of beans, nuts, seeds, and whole grains

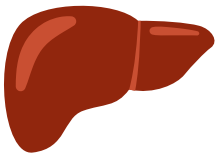
Choline is available in dietary supplements containing choline only, in combination with B-complex vitamins, and in some multivitamin / multimineral products. The forms of choline in dietary supplements include choline bitartrate, phosphatidylcholine, and lecithin. There has no research conducted to find out if any form of supplemental choline is better than the others.

**How much do I need?**

- Adult men 550 mg
- Adult women 425 mg
- Pregnant women 450 mg
- Breastfeeding women 550 mg

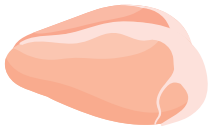
## Sources

*Nutrition value of 100 grams

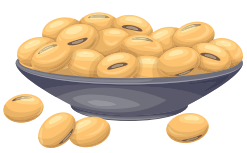


Beef liver - 414 mg

1 Large egg - 147 mg



Chicken breast - 85 mg



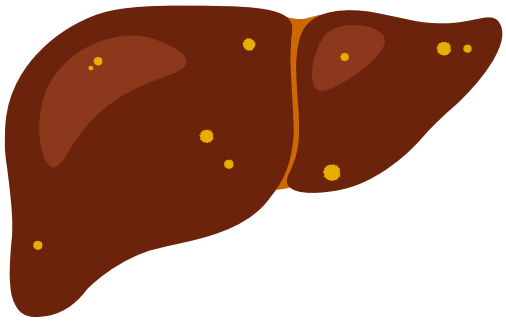
Soybean - 82 mg

Ground beef - 76 mg

1 Cup milk (244 ml) - 43 mg

**Choline deficiency:**

Choline deficiency can lead to muscle and liver damage as well as deposits of fat in the liver (fatty liver). Fatty liver can progress to inflammation of liver and eventually cirrhosis, if left untreated.



Non-alcoholic fatty liver disease (NAFLD) is the term for a range of conditions caused by a build-up of fat in the liver. Early-stage NAFLD does not usually cause any harm, but it can lead to serious liver damage, including cirrhosis, if it gets worse.

**Choline toxicity:**

Getting too much choline can cause a fishy body odor, vomiting, heavy sweating and salivation, low blood pressure, and liver damage. Choline consumption has been shown to increase production of TMAO, a substance that has been linked to a higher risk of cardiovascular disease.

**In adults 19 years and older, total choline intakes from all sources—food, beverages, and supplements—should not exceed 3,500 mg.**

**References:**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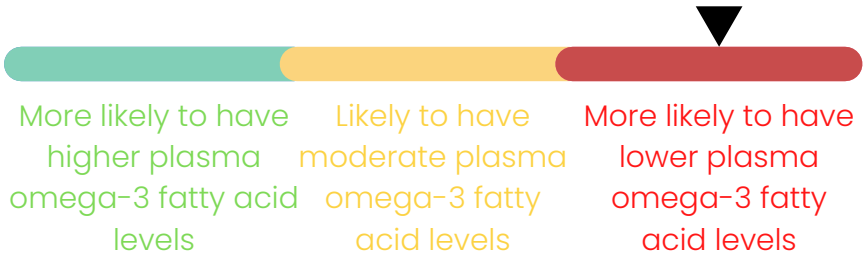
## Omega-3




| Gene | rsID | Genotype |
|---|---|---|
| FADS1 | rs174547 | TT |

| Phenotype |
|---|
| More likely to have lower plasma omega-3 fatty acid levels |

**Know your gene:**

FADS1 gene encodes fatty acid desaturase 1 enzyme, involved in the synthesis of polyunsaturated fatty acids. The FADS1 enzyme is found to be associated with the conversion of omega-3 from plant based fats to functional and longer forms like EPA, DHA. Certain genetic variants of FADS1 can result in lower activity of FADS1 enzyme, hence lower omega-3 fatty acids, specifically EPA levels.

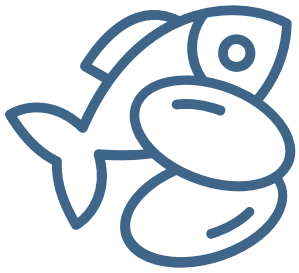
**Interpretation:**

Your gene suggests that you have decreased fatty acid desaturase 1 enzyme activity. Your body cannot efficiently convert omega-3 from plant sources, thus you are more likely to have lower plasma omega-3 fatty acid levels (EPA, DHA).

**Recommendation:**

You can get the daily recommended amount of ALA by eating healthy fat from plant sources, including nuts or seeds (flaxseed, chia seeds and walnuts) and vegetable oils (mainly flaxseed oil). You should get more omega-3 fatty acids from marine sources by consuming fatty fish (salmon, mackerel, tuna, herring and sardines) and other seafood. Aim for at least 2-3 servings (1 serving is around the size of your palm; 3 ounces) of fatty fish per week. If you take certain medications and consider taking omega-3 supplements, you should talk with your healthcare provider.

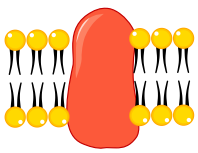
# Omega - 3



**What is omega-3?**

Omega-3 fatty acids are polyunsaturated fatty acids (PUFAs). The three main omega-3 fatty acids are alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). ALA is found mainly in plant oils such as flaxseed, soybean, and canola oils. DHA and EPA are found in fish and other seafood (sometimes called marine omega-3).

