Dear Reader,

Welcome to the new, revised and updated edition of The Truth About Vitamins and Minerals: Choosing the nutrients you need to stay healthy. This edition provides the latest on recommended dietary intakes, as well as new findings on how vitamins, minerals, and other dietary components may influence health—including potential differences when getting these compounds from foods versus multivitamins or supplements. You’ll learn, among other things:

- How B vitamins might slow cognitive decline in the elderly;
- How vitamin C might help lower blood pressure;
- How the combination of vitamin A and dietary omega-3 fatty acids may affect retinitis pigmentosa;
- The results of several new studies on vitamin D, and whether or not we are getting enough of it.

Here in the United States, most of us are fortunate to have access to a diverse and relatively inexpensive food supply. And some of the healthiest foods—vitamin-rich fruits and vegetables—can also be quite affordable. According to a national shopping survey, dozens of fruits and vegetables cost 25 cents or less per serving. For about a dollar, you can meet the government’s recommendation to eat five pieces of produce daily, which is less than many people happily spend on a single cup of coffee.

About half of Americans routinely take dietary supplements, the most common being multivitamin and multimineral supplements. Yet, as this report will explain, there is no compelling evidence to support this practice. Taking pills does not make up for bad eating habits. And the fact that Americans spend $28 billion a year on nutritional supplements from bottles is more a measure of good marketing than of robust health.

The evidence for the health benefits of vitamins and minerals comes from experiments in animals, large observational studies following people’s habits and their health over decades, and trials that compare the effect of a specific supplement to a placebo with respect to disease risk.

This report explains the different types of studies used to assess the benefits and safety profiles of various nutrients. It also includes the recommended minimum and maximum amounts of the vitamins and minerals you should consume, as well as good food sources of each.

The take-home message? Spend your time and money improving your diet, which is far more likely to pay off in the long run than popping a pill.

Dariush Mozaffarian, M.D., Dr.P.H. Medical Editor

Vitamins and minerals: The basics

Every day, your body produces skin, muscle, and bone. It makes tens of thousands of rich red blood cells
that carry nutrients and oxygen to every cell in your body, and multitudes of white blood cells to fight invaders. Your nerves send electrical signals skipping along thousands of miles of brain and body pathways, and your tissues formulate protein and fatty acid chemical messengers that shuttle from organ to organ, issuing the orders that orchestrate and sustain your life.

To do all this, your body requires many different 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 (see Tables 1 and 2). Acting in concert, these essential compounds perform thousands of roles in the body, ranging from shoring up bones and healing wounds to boosting your immune system, converting food into energy, and repairing cell and tissue damage.

These essential 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. British sailors learned centuries ago that living for months without fresh fruits or vegetables—the main sources of vitamin C—causes the bleeding gums and listlessness of scurvy. In many low-income countries, people suffer from numerous vitamin and mineral deficiencies, such as blindness from vitamin A deficiency.

Fortunately, true deficiency of vitamins and minerals is rare in the United States, due to fortification of some nutrients and our extensive supply of inexpensive food. However, eating less of several key vitamins, minerals, and other compounds is still linked to other major chronic diseases, such as heart disease, diabetes, cancers, osteoporosis, and other conditions. Concern for such “insufficiency” is a major driver of both U.S. dietary guidelines and the mass marketing of over-the-counter supplements and herbal remedies.

This report focuses on the evidence for health effects of vitamins and minerals, as well as recommendations for supplementation, in the context of modern diets seen in the United States and similar countries. There is a clear role for vitamin or mineral supplements in treating specific deficiency diseases that are still common in many developing countries; these issues are not reviewed here.

Vitamins, minerals, and other micronutrients don’t perform their health-enhancing activities in isolation. 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. But the interplay of micronutrients isn't always cooperative. For example, too much vitamin C can block your body's ability to assimilate the essential mineral copper. And even a minor overload of the mineral manganese can worsen iron deficiency.

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. That 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.

The essential micronutrients fall into the following categories: water-soluble vitamins, fat-soluble vitamins, major minerals, and trace minerals. Many vitamins and some minerals are classified as antioxidants—a term that's widely used but often misunderstood. This report also reviews other key dietary compounds that have important health effects in small quantities, such as omega-3 fatty acids from seafood.

The following sections sketch out what micronutrients do, where they are found, and how they travel into and through the body. Key information on each micronutrient also appears in Tables 1 and 2.

**Water-soluble vitamins**

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. Several B vitamins are key components of certain coenzymes (molecules that aid enzymes) that help release that energy. Thiamin, riboflavin, niacin, pantothenic acid, and biotin engage in energy production. Vitamins B6, B12, and folic acid metabolize amino acids (the building blocks of proteins) and help cells multiply. 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.
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. (One exception is vitamin B6, which is mostly stored in muscle tissue.) Your kidneys continuously regulate levels of water-soluble vitamins, shunting excesses out of the body in your urine.

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.

Because your kidneys can eliminate excess water-soluble vitamins in the urine, there is relatively small risk that consuming large amounts of some of these micronutrients through supplements may be harmful. Still, there are exceptions. One example is very high doses of B6—such as eating many times the recommended daily amount of 1.3 milligrams (mg) for adults—which can damage nerves, causing numbness and muscle weakness (see “B bonanza: Boon or bust?”).

**Water-soluble vitamins**

- 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

**Fat-soluble vitamins**

In contrast to water-soluble vitamins, which easily move from the bloodstream to your cells and are excreted in urine, fat-soluble vitamins need special pathways and carriers to shuttle them around the body. After being consumed in the diet, fat-soluble vitamins gain entry to the bloodstream via lymph channels in the intestinal wall (see Figure 1). Most fat-soluble vitamins travel through the body only under the escort of special fat-binding proteins, which act as carriers to allow these vitamins to interact with water-rich blood and cells.
Figure 1: 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.

Three of the four main fat-soluble vitamins are vitamins A, D, and K, without which bone formation would be impossible. Vitamin A also helps keep cells healthy and protects your vision. Without vitamin E, the fourth fat-soluble vitamin, your body would have difficulty absorbing and storing vitamin A. Vitamin E also acts as an antioxidant (a compound that helps protect the body against damage from unstable molecules). Together the quartet helps keep your eyes, skin, lungs, gastrointestinal tract, and nervous system in good repair.

Fat-soluble vitamins are stored in your fat tissues and your liver, which together 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. Because these vitamins are stored for long periods, however, toxic levels can build up. As a result, potential toxicity from fat-soluble vitamins is much more common than for water-soluble vitamins. However, this is most likely to happen if you take high doses of supplements. It's very rare to get too much of any vitamin just from food.

**Fat-soluble vitamins**

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

**Major minerals**

The body needs and stores fairly large amounts of major minerals, including sodium, chloride, potassium, calcium, phosphorus, and magnesium. These minerals are no more or less important to your health than the trace minerals; they're just present in your body in greater amounts. One of their key tasks is maintaining the proper electrical balance of all the cell membranes in your body, which are essential for cell signaling and transport of nutrients and messengers into and out of cells. Sodium, chloride, and potassium take the lead in doing this. Three other major minerals—calcium, phosphorus, and magnesium—have similar activities and are also important for healthy bones. Sulfur helps stabilize protein structures, including some of those that make up hair, skin, and nails.

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. In contrast, calcium requires a carrier for absorption and transport.

Having too much of one major mineral can result in a deficiency of another. 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. Likewise, too much phosphorus can hamper your ability to absorb magnesium. These sorts of imbalances are usually caused by overloads from supplements, not food sources.

**Major minerals**

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

**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 carry out a diverse set of tasks. Iron, for example, is best known for ferrying oxygen throughout the body, while 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.

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; for example, a minor overload of manganese can exacerbate iron deficiency. Having too little of one of these minerals 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 relatively small. 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.

**Trace minerals**

• Chromium
• Copper
• Fluoride
• Iodine
• Iron
• Manganese
• Molybdenum
• Selenium
• Zinc

**Understanding antioxidants**

“Antioxidant” is a general term for any compound that can counteract free radicals or similar unstable molecules that damage DNA, cell membranes, and other parts of cells. Free radicals are a natural byproduct of energy metabolism and are also generated by many environmental insults, such as tobacco smoke, ultraviolet rays, and air pollution. Because free radicals lack a full complement of electrons, they are unstable, stealing electrons from other molecules and damaging those molecules in the process.

When they are created in excess from toxic insults, free radicals have a well-deserved reputation for causing cellular damage. But they are an important part of many normal cell processes. 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. Antioxidants such as vitamin C can then disarm the free radicals. Some normal production of free radicals also occurs during exercise, which appears to be necessary to induce some of the beneficial effects of regular physical activity, such as sensitizing your muscle cells to insulin.

Antioxidants are able to neutralize free radicals by giving up some of their own electrons. When a vitamin C or E molecule makes this sacrifice, it acts as a natural “off” switch for the free radicals. This helps break a chain reaction that can affect other molecules in the cell and other cells in the body. 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—for example, in some settings vitamin C is an antioxidant, and in others it can be a pro-oxidant.

Your body’s 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 flavanols in cocoa, 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.

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 of antioxidant supplements (in which people are assigned to take specific nutrient supplements or a placebo) have failed to back up many of these claims. (see “Making sense of scientific studies,” for more detail on different types of research studies.)

A study that pooled results from 68 randomized trials with over 230,000 participants offered further evidence that taking antioxidant supplements is unlikely to help you live longer—and, in fact, that some supplements may even be harmful. After reviewing the literature, the authors found that people who were given vitamin E, beta carotene, and vitamin A supplements had a higher risk of death than those who took a placebo. There appeared to be no harm—or benefit—from vitamin C pills, and a possible small reduction in mortality from selenium pills, but further research on these nutrients is needed. Another pooled analysis of randomized trials found that people given calcium supplements had higher risk of heart attacks. Together, 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 from foods have a lower risk of many diseases, so eating a healthy diet (see “Special section: Does your diet deliver the daily recommended dose?”) is the best way to get your antioxidants.

Federal guidelines

In 1941, the U.S. Food and Nutrition Board published the first in a series of reports on Recommended Dietary Allowances (RDAs). These reports were directly inspired by concern for nutrient deficiencies, which in the early 20th century were still relatively common in the United States, and which the government and nutrition experts worried could be worsened by food shortages caused by the Great Depression and World War II. The RDAs then formed the foundation for the first U.S. Dietary Guidelines for Americans.

This process—setting RDAs based on concern for nutrient deficiencies, and then using these to form the dietary guidelines—has continued with relatively little change over the last 70 years. Although this has contributed to success at largely eliminating nutrient deficiencies in the United States, it has also had unintended consequences. At the same time that simple nutrient deficiencies have disappeared, complex chronic diseases have exploded, including cardiovascular diseases, obesity, diabetes, cancers, and many other conditions. The isolated focus of the RDAs on single nutrients—which works so well for preventing nutrient deficiency diseases—appears to have little relevance for preventing other major, complex, chronic diseases.
The setting of RDAs is now a highly complex—and expensive—process. New RDAs, or even the revision of an existing RDA, can only be set by the Institute of Medicine, an independent scientific organization, and only after it receives a special commission and special funding from the U.S. government. The process is lengthy, and pricey, taking up to two to three years and millions of dollars to revise a single RDA. (The most recent RDA revision was for vitamin D—see “Vitamin D”).

Because RDAs were designed only to prevent clinical nutrient deficiencies, they apply only to a limited set of specific nutrients and their corresponding nutrient deficiency diseases. To set guidelines for appropriate intakes of other nutrients, other criteria have been developed, such as AIs, or “adequate intakes” (see “A primer on vitamin value abbreviations”). Together, these sets of different criteria for nutrient intakes are called the Dietary Reference Intake (DRI) values.

The DRIs are intended to be evidence-based standards that go beyond amending single nutrient deficiencies: they also suggest the amounts of nutrients needed for preventing complex chronic diseases and enhancing health. These DRIs drive the U.S. Dietary Guidelines, which then determine what is served in school lunch programs, government workplaces, jails, and the supplemental nutrition assistance program (formerly known as food stamps). To help people apply these vitamin and mineral guidelines to their daily food choices, the FDA created the “Nutrition Facts” panel that appears on almost all packaged foods (see Figure 2).
Nearly every packaged food or beverage you toss into your shopping cart will have a printed Nutrition Facts panel, which includes a mandated list of selected nutrients contained in the product. This includes the gram or milligram amounts and the percentages of Daily Values of a selected nutrient in a single serving of the food or drink, as well as other information such as serving size, calories per serving, and amounts of fat, sodium, carbohydrate, and protein. Note that only a limited set of nutrients are included. For example, there is no information on potassium, magnesium, omega-3 fatty acids, other polyunsaturated fatty acids, selenium, B vitamins, vitamin K, and so on.

