
The Small Molecules That Make Life Work

By Gigi Reed, MD September 3, 2026

Vitamins are often marketed as simple add-ons to a healthy lifestyle—something to take with breakfast, perhaps, or when we feel run down. Biologically, however, they are far more important and more interesting than that.

A vitamin is an organic compound needed in very small amounts for normal growth, metabolism, and tissue function. The body either cannot manufacture it at all or cannot make enough to meet its needs. For that reason, vitamins generally must come from food, fortified products, or supplements. A few have special exceptions: vitamin D can be produced in the skin from sunlight exposure, for example, and intestinal microbes can contribute to vitamin K production.

Unlike carbohydrates, fats, proteins, and alcohol, vitamins provide no calories. They are not fuel. Instead, they enable the chemical and regulatory processes that allow cells—and therefore organs and the whole body—to function.

Many vitamins serve as coenzymes, meaning they help enzymes carry out essential chemical reactions. The B-complex vitamins are particularly important in this role. Niacin, or vitamin B3, participates in cellular energy-transfer reactions. Folate, vitamin B9, is indispensable for DNA synthesis and normal cell division. Other vitamins act more like hormones. Vitamin D helps regulate gene transcription, calcium and phosphate balance, and bone metabolism. Vitamin C and vitamin E also have antioxidant or redox-active functions, helping protect cells from certain forms of oxidative injury.

When vitamin-dependent biochemical pathways fail, the results can be dramatic. Vitamin C deficiency causes scurvy, once a notorious disease of sailors deprived of fresh fruits and vegetables on long sea voyages. Folate deficiency can cause megaloblastic anemia and, in early pregnancy, raises the risk of neural-tube defects in a developing fetus. Too little vitamin D may lead to rickets in children or osteomalacia in adults. Vitamin A deficiency can impair the eye's ability to adapt to darkness.

Vitamins are usually divided into two practical groups: water-soluble and fat-soluble.

The water-soluble group includes vitamin C and the B vitamins: thiamin (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), vitamin B6, biotin (B7), folate or folic acid (B9), and vitamin B12, also called cobalamin. These vitamins circulate in body fluids, and excess amounts of many are eliminated in urine. That is why regular dietary intake is important. However, “water-soluble” does not automatically mean harmless; large doses of some B vitamins can still cause problems.

The fat-soluble vitamins are A, D, E, and K. They are absorbed with dietary fat and depend on bile salts and normal intestinal fat absorption. Conditions such as cholestatic liver disease, pancreatic insufficiency, celiac disease, inflammatory bowel disease, or altered anatomy after bariatric surgery can interfere with absorption.

Because fat-soluble vitamins can be stored—especially in the liver and adipose tissue—deficiency may develop more slowly. But storage also brings a caution: chronic excess can accumulate and become toxic.

Risk rises when people combine a high-dose single vitamin with a multivitamin and heavily fortified foods or drinks; use “megadose” products; take several supplements with overlapping ingredients; or continue supplements for months or years without adding up their total daily dose. Prescription-strength products, liver or kidney disease, altered metabolism, and inaccurately labeled or unusually concentrated preparations may add further risk.

The history of vitamins began with an especially revealing nutritional disease: beriberi. At the turn of the 20th century, beriberi was common in populations relying heavily on polished white rice. In 1911, Dr. Casimir Funk built on observations that birds fed polished rice developed paralysis resembling beriberi, but recovered when given rice bran or the unpolished hulls. He isolated a substance from rice bran that could cure affected pigeons.

Because the substance was an amine and seemed vital to life, Funk called it a “vitamine.” The name persisted even after scientists learned that not all vitamins are amines. That substance became known as vitamin B1—thiamin.

Thiamin remains clinically important today. Heavy alcohol use can impair thiamin intake, absorption, storage, and utilization. For that reason, people with alcohol use disorder are commonly given thiamin supplementation, particularly during illness, withdrawal, hospitalization, or nutritional rehabilitation. It is a small molecule with a large role: helping the nervous system, heart, and cellular energy metabolism keep working.

Raw raw for vitamins!