All omega-3 fatty acids are essential, meaning that your body can't make it, so you must get it from the foods. Even though your body can convert some ALA into EPA and then to DHA, but only in very small amounts. Therefore you still need EPA and DHA from foods and also dietary supplements.



Cell membrane

Brain and nerve function

Omega-3 fats are an integral part of cell membranes throughout the body and involve in many important functions in your heart, blood vessels, lungs, immune system, and endocrine system (the network of hormone-producing glands).

Docosahexaenoic acid (DHA) is essential for the growth and functional development of the brain in infants. DHA is also required for maintenance of normal brain function in adults.

**Sources:**

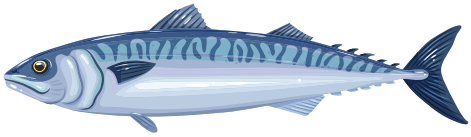
Omega-3s are found naturally in some foods, added to some fortified foods and available as many forms of dietary supplement. You can get adequate amounts of omega-3s by eating a variety of foods, including the following:

- Fish and other seafood (especially salmon, mackerel, tuna, herring, and sardines)
- Nuts and seeds (such as flaxseed, chia seeds, and walnuts)
- Vegetable oils (such as flaxseed oil, soybean oil, and canola oil)
- Fortified foods (such as certain brands of eggs, yogurt, milk, cereal breakfast)

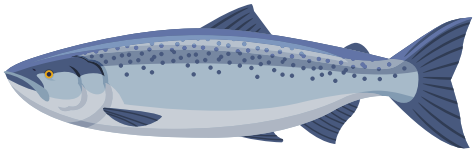
Omega-3 are present in several dietary supplements, including fish oil, krill oil, cod liver oil, and algal oil. A typical fish oil supplement provides about 1,000 mg fish oil, containing 180 mg EPA and 120 mg DHA.

## Sources

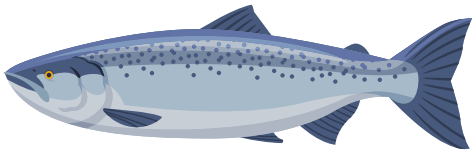
*Nutrition value of 3 ounces (85 grams)



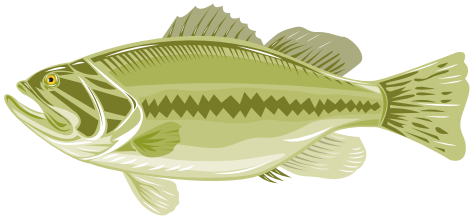
Mackerel
- 590 mg DHA
- 430 mg EPA



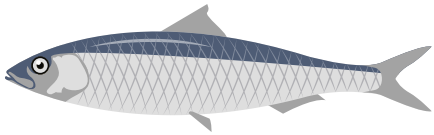
Salmon (farmed)
- 1,240 mg DHA
- 590 mg EPA



Salmon (wild)
- 1,220 mg DHA
- 350 mg EPA

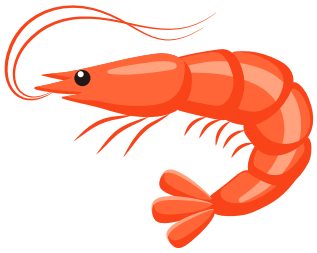


Sea bass
- 470 mg DHA
- 180 mg EPA



Sardine
- 740 mg DHA
- 450 mg EPA

Oyster
- 140 mg ALA
- 230 mg DHA
- 300 mg EPA



Shrimp
- 120 mg DHA
- 120 mg EPA

Cooking oil (1 tbsp)

- Flaxseed oil: 7,260 mg ALA
- Canola oil: 1,280 mg ALA
- Soybean oil: 920 mg ALA

**How much do I need?**

There is no established daily recommended amount of omega-3 fatty acids, except alpha-linolenic acid (ALA) which is found mainly in plant oils. However, for people with existing coronary heart disease, such as a recent myocardial infarction, American Heart Association (AHA) recommends approximately 1 gram per day EPA plus DHA, preferably from oily fish; however, supplements could also be considered under the direction of a physician.

For the daily recommended amounts for ALA are listed below:

- Adult men 1.6 g
- Adult women 1.1 g
- Pregnant women 1.4 g
- Breastfeeding women 1.3 g

**Omega-3 deficiency:**

A deficiency of essential fatty acids—either omega-3s or omega-6s—can cause rough, scaly skin and a red, swollen, itchy rash. There are no known cut-off levels of DHA or EPA that define omega-3 deficiency, but higher omega-3 levels are associated with a reduced risk of several chronic diseases, including coronary heart disease.

**Omega-3 toxicity:**

High doses of DHA / EPA for several weeks might reduce immune function due to suppression of inflammatory responses. It might also increase risk of bleeding. **However, EPA and DHA supplements at combined doses of up to about 5 g/day appears to be safe**. Any side effects from taking omega-3 supplements are usually mild. They include an unpleasant taste in the mouth, bad breath, heartburn, nausea, stomach discomfort, diarrhea, headache, and smelly sweat.

Omega-3 dietary supplements may interact with certain medications, for example, high doses of omega-3s may cause bleeding problems when taken with warfarin or other anticoagulant medicines. You should discuss with your healthcare provider about possible interactions between omega-3 supplements and your medications.

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