When you read nutrition labels, bear in mind that the extent of food processing, the quality of the carbohydrate, and the right kinds of fat are as important as—if not more important than—vitamin and mineral content. It is challenging to glean all this from the Nutrition Facts panel. For example, to assess carbohydrate quality, a simple rule of thumb is to look for no more than 10 grams of total carbohydrate for

![Nutrition Facts Panel](image)

**Figure 2: A sample Nutrition Facts panel**
every 1 grams of fiber (a “10 to 1 ratio” or lower). In the label shown in Figure 2, there are 31 grams of carbohydrate and zero grams of fiber—the ratio is 31 to zero, or “infinity”! If there were 2 grams of fiber, the ratio would be 31 to 2, or about 15 to 1—still higher than 10 to 1. Looking for a 10 to 1 ratio is not a perfect rule of thumb, but it helps to capture the overall quality of the carbohydrate in any product. If you really want to maximize carbohydrate quality, even better than a 10 to 1 ratio is a 5 to 1 ratio—in other words, no more than 5 g of carbohydrate for every 1 g of fiber. For instance, if the product shown here had 6 g of fiber, the ratio would be 31 to 6, or about 5 to 1—a very good ratio.

Even more important than the nutrition label is your overall dietary pattern. If you eat plenty of whole, minimally processed foods—fruits, vegetables, nuts, whole grains, fish, vegetable oils, and modest dairy—there’s little need to become a nutrition label mathematician.

A primer on vitamin value abbreviations

Most people have heard of Recommended Dietary Allowances, the nutrition labeling guidelines established and used by the Food and Nutrition Board of the National Academy of Sciences for 70 years. But how do they differ from DRIs and DVs? And what are ULs and AIs? Reading nutrition labels and recommendations today involves interpreting an alphabet soup of abbreviations. Here’s some help.

Recommended Dietary Allowance (RDA): This value refers to the average minimum amount of a specific nutrient needed to prevent clinical nutrient deficiency in almost all healthy people in a particular life stage and gender group. Because RDAs only apply to a selected set of nutrients and nutrient deficiency diseases, today RDAs are a subset of the broader dietary reference intake values (see below).

Dietary reference intake (DRI): Introduced in 1997, DRI values were created to allow guidelines for a broader range of nutrients and minerals, not to only prevent nutrient deficiencies, but also to enhance health and reduce the risk of chronic diseases such as osteoporosis, cancer, and cardiovascular diseases. DRIs include RDAs, AIs, ULs, and EARs. DRIs are what drive the U.S. Dietary Guidelines and food labeling regulations.

Adequate intake (AI): This value is determined as a range of recommended intake (rather than just a minimum), and is used for nutrients for which there is not a specific clinical deficiency disease, such as the recommended amounts of vitamin K, manganese, or potassium.

Tolerable upper intake level (UL): This is the recommended maximum amount of a nutrient that is considered safe to consume for an extended period by the population, including sensitive subgroups. Exceeding the UL does not mean that harmful effects will always occur; rather, the more a person exceeds the UL, the greater the potential risk of adverse effects.

Estimated average requirement (EAR): This is the amount of a nutrient that is estimated to meet the requirement of half of all healthy people in a particular life stage and gender group to prevent clinical nutrient deficiency. EARs are used as the basis for the RDA, and as such, apply to a relatively limited set of nutrients and their corresponding nutrient deficiency disease.

Daily Value (DV): This reference number, developed by the FDA, is designed to help consumers determine if a food contains a lot or a little of a specific nutrient, based on the DRI for that nutrient. DVs don't take your age, sex, or various other factors into account. They're based on the highest average daily allowance value and are presented as percentages of total daily intake, calculated for a person eating 2,000 calories a day.

Tables 1 and 2 can give you a better understanding of how particular vitamins and minerals work in your body, how much of each nutrient you need every day, and what types of food to eat to ensure that you are getting an adequate supply. When reading the tables, note the following:

- The recommendations vary by age and sex (“M” stands for men, “W” for women). These tables apply to adults ages 19 and over. If you are younger, or if you are pregnant or nursing, these recommendations don't necessarily apply; ask your doctor about what's appropriate for you.
- DRIs are generally going to be either RDAs (for selected nutrients) or AIs (for most other nutrients). The difference lies in the presence or absence of a clinical deficiency disease for the given nutrient (see "A primer on vitamin value abbreviations")—not in the importance of the nutrient for general health in the modern U.S. diet.

- Pay attention to the column that lists the UL, which is the tolerable upper intake level. This is the maximum daily amount of a nutrient considered safe if consumed regularly. Beyond that limit, there is a rising risk for side effects, some of which can be serious. An upper limit hasn't been established for some nutrients; however, it's important to realize that very large amounts of these nutrients could still be harmful. Food sources of nutrients are almost never a problem. People run into trouble mostly through taking high doses of supplements.

Table 1: Recommended amounts of vitamins

<table>
<thead>
<tr>
<th>Vitamin (common names) and benefits</th>
<th>RDA or AI*</th>
<th>UL</th>
<th>Good food sources</th>
<th>Did you know?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vitamin A</strong> (retinol, retinal, and retinoic acid—three active forms of vitamin A in the body—are retinoids, called “preformed” vitamin A; the body can also easily convert a precursor, beta carotene, to vitamin A as needed)</td>
<td>Men: 900 mcg (3,000 IU)</td>
<td>3,000 mcg (about 10,000 IU)</td>
<td>Sources of retinoids: beef, liver, eggs, shrimp, fish, fortified milk, Cheddar cheese, Swiss cheese</td>
<td>- Large amounts of supplemental, or preformed, vitamin A (but not beta carotene) can be harmful to bones.</td>
</tr>
<tr>
<td></td>
<td>Women: 700 mcg (2,333 IU)</td>
<td></td>
<td>Sources of beta carotene: sweet potatoes, carrots, pumpkins, squash, spinach, mangoes, turnip greens</td>
<td>- Smokers should avoid beta carotene supplements to avoid increasing their risk of lung cancer.</td>
</tr>
<tr>
<td></td>
<td>Some supplements report vitamin A in IU.</td>
<td></td>
<td></td>
<td>- The carotenoid lycopene may lower the risk of prostate cancer, and possibly the risk of some other types of cancer, although as yet there is no definitive proof.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Foods rich in the carotenoids lutein and zeaxanthin may protect against cataracts.</td>
</tr>
</tbody>
</table>

The following recommendations are based largely on guidelines from the Institute of Medicine. Recommended amounts may be expressed in milligrams (mg), micrograms (mcg), or international units (IU), depending on the nutrient. Unless specified, values represent those for adults ages 19 and older.
<table>
<thead>
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<th>Vitamin (common names) and benefits</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Thiamin</strong> (vitamin B1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Helps convert food into energy</td>
<td><strong>M: 1.2 mg</strong></td>
<td>Not known</td>
<td>Pork chops, ham, soy milk, watermelons, acorn squash</td>
<td>Thiamin deficiency can occur with chronic, heavy alcohol consumption, leading to a condition called Wernicke-Korsakoff syndrome.</td>
</tr>
<tr>
<td>• Needed for healthy skin, hair, muscles, and brain</td>
<td><strong>W: 1.1 mg</strong></td>
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</tr>
<tr>
<td><strong>Riboflavin</strong> (vitamin B2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Helps convert food into energy</td>
<td><strong>M: 1.3 mg</strong></td>
<td>Not known</td>
<td>Milk, yogurt, cheese, whole and enriched grains and cereals, liver</td>
<td>Most Americans get the RDA for riboflavin, mostly from milk and milk beverages. Riboflavin is destroyed by light, which is why most milk is sold in opaque containers.</td>
</tr>
<tr>
<td>• Needed for healthy skin, hair, blood, and brain</td>
<td><strong>W: 1.1 mg</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Niacin</strong> (vitamin B3, nicotinic acid)</td>
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<tr>
<td>• Helps convert food into energy</td>
<td><strong>M: 16 mg</strong></td>
<td>35 mg</td>
<td>Meat, poultry, fish, fortified and whole grains, mushrooms, potatoes, peanut butter</td>
<td>Niacin occurs naturally in food and can also be made by your body from the amino acid tryptophan, with the help of B6.</td>
</tr>
<tr>
<td>• Essential for healthy skin, blood cells, brain, and nervous system</td>
<td><strong>W: 14 mg</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pantothenic acid</strong> (vitamin B5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Helps convert food into energy</td>
<td>5 mg</td>
<td>Not known</td>
<td>Wide variety of nutritious foods, including chicken, whole grains, broccoli, mushrooms, avocados, tomato products</td>
<td>The name pantothenic comes from the Greek word <em>pantothen</em>, meaning “from all sides”—a nod to its wide availability in many foods. Deficiencies are very rare.</td>
</tr>
<tr>
<td>• Helps make lipids (fats), neurotransmitters, steroid hormones, and hemoglobin</td>
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</table>

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<tr>
<td><strong>Vitamin B6</strong> (pyridoxal, pyridoxine, pyridoxamine)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Aids in lowering homocysteine levels; not clear whether it reduces heart disease risk</td>
<td></td>
<td></td>
<td>Vitamin B6 has been promoted as a treatment for carpal tunnel syndrome and premenstrual syndrome, but studies do not support any benefit for these conditions.</td>
</tr>
<tr>
<td></td>
<td>• Helps convert tryptophan to niacin and serotonin, a neurotransmitter that plays key roles in sleep, appetite, and moods</td>
<td></td>
<td>Meat, fish, poultry, legumes, tofu and other soy products, potatoes, non-citrus fruits such as bananas and watermelons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Helps make red blood cells</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• Influences cognitive abilities and immune function</td>
<td></td>
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<tr>
<td><strong>Ages 19–50:</strong></td>
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</tr>
<tr>
<td>M: 1.3 mg</td>
<td>W: 1.3 mg</td>
<td>100 mg</td>
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<tr>
<td><strong>51+:</strong></td>
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<tr>
<td>M: 1.7 mg</td>
<td>W: 1.5 mg</td>
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</tr>
<tr>
<td><strong>Biotin</strong> (vitamin B7)</td>
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<tr>
<td></td>
<td>• Helps convert food into energy and synthesize glucose</td>
<td></td>
<td>Many foods, including whole grains, organ meats, egg yolks, soybeans, and fish</td>
<td>Your body needs very little biotin. Some is made by bacteria in the gastrointestinal tract. However, it's not clear how much of this the body absorbs.</td>
</tr>
<tr>
<td></td>
<td>• Helps make and break down some fatty acids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Needed for healthy bones and hair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>30 mcg</strong></td>
<td><strong>Not known</strong></td>
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</tbody>
</table>

The following recommendations are based largely on guidelines from the Institute of Medicine. Recommended amounts may be expressed in milligrams (mg), micrograms (mcg), or international units (IU), depending on the nutrient. Unless specified, values represent those for adults ages 19 and older.
Folic acid (vitamin B9, folate, folacin)

- Vital for new cell creation
- Helps prevent brain and spinal birth defects when taken early in pregnancy; should be taken regularly by all women of childbearing age, since women may not know they are pregnant in the first weeks of pregnancy
- Can lower levels of homocysteine; not clear whether it reduces heart disease risk
- May reduce risk for colon cancer
- Offsets breast cancer risk among women who consume alcohol

<table>
<thead>
<tr>
<th>Vitamin (common names) and benefits</th>
<th>RDA or Al*</th>
<th>UL</th>
<th>Good food sources</th>
<th>Did you know?</th>
</tr>
</thead>
</table>
| Folic acid (vitamin B9, folate, folacin) | 400 mcg | 1,000 mcg | Fortified grains and cereals, asparagus, okra, spinach, turnip greens, broccoli, legumes such as black-eyed peas and chickpeas, orange juice, tomato juice | - It's easier to absorb folic acid from supplements and fortified grain products than from dietary sources, where it occurs naturally.
- Some research suggests that women of childbearing age should get 800 mcg per day. You can get this amount through a healthy diet and a daily multivitamin.
- Rarely, folic acid masks a B12 deficiency, which can lead to severe neurological complications. That's not a reason to avoid folic acid; just be sure to get enough B12. |

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<thead>
<tr>
<th>Vitamin (common names) and benefits</th>
<th>RDA or Al*</th>
<th>UL</th>
<th>Good food sources</th>
<th>Did you know?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin B12 (cyanocobalamin)</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>- Aids in lowering homocysteine levels; not clear whether it lowers heart disease risk</td>
<td>2.4 mcg</td>
<td>Not known</td>
<td>Meat, poultry, fish, milk, cheese, eggs, fortified cereals, fortified soy milk</td>
<td>Many people, particularly older adults, are deficient in vitamin B12 because they have trouble absorbing this vitamin from food.</td>
</tr>
<tr>
<td>- Assists in making new cells and breaking down some fatty acids and amino acids</td>
<td></td>
<td></td>
<td></td>
<td>Vitamin B12 occurs naturally only in animal food sources, so strict vegetarians and vegans should take a multivitamin to get enough.</td>
</tr>
<tr>
<td>- Protects nerve cells and encourages their normal growth</td>
<td></td>
<td></td>
<td></td>
<td>A lack of vitamin B12 can cause memory loss, dementia, and numbness in the arms and legs.</td>
</tr>
<tr>
<td>- Helps make red blood cells</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

