HelpGuide

A Harvard Health article

Vitamins and Minerals

Are You Getting What You Need?

Vitamins and minerals are essential nutrients because they perform hundreds of roles in the body. There is a fine line between getting enough of these nutrients (which is healthy) and getting too much (which can end up harming you). Eating a healthy diet remains the best way to get sufficient amounts of the vitamins and minerals you need.

Essential nutrients for your body

Every day, your body produces skin, muscle, and bone. It churns out rich red blood that carries nutrients and oxygen to remote outposts, and it sends nerve signals skipping along thousands of miles of brain and body pathways. It also formulates chemical messengers that shuttle from one organ to another, issuing the instructions that help sustain your life.

But to do all this, your body requires some raw materials. These include at least 30 vitamins, minerals, and dietary components that your body needs but cannot manufacture on its own in sufficient amounts.

Vitamins and minerals are considered essential nutrients—because acting in concert, they perform hundreds of roles in the body. They help shore up bones, heal wounds, and bolster your immune system. They also convert food into energy, and repair cellular damage.

But trying to keep track of what all these vitamins and minerals do can be confusing. Read enough articles on the topic, and your eyes may swim with the alphabet-soup references to these nutrients, which are known mainly be their initials (such as vitamins A,B,C,D,E, and K—to name just a few).

In this article, you'll gain a better understanding of what these vitamins and minerals actually do in the body and why you want to make sure you're getting enough of them.

Micronutrients with a big role in the body

Vitamins and minerals are often called micronutrients because your body needs only tiny amounts of them. Yet failing to get even those small quantities virtually guarantees disease. Here are a few examples of diseases that can result from vitamin deficiencies:

- **Scurvy.** Old-time sailors learned that living for months without fresh fruits or vegetables—the main sources of vitamin C—causes the bleeding gums and listlessness of scurvy.
- **Blindness.** In some developing countries, people still become blind from vitamin A deficiency.
- **Rickets.** A deficiency in vitamin D can cause rickets, a condition marked by soft, weak bones that can lead to skeletal deformities such as bowed legs. Partly to combat rickets, the U.S. has fortified milk with vitamin D since the 1930s.

Just as a lack of key micronutrients can cause substantial harm to your body, getting sufficient quantities can provide a substantial benefit. Some examples of these benefits:

- **Strong bones.** A combination of calcium, vitamin D, vitamin K, magnesium, and phosphorus protects your bones against fractures.
- **Prevents birth defects.** Taking folic acid supplements early in pregnancy helps prevent brain and spinal birth defects in offspring.
- **Healthy teeth.** The mineral fluoride not only helps bone formation but also keeps dental cavities from starting or worsening.

The difference between vitamins and minerals

Although they are all considered micronutrients, vitamins and minerals differ in basic ways. Vitamins are organic and can be broken down by heat, air, or acid. Minerals are inorganic and hold on to their chemical structure.

So why does this matter? It means the minerals in soil and water easily find their way into your body through the plants, fish, animals, and fluids you consume. But it's tougher to shuttle vitamins from food and other sources into your body because cooking, storage, and simple exposure to air can inactivate these more fragile compounds.

Interacting—in good ways and bad

Many micronutrients interact. Vitamin D enables your body to pluck calcium from food

sources passing through your digestive tract rather than harvesting it from your bones. Vitamin C helps you absorb iron.

The interplay of micronutrients isn't always cooperative, however. For example, vitamin C blocks your body's ability to assimilate the essential mineral copper. And even a minor overload of the mineral manganese can worsen iron deficiency.

A closer look at water-soluble vitamins

Water-soluble vitamins are packed into the watery portions of the foods you eat. They are absorbed directly into the bloodstream as food is broken down during digestion or as a supplement dissolves.

Because much of your body consists of water, many of the water-soluble vitamins circulate easily in your body. Your kidneys continuously regulate levels of water-soluble vitamins, shunting excesses out of the body in your urine.

Water-soluble vitamins

(Click on the links below for more information from the Harvard School of Public Health nutrition source website)

B vitamins

- Biotin (vitamin B7)
- Folic acid (folate, vitamin B9)
- Niacin (vitamin B3)
- Pantothenic acid (vitamin B5
- Riboflavin (vitamin B2)
- Thiamin (vitamin B1)
- Vitamin B6
- Vitamin B12

Vitamin C

What they do

Although water-soluble vitamins have many tasks in the body, one of the most important is helping to free the energy found in the food you eat. Others help keep tissues healthy. Here are some examples of how different vitamins help you maintain health:

- **Release energy.** Several B vitamins are key components of certain coenzymes (molecules that aid enzymes) that help release energy from food.
- **Produce energy.** Thiamin, riboflavin, niacin, pantothenic acid, and biotin engage in energy production.
- **Build proteins and cells.** Vitamins B6, B12, and folic acid metabolize amino acids (the building blocks of proteins) and help cells multiply.
- **Make collagen.** One of many roles played by vitamin C is to help make collagen, which knits together wounds, supports blood vessel walls, and forms a base for teeth and bones.