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Vitamin C (ascorbic acid)

- Foods rich in vitamin C may lower the risk for some cancers, including those of the mouth, esophagus, stomach, and breast

- Helps make collagen, a connective tissue that knits together wounds and supports blood vessel walls

- Helps make the neurotransmitters serotonin and norepinephrine

- Acts as an antioxidant, neutralizing unstable molecules that can damage cells

- Bolsters the immune system

<table>
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<tr>
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<th>UL</th>
<th>Good food sources</th>
<th>Did you know?</th>
</tr>
</thead>
<tbody>
<tr>
<td>M: 90 mg</td>
<td></td>
<td>Fruits and fruit juices (especially citrus), potatoes, broccoli, bell peppers, spinach, strawberries, tomatoes, Brussels sprouts</td>
<td></td>
</tr>
<tr>
<td>W: 75 mg</td>
<td>2,000 mg</td>
<td>Smokers: Add 35 mg</td>
<td>Megadoses of vitamin C do not help prevent the common cold, and they may cause diarrhea.</td>
</tr>
</tbody>
</table>

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### Vitamin (common names) and benefits

<table>
<thead>
<tr>
<th>Vitamin D (calciferol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helps maintain normal blood levels of calcium and phosphorus, which strengthen bones</td>
</tr>
<tr>
<td>Helps form teeth and bones</td>
</tr>
<tr>
<td>Supplements can reduce the number of nonvertebral fractures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ages one–70</th>
<th>15 mcg (600 IU)</th>
<th>100 mcg (4,000 IU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>71+</td>
<td>20 mcg (800 IU)</td>
<td>Fortified milk or margarine, fortified cereals, fatty fish</td>
</tr>
</tbody>
</table>

### Vitamin E (alpha tocopherol)

| RDA: 15 mg (about 22 IU from natural sources of vitamin E; 33 IU from synthetic vitamin E) |
| 1,000 mg (nearly 1,500 IU from natural vitamin E; 2,200 IU from synthetic vitamin E) |

Wide variety of foods, including vegetable oils, salad dressings, and margarines made with vegetable oils; wheat germ; leafy green vegetables; whole grains; nuts

### Did you know?

- Some Americans, especially African Americans, don’t get enough of this nutrient.
- The major source is sunlight, not diet. (Your skin naturally makes vitamin D when exposed to the sun.)
- While the body uses sunlight to make vitamin D, it may not make enough if you live in northern climates, always use high SPF levels of sunblock on all exposed skin, or spend little time in the sun.
- Vitamin E does not prevent wrinkles; the extent of its benefits, if any, is unclear.
- If you want to boost your intake, look for a multivitamin with 200 IU of vitamin E, which is more than the RDA but less than the UL.

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### Vitamin K (phyloquinone, menadione)

- Activates proteins and calcium essential to blood clotting
- May help prevent hip fractures

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<th>UL</th>
<th>Good food sources</th>
<th>Did you know?</th>
</tr>
</thead>
<tbody>
<tr>
<td>M: 120 mcg</td>
<td>Not known</td>
<td>Cabbage, liver, eggs, milk, spinach, broccoli, sprouts, kale, collards, and other green vegetables</td>
<td>• Intestinal bacteria make a form of vitamin K that accounts for half your requirements.</td>
</tr>
<tr>
<td>W: 90 mcg</td>
<td></td>
<td></td>
<td>• If you take an anticoagulant, keep your vitamin K intake consistent.</td>
</tr>
</tbody>
</table>

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### Calcium

- Builds and protects bones and teeth
- Helps with muscle contractions and relaxation, blood clotting, and nerve impulse transmission
- Plays a role in hormone secretion and enzyme activation
- Helps maintain healthy blood pressure

<table>
<thead>
<tr>
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<th>Good food sources</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>Ages 19 to 50:</td>
<td></td>
<td>Yogurt, cheese, milk, tofu, sardines, salmon, fortified juices; leafy green vegetables such as broccoli and kale (but not spinach or Swiss chard, which have binders that lessen absorption)</td>
<td>• Adults absorb roughly 30% of calcium ingested, but this can vary depending on the source.</td>
</tr>
<tr>
<td></td>
<td>1,000 mg</td>
<td>2,500 mg</td>
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<tr>
<td></td>
<td>51+: 1,200 mg</td>
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<td></td>
<td>• Diets very high in calcium may increase the risk of prostate cancer.</td>
</tr>
</tbody>
</table>

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Chloride

- Balances fluids in the body
- A component of stomach acid, essential to digestion

Ages 19 to 50:
2,300 mg

51–70:
3,600 mg

71+:
1,800 mg

Salt (sodium chloride), soy sauce, processed foods
Chloride, sodium, and potassium help your body maintain the proper balance of water.

Chromium

- Enhances the activity of insulin
- Helps maintain normal blood glucose levels
- Helps free energy from glucose

Ages 19 to 50:
M: 35 mcg
W: 25 mcg

51+:
M: 30 mcg
W: 20 mcg

Meat, poultry, fish, some cereals, nuts, cheese
Unrefined foods such as brewer’s yeast, nuts, and cheeses are the best sources of chromium.

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<tbody>
<tr>
<td>Copper</td>
<td></td>
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</tr>
<tr>
<td>- Plays an important role in iron metabolism</td>
<td><strong>RDA:</strong> 900 mcg</td>
<td>10,000 mcg</td>
<td>Liver, shellfish, nuts, seeds, whole-grain products, beans, prunes</td>
<td>More than half of the copper in foods is absorbed.</td>
</tr>
<tr>
<td>- Helps make red blood cells</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Fluoride</td>
<td></td>
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<tr>
<td>- Encourages strong bone formation</td>
<td><strong>RDA:</strong> M: 4 mg</td>
<td>10 mg</td>
<td>Water that is fluoridated, toothpaste with fluoride, marine fish, teas</td>
<td>Fluoride is harmful to children in excessive amounts.</td>
</tr>
<tr>
<td>- Keeps dental cavities from starting or worsening</td>
<td><strong>W:</strong> 3 mg</td>
<td></td>
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<tr>
<td>Iodine</td>
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<tr>
<td>- Part of thyroid hormone, which helps set body temperature and influences nerve and muscle function, reproduction, and growth</td>
<td><strong>RDA:</strong> 150 mcg</td>
<td>1,100 mcg</td>
<td>Iodized salt, processed foods, seafood</td>
<td>To prevent iodine deficiencies, some countries add iodine to salt, bread, or drinking water.</td>
</tr>
<tr>
<td>- Prevents goiter and a congenital thyroid disorder in offspring</td>
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<tbody>
<tr>
<td><strong>Iron</strong></td>
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<tr>
<td>- Helps hemoglobin in red blood cells and myoglobin in muscle cells ferry oxygen throughout the body</td>
<td>RDA: Ages 19 to 50: M: 8 mg W: 18 mg</td>
<td>45 mg</td>
<td>Red meat, poultry, eggs, fruits, green vegetables, fortified bread, and grain products</td>
<td>- Many women of childbearing age don't get enough iron.</td>
</tr>
<tr>
<td>- Needed for chemical reactions in body and for making amino acids, collagen, neurotransmitters, and hormones</td>
<td>Ages 51–70: M: 8 mg W: 8 mg</td>
<td></td>
<td></td>
<td>- Eating meat, fish, or poultry with beans or dark leafy greens can boost your absorption of vegetable sources of iron up to three times. Foods rich in vitamin C can also increase iron absorption.</td>
</tr>
<tr>
<td><strong>Magnesium</strong></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>- Needed for many chemical reactions in the body</td>
<td>RDA: Ages 19 to 30: M: 400 mg W: 310 mg</td>
<td>350 mg</td>
<td>Green vegetables such as spinach and broccoli, legumes, cashews, sunflower seeds and other seeds, halibut, whole-wheat bread, milk</td>
<td>- Many Americans don't get the required amounts.</td>
</tr>
<tr>
<td>- Works with calcium in muscle contraction, blood clotting, and regulation of blood pressure; may help protect against heart disease</td>
<td>Ages 31+: M: 420 mg W: 320 mg</td>
<td></td>
<td></td>
<td>- The majority of magnesium in the body is found in bones. If your blood levels are low, your body may tap into these reserves to correct the problem.</td>
</tr>
<tr>
<td>- Helps build bones and teeth</td>
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</tbody>
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</thead>
<tbody>
<tr>
<td><strong>Manganese</strong></td>
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</tr>
<tr>
<td>Helps form bones</td>
<td></td>
<td></td>
<td>Nuts, legumes, whole grains, tea</td>
<td>If you take supplements or have manganese in your drinking water, be careful not to exceed the upper limit.</td>
</tr>
<tr>
<td>Helps metabolize amino acids, cholesterol, and carbohydrates</td>
<td>M: 2.3 mg</td>
<td>11 mg</td>
<td></td>
<td>Those with liver damage or whose diets supply abundant manganese should be especially vigilant.</td>
</tr>
<tr>
<td>W: 1.8 mg</td>
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<tr>
<td><strong>Molybdenum</strong></td>
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<tr>
<td>Part of several enzymes, one of which helps ward off a form of severe neurological damage in infants that can lead to early death</td>
<td>Al: 45 mcg</td>
<td>2,000 mcg</td>
<td>Legumes, nuts, grain products, milk</td>
<td>Molybdenum deficiencies are rare.</td>
</tr>
<tr>
<td><strong>Phosphorus</strong></td>
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<tr>
<td>Helps build and protect bones and teeth</td>
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<td></td>
</tr>
<tr>
<td>Part of DNA and RNA</td>
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<tr>
<td>Helps convert food into energy</td>
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<tr>
<td>Part of phospholipids, which carry lipids in blood and help shuttle nutrients into and out of cells</td>
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<tr>
<td><strong>RDA</strong></td>
<td><strong>Ages 19 to 70</strong>: 4,000 mg, 700 mg, 71+: 3,000 mg</td>
<td></td>
<td>Wide variety of foods, including milk and dairy products, meat, fish, poultry, eggs, liver, green peas, broccoli, potatoes, almonds</td>
<td>Certain drugs bind with phosphorus, making it unavailable and causing bone loss, weakness, and pain.</td>
</tr>
</tbody>
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<tr>
<td><strong>Potassium</strong></td>
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<tr>
<td>• Balances fluids in the body</td>
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<tr>
<td>• Helps maintain steady heartbeat and send nerve impulses</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>• Needed for muscle contractions</td>
<td>AI: 4,700 mg</td>
<td>Not known</td>
<td>Meat, milk, fruits, vegetables, grains, legumes</td>
<td>• Food sources do not cause toxicity, but high-dose supplements might.</td>
</tr>
<tr>
<td>• A diet rich in potassium seems to lower blood pressure</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>• Getting enough potassium from your diet may benefit bones</td>
<td></td>
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</tr>
<tr>
<td><strong>Selenium</strong></td>
<td></td>
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</tr>
<tr>
<td>• Acts as an antioxidant, neutralizing unstable molecules that can damage cells</td>
<td>RDA: 55 mcg</td>
<td>400 mcg</td>
<td>Organ meats, seafood, walnuts, sometimes plants (depending on soil content), grain products</td>
<td>• Those with type 1 diabetes and those taking certain drugs—such as ACE inhibitors, certain diuretics, or nonsteroidal anti-inflammatory drugs—should speak with their doctor before increasing potassium intake.</td>
</tr>
<tr>
<td>• Helps regulate thyroid hormone activity</td>
<td></td>
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</tbody>
</table>

*A single serving of Brazil nuts can contain more than the RDA of selenium.

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<tr>
<td>Sodium</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>• Balances fluids in the body</td>
<td>Al:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Helps send nerve impulses</td>
<td>Ages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Needed for muscle contractions</td>
<td>19 to 50:</td>
<td>1,500 mg</td>
<td>Salt, soy sauce, processed foods, vegetables</td>
<td>While experts recommend that people limit sodium intake to 2,300 mg, Americans typically report consuming 2,300–4,700 mg a day (and the real total may be higher, as this does not include salt added at the table). The 2,300-mg upper limit is roughly equivalent to 1 teaspoon of table salt.</td>
</tr>
<tr>
<td>• Influences blood pressure; even modest reductions in sodium consumption can lower blood pressure</td>
<td>51–70:</td>
<td>1,300 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>71+:</td>
<td>1,200 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Required for making proteins and DNA</td>
<td>M:</td>
<td>11 mg</td>
<td>Meat, some shellfish, legumes, and whole grains</td>
<td>Zinc lozenges may shorten the duration of the common cold.</td>
</tr>
<tr>
<td>• Supports immune system function</td>
<td>W:</td>
<td>8 mg</td>
<td></td>
<td></td>
</tr>
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**Making sense of scientific studies**

Good science nurtures hunches and takes chances. But even the most promising research must work its way through a hierarchy of studies before scientists can draw firm conclusions. In the process, the findings of seemingly reliable studies can be turned on their head by newer research. This can be frustrating for people trying to make healthy choices. However, this is a normal process for all science—knowledge improves as the scientific methods and types of studies progress and improve—and is no different for nutritional science than for any other science, such as physics, medicine, chemistry, and so forth. Learning to judge the types of dietary studies being reported, by gaining an understanding of the various types of research that scientists do and which kinds of studies are most trustworthy, can help you decide how much weight to give to reported health advice.
Instead of rushing off in search of the newest, best thing that garnered headlines in your morning paper, it’s wise to read carefully and consider whether the weight of evidence from a series of solid studies warrants any changes.

Picture the research process as a three-step ladder, with findings increasing in credibility at each successive step. On the first rung are laboratory studies. Experiments done in test tubes or laboratory trials involving animals can suggest how and why the underlying biochemistry might work, but the findings may not automatically translate to people.

On the second rung of the ladder are observational or experimental studies in people that examine risk factors or biomarkers such as high blood pressure, high blood cholesterol levels, elevated blood glucose, or inflammation that put people at risk for developing chronic diseases. These studies are important for understanding how and why specific risk factors affect humans. However, these studies are usually short-term, often in relatively healthy individuals, and usually test only one or a few risk factors at a time. Because these are each markers of disease, rather than the disease itself, and because most chronic diseases are very complex and influenced by numerous risk factors, it is difficult to know whether a short-term change in any one risk factor will translate into long-term changes in actual disease such as heart disease, stroke, diabetes, or cancers—the endpoints people really care about.

On the third rung are observational studies and randomized controlled trials that actually evaluate disease outcomes rather than just risk factors. Observational studies (also often called epidemiological studies) can be very large, involving 100,000 or more people, and can run for decades. Examples include the Women's Health Study, the Nurses’ Health Study, the Health Professionals Follow-up Study, and the Framingham Heart Study (all cited in this report). Scientists collect data of many types at regular intervals as thousands of participants simply live their lives. By comparing those who stay healthy with those who fall ill, scientists try to identify factors that could account for the difference, looking for factors that are independently associated with health or disease after adjusting for other known risk factors. The conclusions of observational studies can be limited by unmeasured differences between people (called “confounding”) that might really explain the differences in health outcomes. On the other hand, such studies can be very powerful, since they follow what people actually do in their lives over many years.

Randomized controlled trials are usually smaller and of shorter duration than observational studies, and often test sicker populations rather than generally healthy people. These studies randomly assign people to receive either an active treatment (such as a vitamin supplement) or a placebo—a pill or other intervention that looks the same as the active treatment but doesn’t have an effect on the body. These types of studies can directly test whether the treatment makes a difference on disease endpoints. However, many types of treatments can’t be practically tested in randomized trials, and people also often stop taking their assigned treatment over time or stop participating in the trial, which each limit the knowledge that can be gained from these types of studies.

Although randomized controlled trials are often considered the most credible studies of all, there are strengths and limitations to each type. The evidence can be considered the strongest when all of these different types of studies show the same result. On the other hand, when results are different between different types of studies, it is important for scientists to look carefully at the design, execution, and quality of each individual study for a possible explanation.

The media cover intriguing studies from every rung of the ladder, but sometimes fail to put a study in context by explaining the type of research reported. Any exciting new finding may be presented as definitive, especially if you just skim the headlines. Yet even when you do know which rung a study rests on, you may
be told little about the quality of the research. Moreover, each type of study faces its own set of challenges and limitations. Here are just a few:

**Metabolic studies** typically involve a small number of volunteers who eat specially prepared meals for short time periods and are tested at regular intervals. These studies are rigorous and closely controlled, but are too brief to show actual effects on disease, and instead study risk factors or biomarkers.

**Observational studies** often suggest a relationship between a nutrient and a certain disease. But they can't say definitively whether the nutrient actually caused or prevented the disease. Beware of headlines that indicate otherwise: “Antioxidants block aging,” “Vitamin C prevents cancer,” and so on. Two common observational study designs are case-control and cohort studies.

- **Case-control studies**, which compare people who have a particular condition against people who don't, may be tainted by a problem called “selection bias” or “recall bias.” For example, when ill participants are asked to describe their diet, they often recall a worse diet than the one they actually followed. Healthier folks, meanwhile, tend to see their diets through rose-colored glasses.

- **Cohort studies**, in which researchers follow a large group of people and question them routinely about their diets and lifestyles, are the strongest observational design. Because they are very large, they often rely on questionnaires to assess diet—which can be subjective and lead to an underestimate of the true size of the effect.

**Randomized controlled trials** are excellent for minimizing “confounding” at the start of the study, but have their problems as well. To begin with, they may be too short to observe a nutrient's long-term consequences. For example, in the Harvard-based Physicians' Health Study, beta carotene didn't appear to have any effect on cognition at the 12-year mark, but at 18 years, benefits were detected. Also, these studies may involve participants who are in better or worse health than you are. Some of the negative findings about multivitamin and mineral supplements, for instance, have come from studies that enrolled people who had existing vascular disease or diabetes; it's not clear how well they apply to healthier folks. With the B vitamin research, it's the reverse: the patients in those studies had homocysteine levels that were normal or just slightly elevated, so the results may not apply to people with higher levels. In addition, because of limited knowledge about a disease (for instance, cancer), randomized controlled trials may not introduce a dietary intervention when it could have done the most good; participants may already be so ill that the treatment may come too late to make a meaningful difference in the outcome. Lastly, these trials can be extremely difficult to conduct because researchers have to control the behaviors of large numbers of people, often for many years. Some people may not take their pills as prescribed, may try other treatments as well, or may drop out of the study. If participants do not stay with the assigned treatment, findings could be blurred or even eradicated.

**Meta-analysis** is a statistical strategy that assembles numerous previously published studies containing comparable data and adds the evidence together, looking for patterns that corroborate or contradict each other. The main output is a single overall estimated effect, based on all of the evidence combined—in effect, a study of studies. A key strength of meta-analysis is the ability to combine data from multiple previously published studies, usually across different populations and countries, to derive a best overall estimate of effects. A potential limitation is that the truth of the final estimate depends almost entirely on the quality of the individual studies that are going into the meta-analysis: if good studies are included, a good meta-analysis results; but garbage in, garbage out is another possibility as well.

Instead of rushing off in search of the newest, best thing that garnered headlines in your morning paper, it's wise to read carefully and consider whether the weight of evidence from a series of solid studies warrants making any changes. It's also important to consider whether the possible benefits to your health outweigh potential risks. Be sure to look beyond the headlines for more information. Reputable sources of health information try to put key studies in perspective. And always check with your doctor before making dietary changes.

**Cast of characters: From vitamin A to zinc**

This chapter features a broad overview of the best-known vitamins and minerals. For each nutrient
The Recommended Dietary Allowance (RDA) or adequate intake (AI) for people ages 19 and older (with gender and age differences noted when applicable) and a brief description of the nutrient's role in the body.

A table of selected food sources containing the nutrient, with an emphasis on the best sources in commonly consumed foods. You can also search the U.S. Department of Agriculture (USDA) National Nutrient Database for Standard Reference, at www.nal.usda.gov/fnic/foodcomp/search, to see exhaustive lists of foods organized by nutrient content.

A summary of the data linking the nutrient to different health conditions. If a condition is not listed, that means there is insufficient evidence to support a connection between the nutrient and the disease.

A recommendation about taking the nutrient in supplement form.

As a rule, your best strategy is to get vitamins and minerals from foods, not multivitamins or supplements. A vast amount of research has shown that you can cut your risk for chronic disease and disability by following a healthy diet, as well as by exercising regularly and not smoking. The evidence for taking vitamin and mineral supplements is much less convincing.

Also keep in mind that these nutrients, while important, are simply one part of an overall plan for good health. Use them along with other well-established health care recommendations and treatments, not in lieu of them. If you're worried about lung cancer, for example, quitting smoking will have a much greater impact on your health than taking supplements. Before taking more than a daily multivitamin supplement, discuss your decision with your doctor. Your medical history, genetic profile, and medications may affect the doses and types of supplements you can safely take.

**Vitamin A and carotenoids**

- **Men:** 900 mcg (3,000 IU)
- **Women:** 700 mcg (2,333 IU)

“Eat your carrots, they're good for your eyes!” This oft-heard advice is rooted in truth: carrots and other colorful fruits and vegetables are rich in pigments known as carotenoids. Some carotenoids, such as beta carotene and alpha carotene, are known as provitamin A carotenoids, because they can be converted to vitamin A in the body.

The most usable form of vitamin A, retinol, is essential to the proper function of the retina, the light-sensitive tissue lining the back of the eye. In addition to its role in healthy vision, vitamin A aids bone growth and helps regulate the body’s infection-fighting abilities. People in the United States obtain one-quarter to one-third of their vitamin A from provitamin A carotenoids—most commonly from carrots, cantaloupes, sweet potatoes, and spinach. There is no RDA for beta carotene or other provitamin A carotenoids, but 3 mg to 6 mg is equivalent to 833 IU to 1,667 IU of vitamin A—the amount that will keep blood levels in a range linked to a lower risk of chronic disease, according to the Institute of Medicine.

Animal-based foods, including liver, milk, and eggs, contain preformed vitamin A, which makes up the bulk of the vitamin A in the average adult's diet. Most fat-free milk and dried nonfat milk solids are fortified with vitamin A to replace the amount lost when the fat is removed. Many breakfast cereals are also vitamin A–fortified. According to the National Health and Nutrition Examination Survey (NHANES), a long-running study of the health status of Americans, the average adult in the United States gets 3,300 IU of vitamin A daily—well above the RDA for both men and women.
<table>
<thead>
<tr>
<th>Food</th>
<th>Vitamin A (IU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots, sliced, boiled, 1/2 cup</td>
<td>13,418</td>
</tr>
<tr>
<td>Spinach, frozen, boiled, 1/2 cup</td>
<td>11,458</td>
</tr>
<tr>
<td>Kale, frozen, boiled, 1/2 cup</td>
<td>9,558</td>
</tr>
<tr>
<td>Apricots with skin, juice packed, 1/2 cup</td>
<td>2,063</td>
</tr>
<tr>
<td>Mango, sliced, 1 cup</td>
<td>1,262</td>
</tr>
<tr>
<td>Milk, fortified, skim, 8 ounces</td>
<td>500</td>
</tr>
<tr>
<td>Egg, hard-boiled, 1 large</td>
<td>293</td>
</tr>
<tr>
<td>Cheese, cheddar, 1 ounce</td>
<td>284</td>
</tr>
</tbody>
</table>

*Animal sources contain preformed vitamin A; plant sources contain beta carotene.


**Cancer**

Epidemiological studies suggest that people who eat foods rich in beta carotene and vitamin A are less likely to develop many types of cancer, especially lung cancer. But when researchers tested beta carotene supplements in smokers, they found that people who took the supplements were more likely to develop lung cancer. In one study, people who took 30 mg of beta carotene plus 25,000 IU of vitamin A were 46% more likely to die of lung cancer than those taking a placebo. Based on these findings, experts now advise people—especially former and current smokers—not to take beta carotene supplements.

**Fractures**

Several observational studies show that too much preformed vitamin A in the diet may raise the risk of osteoporosis, a condition marked by porous, weak bones and a higher likelihood of fractures. The risk appears when people consume more than double the RDA for preformed vitamin A and may be limited to those who don’t get enough vitamin D. An analysis from the Women’s Health Initiative of more than 75,000 women found a modestly increased risk of hip fracture only among women with high vitamin A and low vitamin D intakes, as described in a 2009 paper in *The American Journal of Clinical Nutrition*. There is no evidence of a link between beta carotene and osteoporosis risk.

**Eye diseases**

Healthy eyes depend on vitamin A as well as carotenoids that aren’t transformed into vitamin A. Lutein and zeaxanthin are the only carotenoids found in the retina of the eye. Spinach and kale, two lutein-rich vegetables, appear to moderately reduce the risk of cataracts (the clouding of the normally clear lens of the eye). And one study found that women who got the most lutein and zeaxanthin through their diets lowered their risk of needing surgery to remove a cataract by 22% compared with women who got the least.
Observational studies also suggest that dietary carotenoids seem to lessen the likelihood of age-related macular degeneration (AMD), a condition that leads to blurred, distorted vision and blind spots in the field of vision.

In an observational study, scientists from Harvard Medical School and the Harvard School of Public Health found that the rate of loss of eyesight in retinitis pigmentosa patients was slower among patients, who were all taking vitamin A supplements (15,000 IU/d), when they also consumed a diet rich in omega-3 fatty acids.