Words to the wise

Contrary to popular belief, some water-soluble vitamins can stay in the body for long periods of time. You probably have several years' supply of vitamin B12 in your liver. And even folic acid and vitamin C stores can last more than a couple of days.

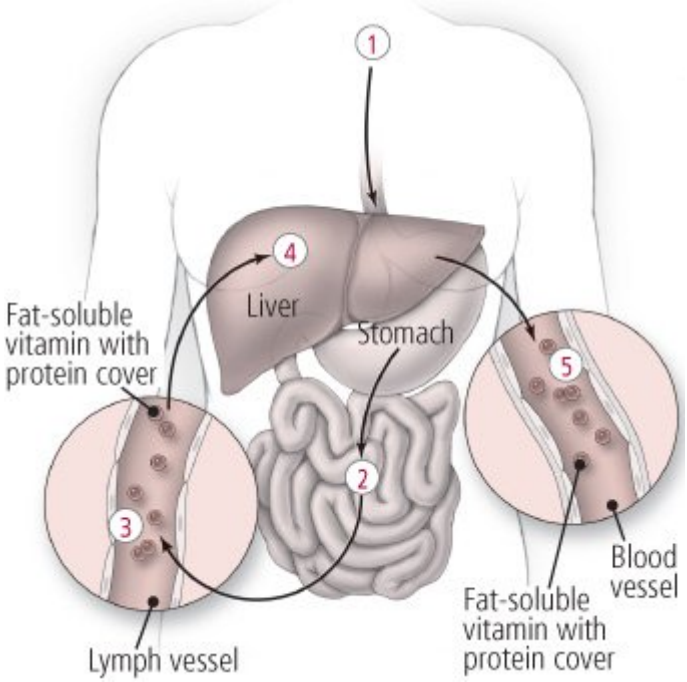
Generally, though, water-soluble vitamins should be replenished every few days.

Just be aware that there is a small risk that consuming large amounts of some of these micronutrients through supplements may be quite harmful. For example, very high doses of B6—many times the recommended amount of 1.3 milligrams (mg) per day for adults—can damage nerves, causing numbness and muscle weakness.

A closer look at fat-soluble vitamins

Rather than slipping easily into the bloodstream like most water-soluble vitamins, fat-soluble vitamins gain entry to the blood via lymph channels in the intestinal wall (see illustration). Many fat-soluble vitamins travel through the body only under escort by proteins that act as carriers.

Absorption of fat-soluble vitamins



1. Food containing fat-soluble vitamins is ingested.
2. The food is digested by stomach acid and then travels to the small intestine, where it is digested further. Bile is needed for the absorption of fat-soluble vitamins. This substance, which is produced in the liver, flows into the small intestine, where it breaks down fats. Nutrients are then absorbed through the wall of the small intestine.
3. Upon absorption, the fat-soluble vitamins enter the lymph vessels before making their way into the bloodstream. In most cases, fat-soluble vitamins must be coupled with a protein in order to travel through the body.
4. These vitamins are used throughout the body, but excesses are stored in the liver and fat tissues.
5. As additional amounts of these vitamins are needed, your body taps into the reserves, releasing them into the bloodstream from the liver.

Fatty foods and oils are reservoirs for the four fat-soluble vitamins. Within your body, fat tissues and the liver act as the main holding pens for these vitamins and release them as needed.

To some extent, you can think of these vitamins as time-release micronutrients. It’s possible to consume them every now and again, perhaps in doses weeks or months apart rather than daily, and still get your fill. Your body squirrels away the excess and doles it out gradually to meet your needs.

Fat-soluble vitamins

(Click on the links below for more information from the Harvard School of Public Health nutrition source website)

- Vitamin A
- Vitamin D
- Vitamin E
- Vitamin K

What they do

Together this vitamin quartet helps keep your eyes, skin, lungs, gastrointestinal tract, and nervous system in good repair. Here are some of the other essential roles these vitamins play:

- **Build bones.** Bone formation would be impossible without vitamins A, D, and K.
- **Protect vision.** Vitamin A also helps keep cells healthy and protects your vision.
- **Interact favorably.** Without vitamin E, your body would have difficulty absorbing and storing vitamin A.
- **Protect the body.** Vitamin E also acts as an antioxidant (a compound that helps protect the body against damage from unstable molecules).

Words to the wise

Because fat-soluble vitamins are stored in your body for long periods, toxic levels can build up. This is most likely to happen if you take supplements. It's very rare to get too much of a vitamin just from food.

A closer look at major minerals

The body needs, and stores, fairly large amounts of the major minerals. These minerals are no more important to your health than the trace minerals; they're just present in your body in greater amounts.

Major minerals travel through the body in various ways. Potassium, for example, is quickly absorbed into the bloodstream, where it circulates freely and is excreted by the kidneys, much like a water-soluble vitamin. Calcium is more like a fat-soluble vitamin because it requires a carrier for absorption and transport.