**Recommendation:** If you take a multivitamin, make sure most or all of the vitamin A comes in the form of beta carotene and not retinol or retinyl compounds (the preformed versions of vitamin A). These can be toxic at high levels.

**B vitamins**

The B vitamins consist of eight distinct vitamins (see “The B list”) that help cells function optimally. Many Americans, especially the elderly, don't meet the RDAs for three of them: B6, B12, and folic acid. As such, these Bs have garnered the most attention from public health officials and researchers.

**The B list**

- Vitamin B1: thiamine
- Vitamin B2: riboflavin
- Vitamin B3: niacin or niacinamide
- Vitamin B5: pantothenic acid
- Vitamin B6: pyridoxine, pyridoxal, pyridoxamine, or pyridoxine hydrochloride
- Vitamin B7: biotin
- Vitamin B9: folate, folic acid
- Vitamin B12: various cobalamins; commonly cyanocobalamin in vitamin supplements

Note: Vitamins B4, B8, B10 and B11–missing from the list above–were originally thought to be vitamins but were later discovered to be nonessential to humans.

**Vitamin B6 (pyridoxine)**

- **Ages 19–50:** 1.3 mg
- **Ages 51 and older:** men, 1.7 mg; women, 1.5 mg

Your body needs vitamin B6 to break down protein and build red blood cells. It occurs naturally in a variety of foods, including meat, poultry, fish, and some fruits and vegetables. Most people meet the RDA for this vitamin, but one survey of people over 60 found that men got 1.2 mg and women just 1.0 mg daily, versus the recommended 1.7 mg and 1.5 mg, respectively.

<table>
<thead>
<tr>
<th>Food</th>
<th>Milligrams (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source: USDA National Nutrient Database for Standard Reference</td>
<td></td>
</tr>
</tbody>
</table>
Folic acid (vitamin B9, folate)

- 400 mcg

Folic acid or folate (the terms refer, respectively, to the vitamin's synthetic and natural forms) plays a role in the synthesis, repair, and function of DNA, the genetic material found in all cells. Leafy green vegetables and dried beans are good sources. Some Americans, including a fair number of women of childbearing age, don't get enough of this vitamin. That's worrisome, because having insufficient levels just before and during the early stages of pregnancy increases the risk of having a baby with a neural tube defect—a serious malformation of the spine, skull, or brain. To address this problem, folic acid has been added to enriched breads, cereals, flours, corn meal, pastas, rice, and other grain products since 1998, when an FDA regulation mandating the addition took effect. As a result, the average intake of folic acid has risen by an estimated 100 micrograms (mcg) per day, and the incidence of neural tube defects has fallen by 25% to 50% in the United States and other countries that require folic acid fortification (although other factors, such as ultrasound screening, may have contributed to the drop).
<table>
<thead>
<tr>
<th>Food</th>
<th>Micrograms (MCG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast cereal, fortified with 25% of the DV, 3/4 cup</td>
<td>100</td>
</tr>
<tr>
<td>Spinach, frozen, boiled, 1/2 cup</td>
<td>100</td>
</tr>
<tr>
<td>Great Northern beans, boiled, 1/2 cup</td>
<td>90</td>
</tr>
<tr>
<td>Asparagus, boiled, 4 spears</td>
<td>85</td>
</tr>
<tr>
<td>Rice, white, long-grain, parboiled, enriched, cooked, 1/2 cup</td>
<td>65</td>
</tr>
<tr>
<td>Baked beans, vegetarian, canned, 1 cup</td>
<td>60</td>
</tr>
<tr>
<td>Spinach, raw, 1 cup</td>
<td>60</td>
</tr>
<tr>
<td>Green peas, frozen, boiled, 1/2 cup</td>
<td>50</td>
</tr>
<tr>
<td>Broccoli, chopped, frozen, cooked, 1/2 cup</td>
<td>50</td>
</tr>
<tr>
<td>Egg noodles, enriched, cooked, 1/2 cup</td>
<td>50</td>
</tr>
<tr>
<td>Broccoli, raw, 2 spears (each 5 inches long)</td>
<td>45</td>
</tr>
</tbody>
</table>

Selected food sources of folic acid

Source: USDA National Nutrient Database for Standard Reference

B12 (cyanocobalamin)

- 2.4 mcg

Vitamin B12, which is required for proper brain function and a host of chemical reactions within the body, is found naturally only in animal products (meat, fish, poultry, eggs, and milk), but many fortified cereals contain the synthetic form. Vegans, who avoid all animal-based foods, need to ensure they get enough of this vitamin through fortified foods or supplements. About 6% of people ages 60 and older are deficient in vitamin B12, and nearly one in five is borderline deficient. As you age, it often becomes harder to absorb enough B12 from food. This problem usually reflects a lack of stomach acid, which liberates B12 from food. But since this stomach acid isn’t needed for your body to absorb B12 from supplements or fortified foods, you can avoid a deficiency by getting enough B12 from these sources. In rare cases, a B12 deficiency can cause pernicious anemia (see Figure 3). This condition is usually treated with monthly injections of B12.
In rare cases, low vitamin B12 levels can cause pernicious anemia, a condition in which the bone marrow produces red blood cells that are both larger and less numerous than normal. Symptoms can include yellowish skin, fatigue, shortness of breath, and headaches. Numbness or tingling in the hands and feet and trouble keeping balance are also common.

**Heart disease**

Starting in the mid-1980s, numerous studies noted a link between high blood levels of homocysteine (an amino acid found in everyone’s blood) and an increased risk of cardiovascular disease. Many people with high homocysteine levels are deficient in vitamins B6, B12, and folic acid. Supplements of these vitamins can reduce homocysteine levels within weeks. But this has no effect on the number of heart attacks or deaths from heart disease, according to two studies published in 2008.

**Selected food sources of vitamin B12**

<table>
<thead>
<tr>
<th>Food</th>
<th>Micrograms (mcg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source: USDA National Nutrient Database for Standard Reference</td>
<td></td>
</tr>
</tbody>
</table>
Cancer

The relationship between B vitamins—folic acid, in particular—and cancer has proved complex. There’s evidence that people with low blood levels of folate are more prone to cancer, and several large, long-term studies suggest that people who consume more folic acid are less likely to develop colon cancer. Other research suggests that greater consumption of folic acid can lower breast cancer risk, at least among women who drink alcohol and have low folic acid levels. Alcohol consumption is believed to increase the risk of some cancers, including breast and colon cancers. But folic acid seems to counteract, in part, such adverse effects of alcohol.

But while adequate amounts of folic acid appear to stifle the birth and spread of early tumors, it’s possible that too much may speed up the growth of existing tumors. In fact, one randomized trial found that folic acid supplements increased the recurrence of adenomatous polyps, which can turn into colon cancer. Several studies suggest that excess folic acid may raise the risk of cancer of the colon, breast, and prostate. A study that reviewed cancer registries in the United States and Canada (which also began folic acid fortification in 1998) revealed a slight uptick in colon cancer rates in the early fortification years, when average blood levels of folate doubled. The findings were published in *Cancer Epidemiology Biomarkers and Prevention* in 2007. However, the overall steady decline in deaths from colon cancer before and after folic acid fortification suggests that improved screening from colonoscopies is a more likely explanation for the upward blip.

In 2009, a study in the *Journal of the American Medical Association* documented an increased risk of
cancer in people who took folic acid and vitamin B12 supplements. Done in Norway (where there is no folic acid fortification), the study pooled data from two trials originally designed to see if B vitamins could lower heart disease risk in people who already had the disease. But it’s worth noting that the participants were taking 800 mcg of folic acid, which is double the RDA in the United States. In fact, the tolerable upper limit—the maximum safe amount—for folic acid is 1,000 mcg per day.

An observational analysis of three large case-control studies, however, found that among people with a genetic variation that might ordinarily make them more susceptible to certain diseases, including colon cancer, lower levels of folate were associated with lower (not higher) rates of this cancer.

Memory problems

Several epidemiological studies have shown that blood concentrations of vitamins B6, B12, and folic acid are linked to people’s performance on tests of memory and abstract thinking. In one, investigators collected blood from 816 older people. After about four years, 112 of them had developed dementia, including 70 diagnosed with Alzheimer’s disease. An analysis of the blood test results revealed that people who started with higher concentrations of folate were less likely to have suffered cognitive decline.

However, a randomized controlled trial of people with mild to moderate Alzheimer's disease found no benefit from high-dose vitamin B supplements in slowing cognitive decline. Supplements of these vitamins also didn't show any power to protect thinking skills or slow age-related decline in healthy older people, according to results from three studies reviewed by the Cochrane Collaboration, an international group of independent experts.

The record on dementia and folic acid supplements is somewhat more promising, but results are preliminary. Several recent, smaller randomized controlled studies suggest that treatment with folic acid and other B vitamin supplements may slow cognitive decline in older people. The improvement may be related to the B vitamins’ ability to lower homocysteine.

Recommendation: B6—

Avoid supplements that contain more than the RDA for vitamin B6, as excess amounts can cause neuropathy (see “B bonanza: Boon or bust?”). Folic acid—Beware of getting too much folic acid from supplements and fortified foods. Most multivitamins contain 400 mcg, but many fortified breakfast cereals also contain that much. Add a few other enriched grain products (10 pretzels adds 172 mcg, and a cup of spaghetti, 166 mcg) and you’re over your daily limit. If you take a daily multivitamin, avoid foods fortified with 300 to 400 mcg of folic acid. B12—Vegans, who avoid all animal-based foods, and elderly people, who may have trouble absorbing vitamin B12 from food, should consider eating a vitamin B12–fortified breakfast cereal or taking a supplement.

B bonanza: Boon or bust?

Presumably because of their role in helping cells use energy, B vitamins are often added to energy drinks and nutrition bars—sometimes in extremely high amounts. A can of Red Bull, for example, contains 250% of the Daily Value\(^1\) (DV) for vitamin B6. And a single 2-ounce bottle of 5-Hour Energy includes a whopping 2,000% of the Daily Value for vitamin B6 and 8,333% of the DV for vitamin B12—and the label even suggests you can drink two bottles per day. Various brands of bottled water, such as vitamin water, contain up to four B vitamins in amounts up to 40% of the DV, but the amounts are for an 8-ounce serving, which is less than half a bottle (most bottles contain 2.5 servings). And you can’t necessarily trust the labels. According to Consumerlab.com, which does independent reviews of vitamins and other supplements and related products, one brand of vitamin water the agency tested contained 15 times its claimed amount of folic acid. Many nutrition bars also contain the RDA (400 mcg for adults) for folic acid. For example, one PowerBar or Luna bar contains 400 mcg, and a Nitro-Tech bar has 800 mcg. Because many other foods are enriched with folic acid, it’s not hard to exceed the safe upper limit of 1,000 mcg for this nutrient if you take a multivitamin and eat these fortified products on a regular basis (see “Recommendation”).

These megadoses do nothing to enhance any bodily functions, and because B vitamins are water-soluble,
they're not stored in the body, so any extra is simply excreted in the urine. However, taking too much B6 on a routine basis can lead to neuropathy, nerve damage that can cause pain, weakness, and loss of sensation. Decades ago, some experts recommended megadoses (roughly 50 to 150 times the recommended dose) of vitamin B6 to treat carpal tunnel syndrome—a pinched nerve in the wrist that can cause finger tingling and numbness. But several cases of people developing neuropathy as a result of this treatment have been reported in the medical literature. Vitamin B6 has also been touted as a treatment for premenstrual syndrome, but there’s no evidence it helps—and a review article reported neuropathy symptoms in 23 of 58 women taking daily vitamin B6 for this reason.

A recent observational study nested in the Nurses’ Health Study II cohort suggests that a diet rich in thiamine and another B vitamin, riboflavin, may significantly lower the risk of premenstrual syndrome, but that taking a supplement did not have the same beneficial effect.

Vitamin C

- **Men:** 90 mg
- **Women:** 75 mg
- **Smokers:** add 35 mg

Vitamin C is perhaps best known for its one time reputation for preventing and treating the common cold—an idea first promoted in the 1970s by Nobel laureate Linus Pauling. But according to a meta-analysis of 30 placebo-controlled trials, taking up to 2 grams of vitamin C per day does not decrease your chances of catching a cold, although it may very slightly shorten the duration of your sniffles.

In the body, vitamin C is crucial for making collagen, which lends structural support to tendons, ligaments, bones, and blood vessels. This vitamin is also a potent antioxidant (see “Understanding antioxidants”), which is why smokers, who are exposed to more free radicals because of their habit, are advised to get extra vitamin C (see Table 1).

Most people meet the RDA for vitamin C via their diets. Citrus fruits are rich in vitamin C, but sweet red pepper contains nearly twice as much per serving.

<table>
<thead>
<tr>
<th>Food</th>
<th>Milligrams (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red sweet pepper, raw, 1/2 cup</td>
<td>142</td>
</tr>
<tr>
<td>Kiwi fruit, 1 medium</td>
<td>70</td>
</tr>
<tr>
<td>Orange, 1 medium</td>
<td>70</td>
</tr>
<tr>
<td>Green sweet pepper, raw, 1/2 cup</td>
<td>60</td>
</tr>
<tr>
<td>Grapefruit juice, 3/4 cup</td>
<td>50–70</td>
</tr>
</tbody>
</table>

*Source: USDA National Nutrient Database for Standard Reference*
Heart disease and cancer

Despite a handful of studies hinting that vitamin C might ward off heart disease and cancer, the evidence offers no support for supplemental C. Findings from the Physicians' Health Study II, which followed 14,641 men who took 500 mg of vitamin C daily for a decade, found no difference in the number of heart attacks, strokes, or deaths from cardiovascular disease compared with men who took placebos. In a separate analysis, researchers found that the likelihood of developing cancer was also nearly identical whether the men took vitamin C or a placebo. The study results were published in The Journal of the American Medical Association in 2008 and 2009, respectively.

Vitamin C supplements might have an effect on blood pressure, according to a recent meta-analysis of data from 29 randomized, controlled, previously published clinical trials that reported systolic and diastolic blood pressure values, or both, and also compared vitamin C intake to a placebo. This analysis found that people who were given a median dose of 500 mg per day of supplemental vitamin C had reduced systolic blood pressure by 3.8 millimeters of mercury (mm Hg) over the short term. Among participants who had a diagnosis of hypertension, the drop was nearly 5 mm Hg.

Eye diseases

Eye tissue contains large amounts of vitamin C, and some studies suggest that the vitamin may help ward off cataracts, which cloud the eye's lens and diminish vision. For instance, one 2008 study found that people who consume about eight to 10 times more than the RDA of vitamin C, through both foods and supplements, were less likely to develop cataracts than people who consumed the RDA. But a prospective study of more than 35,000 female health professionals found no association between vitamin C intake and the incidence of cataracts. And in a Swedish study that followed more than 24,000 women for about eight years, researchers found that women who took 1,000 mg of vitamin C supplements on a regular basis were more likely to develop cataracts. In women ages 65 and older, the risk was 38% more than that of women who didn't take vitamin C supplements.

Recommendation: Taking vitamin C supplements in amounts far higher than the RDA offers no health benefits but is probably harmless, despite the cataract study noted above.

Vitamin D

- Ages 1–70: 15 mcg (600 IU)
- Ages 71 and older: 20 mcg (800 IU)

This fat-soluble vitamin is unique because it's found naturally in only a few foods. Fatty fish, the main food source of vitamin D, isn't something most Americans eat daily. Milk doesn't naturally contain vitamin D, but it's been fortified since the 1930s to combat rickets, a disease caused by vitamin D deficiency that leads to soft, weak bones. The RDA for most adults is 600 to 800 IU of vitamin D.

However, for older adults to meet the RDA, they would have to drink at least a quart of milk per day. Dairy products made from milk (such as cheese and ice cream) aren't typically fortified with vitamin D and contain only small amounts. But some brands of yogurt are fortified with vitamin D, and so are some juices and breakfast cereals.
Fortunately, most people don’t rely on diet for vitamin D, because exposing your skin to sunshine—more specifically, ultraviolet B (UVB) rays—enables the body to make vitamin D, which is why it’s also known as the “sunshine vitamin.” But the skin’s production of vitamin D depends on a number of factors, only some of which are under your control.

### Selected food sources of vitamin D

<table>
<thead>
<tr>
<th>Food</th>
<th>International units (IU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon, cooked, 3-1/2 ounces</td>
<td>360</td>
</tr>
<tr>
<td>Mackerel, cooked, 3-1/2 ounces</td>
<td>345</td>
</tr>
<tr>
<td>Tuna fish, canned in oil, drained, 3 ounces</td>
<td>200</td>
</tr>
<tr>
<td>Sardines, canned in oil, drained, 1-3/4 ounces</td>
<td>250</td>
</tr>
<tr>
<td>Orange juice, fortified, 8 ounces</td>
<td>100</td>
</tr>
<tr>
<td>Milk, any fat content, vitamin D–fortified, 1 cup</td>
<td>98</td>
</tr>
<tr>
<td>Breakfast cereal, fortified with 10% of the DV, 3/4-cup to 1-cup serving (depending on brand)</td>
<td>40–100</td>
</tr>
</tbody>
</table>

Source: USDA National Nutrient Database for Standard Reference

### The lowdown on low vitamin D levels

Humans first evolved near the equator in Africa, where the sun shines directly overhead for much of the year. Our ancestors there wore little or no clothing and therefore probably produced tens of thousands of IU of vitamin D each day. Heavy pigmentation protected the deeper layers of their skin from sun-induced damage. As some groups of humans migrated away from the equator, their skin lightened to enable faster vitamin D production.

For centuries, people typically spent plenty of time outdoors during much of the year. But in the last 300 years, more people began working indoors, and in the last 100 years, began riding in cars. (Not only do cars shield people from the sun, they also contribute to air pollution, which screens out some of the UV radiation that reaches Earth.) In the past few decades, putting on sunscreen has become de rigueur before heading outdoors. And in sharp contrast to the trend favoring the “healthy tan” in the mid-20th century, many Americans now intentionally avoid the sun. All of these changes mean that some of us may be getting less vitamin D than our bodies need. However, true vitamin D deficiency is far less common in the United States than potential vitamin D insufficiency—a nebulous concept that has attracted much attention in the media recently, but is difficult to define precisely (see “Defining deficiency”).

### Defining deficiency

Despite widespread assertions in the popular and scientific press that many Americans are deficient in vitamin D, the term “deficiency” isn’t strictly accurate. The official definition of a vitamin deficiency refers to
specific health problems that stem solely from the lack of (or inability to use) a specific nutrient. Vitamin D deficiency, for example, results in rickets, which is rare in the United States.

On the other hand, lower than optimal levels of specific vitamins, including vitamin D, may increase disease risk, but these low levels are not considered deficiencies. If they were, one could argue that many Americans are deficient in vegetables and physical activity—and make the case that such shortfalls are much more important “deficiencies” than low levels of vitamin D when it comes to safeguarding your health. “Insufficiency” may be a better term for such lower levels, but it cannot be as strictly defined as outright deficiency.

People who should consider vitamin D testing are those with medical conditions that affect fat absorption (including those who have undergone weight-loss surgery) or people who routinely take anticonvulsant medications, glucocorticoids, or other drugs that interfere with vitamin D activity. Beware of the now-popular misuse of the term “deficiency” when interpreting your test results. Some experts consider values lower than 30 nanograms per milliliter (ng/ml) to be deficient, but others—including the Institute of Medicine (IOM), which officially sets the DRIs—assert that a value of 20 ng/ml makes more sense.

The confusion and controversy surrounding optimal vitamin D intake and blood values prompted the U.S. and Canadian governments to request that the IOM re-review the evidence on vitamin D and calcium and update the DRIs. The long-awaited report, Dietary Reference Intakes for Calcium and Vitamin D, was published in 2011. The scientific committee, comprising researchers from a number of academic institutions including Harvard, concluded that scientific evidence for benefits of vitamin D beyond bone health—which were often reported in the media—was from studies that provided often-conflicting results and could not be considered reliable. The IOM also concluded that the prevalence of vitamin D inadequacy in North America has been widely overestimated.

Based on evidence for bone health, the IOM panel increased the recommended daily allowance for vitamin D to 600 IU for people up to age 70, and to 800 IU for those over 70. That's a fairly sizeable boost over the previous recommendations of 200 IU per day through age 50, 400 IU for ages 51 to 70, and 600 IU for ages over 70. The IOM also raised the safe upper limit of daily intakes for most age groups from 2,000 to 4,000 IU.

The IOM report concluded that vitamin D blood levels above 20 ng/ml are adequate for maintaining healthy bones, and that most people in the United States have values in that range. The IOM committee therefore determined that the majority of Americans and Canadians are currently receiving adequate amounts of vitamin D, suggesting that supplements may not be necessary. Other organizations, including the American Association of Clinical Endocrinologists, assert that values between 30 and 50 ng/ml have potential health benefits beyond bone health. However, the IOM report cautioned that higher levels of vitamin D have not been proven to confer additional benefits and have been linked to health problems, challenging the notion that “more is better.”

Factors that affect vitamin D production

Where you live, the season, and the time of day all affect how much UVB reaches your skin. The farther you live from the equator, the less UVB radiation you receive. People who live north of about 37 degrees latitude (picture an imaginary line between San Francisco, CA, and Richmond, VA) can’t make any vitamin D from sunlight from November to March, even if they were to stay outside all day. This phenomenon has to do with the angle of the sun: during the winter months, the earth tilts away from the sun, increasing the angle at which the sun’s light reaches the earth’s surface. More UVB radiation is absorbed by the ozone layer, which lowers or eliminates the amount that can reach a person’s skin. As for time of day, the sun’s rays are most direct between 10 a.m. and 3 p.m.

What's more, your age, your skin color, how much skin you expose, and your sunscreen use influence your production of vitamin D. Many people also avoid the sun because they fear skin cancer—a valid concern, given that ultraviolet radiation is a known contributor to most of the estimated 1.5 million skin cancers that occur each year in the United States. Any of these factors can combine to limit vitamin D production, which is
why a large number of Americans—including half of those age 65 and older—have relatively lower levels of vitamin D. Most of these people are not frankly deficient in vitamin D. Whether these people have insufficient vitamin D—a looser concept—is a matter of some debate.

**Different forms of vitamin D**

Vitamin D comes in two forms: D3 (cholecalciferol) and D2 (ergocalciferol). D3, the form made naturally by the body in response to sunlight, is also the form most often used to fortify milk and other foods, such as breakfast cereals. Vitamin supplements contain either D3 or D2, which is made from plant material. If you take supplements, some experts recommend choosing one that contains D3. However, the IOM report concludes that D2 is just as effective as D3 at the recommended dosage levels.

**Osteoporosis and fractures**

One of vitamin D's most important and best-known roles is to signal the intestines to absorb calcium into the bloodstream. Without sufficient vitamin D, your body will break down bone to get the calcium it needs—no matter how much calcium you consume through food and supplements (see Figure 4). There is evidence supporting adequate vitamin D intake to prevent osteoporosis, which diminishes bone density and increases the risk of broken bones (fractures). One in five people dies within a year of experiencing a hip fracture, which is nearly always the result of a fall. Vitamin D helps not only by building bone strength but also by shoring up muscles, which lessens a person's chances of falling.
Vitamin D’s main role in the body is to help the intestines absorb calcium and phosphorus.

One study pooled results from 12 randomized controlled trials involving more than 19,000 people older than 60 and found that 700 to 800 IU of supplemental vitamin D daily cut the risk of hip and other nonvertebral fractures by about a quarter, compared with calcium supplementation alone or placebo.

A new meta-analysis and draft recommendation on vitamin D and calcium supplements were recently published by the U.S. Preventive Services Task Force (USPSTF). Results were mixed. The study concludes that combined vitamin D (at 300 to 1,100 IU per day) and calcium supplementation (500 to 1,200 mg per day), “but not vitamin D supplementation alone, can reduce the fracture risk in older adults. However, the effects may vary according to setting, with smaller effects in community-dwelling elderly persons or postmenopausal women than in institutionalized elderly persons.” In a pending draft of their recommendations, the task force says that for adults who live at home, and not in assisted-living or nursing homes, there isn't enough evidence to determine if vitamin D with calcium supplements can prevent fractures in men, in women who have yet to go through menopause, or in older women. In fact, “lower doses of vitamin D and calcium supplements,” the draft says, “do not prevent fractures in older women and may lead to kidney stones in a small number of women.”
Muscle weakness and falls

Inadequate vitamin D levels can lead to muscle weakness, and getting enough may improve muscle function. A study of nursing home residents found that, over a five-month period, people who took 800 IU of supplemental vitamin D per day were 72% less likely to fall, and fell less often, compared with people who took a placebo. Lower doses of vitamin D did not offer the same protective effect. Based on this and other evidence, the 2011 USPSTF report mentioned previously does recommend that vitamin D supplementation can be effective in preventing falls in community-dwelling adults over age 65 years who are at increased risk for falls.

High blood pressure and heart disease

A handful of observational studies suggest that people with low vitamin D levels face a higher risk of heart disease. And one study linked low blood levels of vitamin D with a 76% increased risk of high blood pressure, a common risk factor for heart disease. A recent observational study by Harvard scientists also found a modest correlation between lower vitamin D levels and higher risk of stroke. A meta-analysis of 14 prospective observational studies throughout Europe that included over 60,000 individuals found lower blood levels of vitamin D were related to higher risk of total deaths. The data suggested a “U-shaped” relationship between blood vitamin D levels and total mortality, with lowest risk at concentrations of about 75–87.5 nanomoles per liter.