Major minerals

- Calcium
- Chloride
- Magnesium
- Phosphorus
- Potassium
- Sodium
- Sulfur

What they do

One of the key tasks of major minerals is to maintain the proper balance of water in the body. Sodium, chloride, and potassium take the lead in doing this. Three other major minerals—calcium, phosphorus, and magnesium—are important for healthy bones. Sulfur helps stabilize protein structures, including some of those that make up hair, skin, and nails.

Words to the wise

Having too much of one major mineral can result in a deficiency of another. These sorts of imbalances are usually caused by overloads from supplements, not food sources. Here are two examples:

- **Salt overload.** Calcium binds with excess sodium in the body and is excreted when the body senses that sodium levels must be lowered. That means that if you ingest too much sodium through table salt or processed foods, you could end up losing needed calcium as your body rids itself of the surplus sodium.
- **Excess phosphorus.** Likewise, too much phosphorus can hamper your ability to absorb magnesium.

A closer look at trace minerals

A thimble could easily contain the distillation of all the trace minerals normally found in your body. Yet their contributions are just as essential as those of major minerals such as calcium and phosphorus, which each account for more than a pound of your body weight.

Trace minerals

- Chromium
- Copper

- Fluoride
- Iodine
- Iron
- Manganese
- Molybdenum
- Selenium
- Zinc

What they do

Trace minerals carry out a diverse set of tasks. Here are a few examples:

- Iron is best known for ferrying oxygen throughout the body.
- Fluoride strengthens bones and wards off tooth decay.
- Zinc helps blood clot, is essential for taste and smell, and bolsters the immune response.
- Copper helps form several enzymes, one of which assists with iron metabolism and the creation of hemoglobin, which carries oxygen in the blood.

The other trace minerals perform equally vital jobs, such as helping to block damage to body cells and forming parts of key enzymes or enhancing their activity.

Words to the wise

Trace minerals interact with one another, sometimes in ways that can trigger imbalances. Too much of one can cause or contribute to a deficiency of another. Here are some examples:

- A minor overload of manganese can exacerbate iron deficiency. Having too little can also cause problems.
- When the body has too little iodine, thyroid hormone production slows, causing sluggishness and weight gain as well as other health concerns. The problem worsens if the body also has too little selenium.

The difference between “just enough” and “too much” of the trace minerals is often tiny. Generally, food is a safe source of trace minerals, but if you take supplements, it’s important to make sure you’re not exceeding safe levels.

A closer look at antioxidants

Antioxidant is a catchall term for any compound that can counteract unstable molecules such as free radicals that damage DNA, cell membranes, and other parts of cells.

Your body cells naturally produce plenty of antioxidants to put on patrol. The foods you eat—and, perhaps, some of the supplements you take—are another source of antioxidant compounds. Carotenoids (such as lycopene in tomatoes and lutein in kale) and flavonoids (such as anthocyanins in blueberries, quercetin in apples and onions, and catechins in green tea) are antioxidants. The vitamins C and E and the mineral selenium also have antioxidant properties.

Why free radicals may be harmful

Free radicals are a natural byproduct of energy metabolism and are also generated by ultraviolet rays, tobacco smoke, and air pollution. They lack a full complement of electrons, which makes them unstable, so they steal electrons from other molecules, damaging those molecules in the process.

Free radicals have a well-deserved reputation for causing cellular damage. But they can be helpful, too. When immune system cells muster to fight intruders, the oxygen they use spins off an army of free radicals that destroys viruses, bacteria, and damaged body cells in an oxidative burst. Vitamin C can then disarm the free radicals.

How antioxidants may help

Antioxidants are able to neutralize marauders such as free radicals by giving up some of their own electrons. When a vitamin C or E molecule makes this sacrifice, it may allow a crucial protein, gene, or cell membrane to escape damage. This helps break a chain reaction that can affect many other cells.

It is important to recognize that the term “antioxidant” reflects a chemical property rather than a specific nutritional property. Each of the nutrients that has antioxidant properties also has numerous other aspects and should be considered individually. The context is also important—in some settings, for example, vitamin C is an antioxidant, and in others it can be a pro-oxidant.

Words to the wise

Articles and advertisements have touted antioxidants as a way to help slow aging, fend off heart disease, improve flagging vision, and curb cancer. And laboratory studies and many large-scale observational trials (the type that query people about their eating habits and supplement use and then track their disease patterns) have noted benefits from diets rich in certain antioxidants and, in some cases, from antioxidant supplements.

But results from randomized controlled trials (in which people are assigned to take specific nutrients or a placebo) have failed to back up many of these claims. One study that pooled

results from 68 randomized trials with over 230,000 participants found that people who were given vitamin E, beta carotene, and vitamin A had a higher risk of death than those who took a placebo. There appeared to be no effect from vitamin C pills and a small reduction in mortality from selenium, but further research on these nutrients is needed.

These findings suggest little overall benefit of the antioxidants in pill form. On the other hand, many studies show that people who consume higher levels of these antioxidants in food have a lower risk of many diseases.

The bottom line? Eating a healthy diet is the best way to get your antioxidants.

Adapted with permission from *Making Sense of Vitamins and Minerals: Choosing the foods and nutrients you need to stay healthy*, a special health report published by Harvard Health Publishing.