However, two large randomized controlled trials of vitamin D supplementation—including one that was part of the large Women's Health Initiative study—showed no benefit in reducing the likelihood of heart disease or stroke. Currently, there isn't sufficient evidence to conclude that vitamin D supplements can lower the risk of high blood pressure, heart disease, or stroke.

A large study that began recruiting participants in January 2010, called VITAL (the Vitamin D and Omega-3 Trial), aims to provide more evidence about the potential worth of both vitamin D and omega-3 fatty acid supplements. (For more information on omega-3 fatty acids, see “Fish oils.”) The trial, sponsored by the National Institutes of Health, plans to include 20,000 participants from across the United States—including women over age 60 and men over age 65—who have never had a stroke or been diagnosed with heart disease or cancer. Participants will be randomly assigned to take either 2,000 IU of vitamin D; 1,000 mg of fish oil; both supplements; or placebos.

Depression

In a cross-sectional observational study of the records of 12,594 patients in a database at the Mayo Clinic, researchers found a link between depression and low levels of vitamin D, especially in people with a prior history of depressive disorders.

Cancer

Higher blood vitamin D levels are linked to lower risk of colon cancer in observational studies. For example, a cross-sectional study of 3,121 adults ages 50 and older found that those with the highest vitamin D intakes (more than 645 IU per day) were less likely to have cancerous lesions detected via colonoscopy than those with lower intakes. An analysis of 16,618 participants in the NHANES nutrition survey found a relationship between vitamin D status and colon cancer, but not total cancer.

Randomized trials, however, have not found benefits for vitamin D supplementation in relation to cancer risk. Also, in the observational studies, most of the differences in blood vitamin D levels were related to sunlight exposure, not dietary intake from food or supplements.

As for the potential increase in skin cancers due to UVB exposure in an effort to generate vitamin D, it's worth noting that the vast majority of skin cancers are not fatal, and some analyses suggest that any increase in skin cancer from adding a small amount of unprotected sun exposure would be offset by declines in other forms of cancer.
Evidence is not sufficiently robust to draw conclusions regarding the benefits or harms of vitamin D supplementation for the prevention of cancer. A draft recommendation statement from the USPSTF is available at www.uspreventiveservicestaskforce.org.

**Recommendation:** When possible, get your vitamin D from foods and from modest sun exposure, making sure to avoid a sunburn. About five to 30 minutes of sun exposure between 10 a.m. and 3 p.m. at least twice a week to the face, arms, legs, or back without sunscreen will enable you to make enough of the vitamin. When sun-generated vitamin D is not feasible (see “Factors that affect vitamin D production”), and if you don’t get much vitamin D in your diet (see “Selected food sources of vitamin D”), then consider a daily supplement to meet the recommended dietary intake of 600 to 800 IU per day. If you take a multivitamin that contains some vitamin D, but less than 600 to 800 IU, your diet and some sun exposure will likely make up the difference. You could also take a separate vitamin D supplement to be sure you’re getting the recommended amount. Some scientists believe there is enough evidence to advise taking 1,000 IU per day or more of supplementary vitamin D, which is well below the safe upper limit of 4,000 IU. However, the potential benefits of higher doses remain controversial. Large studies now underway should help determine if these higher doses offer benefits beyond bone health.

**Vitamin E**

- **15 mg (equivalent to 22 IU from natural sources or 33 IU from synthetic sources)**

In the 1970s, megadoses of vitamin E in amounts up to 1,000 IU (about 45 times the RDA) were touted as a way to enhance your sex life, improve your immune response, and boost your well-being overall. But there's little or no evidence for such claims, some of which were based on studies in rats. In fact, two meta-analyses suggest that taking vitamin E supplements might increase a person's risk of dying early. One documented an increased risk of death in people taking 400 IU of vitamin E or more daily; the other found a slightly higher risk of mortality with vitamin E either alone or combined with up to four other antioxidants. These findings, coupled with other research showing no beneficial effects from vitamin E supplements for heart disease, cancer, or cognitive decline (see “Mind and Memory”), make a strong case for avoiding these amber-colored capsules altogether.

Vitamin E exists in eight different chemical forms, but only one, alpha tocopherol, meets human requirements. In the body, it functions as an antioxidant (see “Understanding antioxidants”) and also plays a role in immune functioning and blood cloting.

Nuts, seeds, and vegetable oils (as well as salad dressings and margarines made from these oils) are the best food sources of vitamin E. NHANES surveys suggest that most Americans don’t get the RDA for vitamin E, but these estimates are likely lower than reported because people don’t typically recall how much fat (often vegetable oils) they add during cooking.

**Selected food sources of vitamin E**

<table>
<thead>
<tr>
<th>Food</th>
<th>Milligrams (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonds, dry roasted, 1 ounce</td>
<td>7.4</td>
</tr>
<tr>
<td>Sunflower seeds, dry roasted, 1 ounce</td>
<td>6.0</td>
</tr>
<tr>
<td>Sunflower oil, 1 tablespoon</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Source: USDA National Nutrient Database for Standard Reference
### Heart disease

As is the case with many vitamins, observational studies suggested that people with higher vitamin E intakes were less likely to develop heart disease. But in 2005, results from the Women's Health Study, a randomized trial that followed about 36,000 women for more than 10 years, showed that an every-other-day supplement of 600 IU of vitamin E did not reduce the risk of having a heart attack or stroke. However, it did decrease the risk of dying from cardiovascular disease by about 25%.

Expectations for vitamin E fade further as the results from other randomized trials are considered. The Heart Outcomes Prevention Evaluation–The Ongoing Outcomes (HOPE-TOO) study included almost 4,000 people, ages 55 and over, with existing vascular disease or diabetes. Half were randomized to 400 IU of vitamin E daily, and the others to a placebo. After seven years, the vitamin E did not provide any more protection against heart disease or cancer than the placebo. In addition, the vitamin E takers were more likely to suffer heart failure and to be hospitalized for the condition.

The Physicians' Health Study (see “Vitamin C”) was another randomized trial that also found no benefit from 400 IU of vitamin E taken every other day for preventing heart disease, stroke, or death from heart disease. In fact, vitamin E increased the risk of bleeding (hemorrhagic) stroke.

The GISSI-Prevenzione trial was another large randomized trial that tested whether vitamin E supplements reduce the risk of heart disease, enrolling Italian patients with recent heart attacks and randomizing them to a vitamin supplement (300 mg per day) or usual care. No benefits were seen for any outcome, including total deaths or recurrent heart attacks.

### Cancer

Some observational studies have linked higher vitamin E intakes with a lower risk of breast and prostate cancers, but not consistently. And findings from the Women's Health Study, in which healthy women ages 45 and older took 600 IU of vitamin E or a placebo every other day for 10 years, showed no difference in cancer rates between the two groups.

In October 2008, the National Cancer Institute halted a study designed to test whether 200 mcg of selenium and 400 IU of vitamin E, taken alone or in combination, could lower the risk of prostate cancer. The trial was slated to last eight years but was stopped after just five. Researchers were concerned that taking the supplements might do more harm than good, based on a slight increase in prostate cancer rates among the men taking vitamin E alone.

A further trial to determine the long-term effect of vitamin E and selenium on the risk of prostate cancer among relatively healthy men was published in 2011. Between 2001 and 2004, researchers enrolled almost

<table>
<thead>
<tr>
<th>Food</th>
<th>Vitamin E (IU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safflower oil, 1 tablespoon</td>
<td>4.6</td>
</tr>
<tr>
<td>Peanut butter, 2 tablespoons</td>
<td>2.9</td>
</tr>
<tr>
<td>Peanuts, dry roasted, 1 ounce</td>
<td>2.2</td>
</tr>
<tr>
<td>Corn oil, 1 tablespoon</td>
<td>1.9</td>
</tr>
<tr>
<td>Spinach, boiled, 1/2 cup</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Source: USDA National Nutrient Database for Standard Reference
35,000 men in the United States, Canada, and Puerto Rico, all aged 50 to 55 or older and with a prostate-specific antigen no higher than 4.0. The men were randomly divided into four roughly equal-sized groups: One group received 200 mg of selenium a day; one group received 400 IU of vitamin E a day; one group received both supplements; and a final group received only placebos. Contrary to expectations, the fewest cases of prostate cancer actually occurred in the placebo group, in which 529 men developed prostate cancer; compared with 575 in the selenium-alone group; 555 in the vitamin E–plus-selenium group; and 620 men in the vitamin E–alone group. Overall, the daily vitamin E supplement alone actually significantly increased the risk of prostate cancer among these healthy men.

**Mind and memory**

Despite some promising early suggestions that large amounts of vitamin E might slow the progress of Alzheimer’s, results from research have been disappointing. In a study of about 770 people with mild cognitive impairment, often a precursor to Alzheimer’s disease, 2,000 IU of vitamin E per day showed no benefit in slowing progression of the disease compared with a placebo. However, study participants who took vitamin E supplements were able to avoid being institutionalized longer than those who did not.

**Eye disorders**

People whose diets include about 30 IU of vitamin E daily have about a 20% lower risk of developing age-related macular degeneration, a leading cause of vision loss in people over 60, compared with people who get less than the RDA according to prospective cohort studies. Similarly, taking vitamin E supplements appeared to lessen the risk of cataracts. But overall, the evidence to support vitamin E for preventing either disorder has been inconsistent. The Age-Related Eye Disease Study found that the following combination of vitamins and minerals may help protect against advanced age-related macular degeneration (AMD). Copper is added to the mix because high levels of zinc may cause copper deficiency:

- 500 mg vitamin C
- 400 IU vitamin E
- 15 mg beta carotene
- 80 mg zinc
- 2 mg copper (cupric oxide).

**Recommendation:** Do not take vitamin E supplements unless you have AMD and are taking the vitamin in consultation with your health care provider. If you take a multivitamin, make sure it does not contain more than 100 to 200 IU of vitamin E.

**Vitamin K**

- **Men:** 120 mcg
- **Women:** 90 mcg

This relatively unknown vitamin got its name from koagulation, the German word for coagulation (blood clotting), because vitamin K is essential for that process. Vitamin K also helps produce a key protein used in bone remodeling, and blocks substances that speed the breakdown of bone. The vitamin also helps regulate calcium excretion from the body in urine.

Vitamin K is found in green leafy vegetables, certain fruits, and commonly used cooking oils. People who shy away from salads and other greens may be low in this vitamin. If you take the blood-thinning medication warfarin (Coumadin), it's important to keep your vitamin K intake about the same every day, because the drug interferes with the way vitamin K helps produce clotting proteins. The more vitamin K you consume, the more warfarin you need to reach the desired anti-clotting levels.
Selected food sources of vitamin K

<table>
<thead>
<tr>
<th>Food</th>
<th>Micrograms (mcg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kale, frozen, boiled, 1/2 cup</td>
<td>574</td>
</tr>
<tr>
<td>Spinach, raw, 1 cup</td>
<td>145</td>
</tr>
<tr>
<td>Broccoli, cooked, 1/2 cup</td>
<td>220</td>
</tr>
<tr>
<td>Romaine lettuce, 1 cup</td>
<td>57</td>
</tr>
<tr>
<td>Cabbage, raw, 1 cup</td>
<td>42</td>
</tr>
<tr>
<td>Kiwi fruit, 1 medium</td>
<td>31</td>
</tr>
<tr>
<td>Blueberries, 1 cup</td>
<td>28</td>
</tr>
<tr>
<td>Red or green seedless grapes, 1 cup</td>
<td>23</td>
</tr>
<tr>
<td>Canola oil, 1 tablespoon</td>
<td>17</td>
</tr>
<tr>
<td>Iceberg lettuce, 1 cup</td>
<td>13</td>
</tr>
</tbody>
</table>

Source: USDA National Nutrient Database for Standard Reference

Fractures

Low vitamin K levels have been linked to a higher risk of hip fracture in at least two epidemiological studies, but other research shows no association between dietary vitamin K and bone mineral density, bone strength, or fracture rates.

**Recommendation**: If you take warfarin and a multivitamin, check to see if it contains vitamin K, which is found in some preparations in amounts ranging from 10 mcg to 80 mcg. For people who usually get a fair amount of vitamin K from food, the extra vitamin K found in a multivitamin is probably not enough to affect your daily warfarin requirement. But if you get little or no vitamin K in your diet, even a small amount (25 mcg) could upset the balance between vitamin K and warfarin and require a higher daily dose of the drug. Consult your health care provider for more detailed advice.

Calcium

- **Ages 19–50**: 1,000 mg
- **Ages 51 and older**: 1,200 mg

Mention calcium, and most people think of bones. It’s true that calcium builds strong bones and teeth, but it
also helps muscles to contract, blood to clot, and nerves to send signals to one another.

People who eat a couple of servings of dairy products along with some fruits and vegetables every day probably get close to the RDA of this common mineral. But many Americans, especially women, don’t get recommended amounts of calcium from food. For this reason, doctors often advise women to take calcium supplements to ward off osteoporosis—the bone-weakening disease that is a common cause of fractures and is far more prevalent among women than men.

The IOM’s 2011 report *Dietary Reference Intakes for Calcium and Vitamin D* found that most people get adequate amounts, with the exception of girls ages 9 to 18, who have higher requirements. The report also concluded that some postmenopausal women who take calcium supplements to protect against osteoporosis might be getting too much.

Some experts also believe that the RDAs for calcium may be higher than necessary, given that very high calcium intakes don’t necessarily protect against fractures and may raise the risk of prostate cancer. They also note that in countries such as India, Japan, and Peru, average daily calcium intake is as low as 300 mg per day—yet fractures are far less common in those countries than in the United States. However, other important bone health factors, such as level of physical activity and amount of sunlight, could account for the difference.

The U.S. Preventive Services Task Force has issued a new “draft” recommendation regarding the benefits and risks of using calcium and vitamin D supplements. There is not enough evidence, it says, to determine if the two supplements taken together can prevent bone fractures or cancer, and in older woman they may even lead to kidney stones. (For more information on the USPSTF report, see the vitamin D section). More detail on calcium and each of these conditions is found below.

### Selected food sources of calcium

<table>
<thead>
<tr>
<th>Food</th>
<th>Milligrams (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yogurt, plain, 1 cup</td>
<td>415</td>
</tr>
<tr>
<td>Cheddar cheese, 1 ounce</td>
<td>306</td>
</tr>
<tr>
<td>Milk, nonfat, 1 cup</td>
<td>302</td>
</tr>
<tr>
<td>Yogurt, fruit, low-fat, 1 cup</td>
<td>245–384</td>
</tr>
<tr>
<td>Orange juice, calcium-fortified, 6 ounces</td>
<td>200–260</td>
</tr>
<tr>
<td>Tofu, firm, made with calcium sulfate, 1/2 cup</td>
<td>204</td>
</tr>
<tr>
<td>Salmon, pink, canned, with bones</td>
<td>181</td>
</tr>
<tr>
<td>Cottage cheese, 1% milk fat, 1 cup</td>
<td>138</td>
</tr>
</tbody>
</table>

*Source: USDA National Nutrient Database for Standard Reference*
Fractures

Although calcium is clearly important for sturdy bones, evidence that a high calcium intake can prevent fractures isn’t as strong you might think. For example, observational results from the Physicians’ Health Study and Nurses’ Health Study showed that people who drank no more than one glass of milk per week weren’t any more likely to break a hip or forearm than were those who drank two or more glasses per week. And a meta-analysis of prospective trials found no association between calcium intake and fracture risk. What’s more, the combined results of randomized trials that compared calcium supplements with a placebo showed that calcium supplements did not protect against fractures of the hip or other bones.

Because many people are low in vitamin D, which is crucial for calcium absorption, studies that look at the two nutrients together may be a fairer test. A trial of 36,000 healthy postmenopausal women (conducted as part of the Women's Health Initiative) found that taking calcium and vitamin D supplements cut hip fracture rates by only 12% overall. Yet when researchers analyzed the impact on particular subsets of women, they found greater benefits for two groups. Women of any age in the study who consistently took the supplements (as opposed to those who tended to miss doses) had a 29% reduction. The best supplement for strong bones, however, is regular exercise. And, as previously mentioned, the new draft recommendations from the USPSTF conclude that there is insufficient evidence to conclude that vitamin D and calcium supplements prevent fractures.

High blood pressure and heart disease

Some research suggests a low calcium intake may contribute to high blood pressure, but calcium’s exact role in hypertension is unknown. One theory holds that a lack of calcium in the diet predisposes your body to retain sodium, which raises blood pressure. For this reason, it may be especially important that salt-sensitive people with hypertension get enough calcium. (Nearly half of all people with high blood pressure are salt-sensitive, meaning their blood pressure rises in relation to the amount of salt in their diet.)

Efforts to control blood pressure with calcium supplements have had mixed results. Studies found that supplements successfully reduced blood pressure in pregnant women with elevated blood pressure. But clinical trials involving people with essential hypertension (the type with no known cause) have been largely disappointing. For most people, calcium supplements either made no difference or reduced blood pressure only slightly—by an average of 1 to 2 millimeters of mercury (mm Hg) in the systolic reading (the first and higher number in a blood pressure reading). Although some people experienced larger reductions in blood pressure with the supplements, there seems to be no common denominator, such as race or sex, among those who achieved such gains.

Most importantly, calcium supplements are actually linked to higher risk of heart attacks in randomized trials. A meta-analysis of nine randomized controlled trials found that people who were assigned calcium supplements had about a 25% higher risk of heart attacks, compared with placebo.

Cancer

Many observational studies show that people whose diets are rich in calcium and dairy products tend to have a lower risk of colon cancer. Less certain are findings that suggest some protective effect for lung and breast cancers. However, some studies have linked calcium and dairy intake to ovarian cancer and prostate cancer. Data from the Health Professionals Follow-up Study found that men who got more than 2,000 mg of

<table>
<thead>
<tr>
<th>Food</th>
<th>Calcium (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinach, cooked, 1/2 cup</td>
<td>120</td>
</tr>
<tr>
<td>Chinese cabbage, raw, 1 cup</td>
<td>74</td>
</tr>
</tbody>
</table>

Source: USDA National Nutrient Database for Standard Reference
calcium a day were almost three times as likely to develop advanced prostate cancer as men who got less than 500 mg a day. The Nurses' Health Study investigators noted that milk, which is a major source of calcium, might contain another substance that raises ovarian cancer risk. The risk, if it is real, is probably not caused by calcium itself—since calcium supplements seem safe for women—but by the high levels of natural hormones found in milk.

A systematic review and series of meta-analyses at the Imperial College London found that, in observational studies, dietary calcium is linked to a modestly lower risk of colorectal cancer, but also a modestly higher risk of prostate cancer.

**Kidney stones**

The Women's Health Initiative was a randomized clinical trial of calcium and vitamin D supplements among more than 36,000 postmenopausal women between the ages of 50 and 79. Half were given daily doses of 1,000 mg of calcium carbonate and 400 IU of vitamin D3, and half were given a placebo, for seven years. Among the women taking active pills, 449 developed kidney stones, compared with only 381 in the placebo group.

**Recommendation:** If you avoid dairy products completely, you probably don’t meet the RDA for calcium, so a supplement may be considered, although the evidence that this actually prevents fractures is not strong. Most calcium supplements are made with either calcium carbonate or calcium citrate. Calcium carbonate supplements, which include antacid pills like Tums and Rolaids, are usually less expensive and contain twice as much calcium as citrate tablets. They require stomach acid to be absorbed, so they're best taken just after a meal. Calcium citrate isn't as dependent on stomach acid, so it can be taken any time. You should choose calcium citrate if you take medications that reduce stomach acid (such asPrevacid, Prilosec, Tagamet, and Zantac). Also, the body can absorb only about 500 to 600 mg of the mineral at a time, so divide your dose if you take more than that amount. Remember that calcium supplements may also increase risk of other diseases, such as heart attacks, kidney stones, and (in men) prostate cancer, so trying to get your calcium from your diet is still likely the safest approach for most people.

**Magnesium**

- Ages 19–30: men, 400 mg; women, 310 mg
- Ages 31 and older: men, 420 mg; women, 320 mg

If you eat whole-grain bread and your tap water is “hard”—meaning it contains relatively high levels of minerals—you probably consume more magnesium than a person who favors white bread and drinks “soft” water. Why? The refining process used to make white flour strips away the magnesium-rich germ and bran layer of the wheat, along with a number of other nutrients (see Figure 5). And hard water, which is more common in the Midwestern and Southwestern states, contains more magnesium than soft water. Magnesium is also found in legumes (beans and peas), nuts, and seeds, as well as many vegetables.
Important nutrients disappear when whole wheat or other grains are refined. As this baker's dozen shows, the losses can be dramatic. For example, refined wheat flour has only 5% of the vitamin E of whole wheat flour.

Many American adults don't get recommended amounts of this mineral, which is key for proper muscle, nerve, and immune function. Magnesium also plays a role in maintaining normal blood pressure and blood sugar.

Selected food sources of magnesium

<table>
<thead>
<tr>
<th>Food</th>
<th>Milligrams (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halibut, cooked, 3 ounces</td>
<td>90</td>
</tr>
</tbody>
</table>

Source: USDA National Nutrient Database for Standard Reference
<table>
<thead>
<tr>
<th>Food Item</th>
<th>Magnesium (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonds, dry roasted, 1 ounce</td>
<td>80</td>
</tr>
<tr>
<td>Soybeans, cooked, 1/2 cup</td>
<td>75</td>
</tr>
<tr>
<td>Cereal, shredded wheat biscuits, 2 large</td>
<td>55</td>
</tr>
<tr>
<td>Potato, baked, with skin, 1 medium</td>
<td>50</td>
</tr>
<tr>
<td>Peanut butter, smooth, 2 tablespoons</td>
<td>50</td>
</tr>
<tr>
<td>Yogurt, plain, nonfat, 1 cup</td>
<td>45</td>
</tr>
<tr>
<td>Baked beans, vegetarian, 1/2 cup</td>
<td>40</td>
</tr>
<tr>
<td>Banana, 1 medium</td>
<td>30</td>
</tr>
<tr>
<td>Bread, whole-wheat, 1 slice</td>
<td>25</td>
</tr>
</tbody>
</table>

**Source:** USDA National Nutrient Database for Standard Reference

**Diabetes**

Magnesium may influence the release and control of insulin, the hormone that regulates blood sugar levels. People with Type 2 diabetes (the most common form of the disease) have high blood sugar levels because their bodies have become resistant to insulin or are not producing enough insulin. They also frequently have low magnesium levels. In the Nurses’ Health Study and Health Professionals Follow-up Study, researchers found a higher incidence of type 2 diabetes among men and women with low magnesium intakes. The Iowa Women’s Health Study, which followed a group of older women for several decades, showed that women who ate more whole grains, dietary fiber, and magnesium were less likely to develop diabetes.

However, small randomized trials of magnesium supplementation have yielded conflicting results. One, which tested high-dose (300 mg) liquid magnesium supplements in people with diabetes and low magnesium levels, suggested the mineral helps improve blood sugar control. But another, which tested even higher doses (600 mg), showed no such benefit.

**High blood pressure and heart disease**

A recent meta-analysis of 22 randomized controlled trials found that magnesium supplements (in a dose range of 120–973 mg per day, with an average of 410 mg per day) lowered blood pressure, with an average decrease in systolic blood pressure of 3–4 mm Hg and in diastolic blood pressure of 2–3 mm Hg. The researchers called it “a small but clinically significant reduction in blood pressure” and worthy of larger-scale investigation.

Clinically low blood magnesium levels (below the normal range) are clearly related to higher risk of heart electrical disturbances and death. Such levels are typically seen in people with kidney disease or who are taking certain drugs that lower magnesium levels. Within the normal range of blood magnesium levels, the evidence is less clear. Higher dietary or blood levels of magnesium are associated with a lower risk of heart...
disease in some observational studies, but not in all such studies. For example, higher dietary intake of magnesium was associated with lower risks of sudden cardiac death in women, according to an observational study by Harvard-affiliated scientists. Low magnesium may also affect the heart's electrical rhythms, resulting in problems such as arrhythmia (an irregular heartbeat). Two small studies that gave magnesium supplements to people with heart disease documented improved exercise tolerance (the ability to exercise without breathing difficulties or discomfort).

**Recommendation:** Magnesium supplements modestly lower blood pressure, but high doses should not be taken without a doctor's guidance. Popular multivitamin brands contain between 10% to 30% of the RDA for magnesium. Getting your magnesium from healthy foods, such as nuts, fish, certain fruits, and whole grains, is your best bet

**Potassium**

- **4,700 mg**

Bananas are often touted as a good source of potassium, but potatoes—either sweet or white—also contain this often-neglected nutrient. Most Americans get barely half of the recommended amount of potassium in their diets.

Potassium is necessary for the normal functioning of all cells. It regulates the heartbeat, ensures proper function of the muscles and nerves, and is vital for synthesizing protein and metabolizing carbohydrates.

Thousands of years ago, when humans roamed the earth gathering and hunting, potassium was abundant, while sodium was scarce. The so-called Paleolithic diet delivered about 16 times more potassium than sodium. Today, the average American diet contains about twice as much sodium as potassium, thanks to the preponderance of salt hidden in processed or prepared foods. This imbalance, which is at odds with how humans evolved, is thought to be a major contributor to high blood pressure, which affects one in three American adults.

<table>
<thead>
<tr>
<th>Food</th>
<th>Milligrams (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet potato, baked, 1 medium</td>
<td>694</td>
</tr>
<tr>
<td>Tomato paste, 1/4 cup</td>
<td>664</td>
</tr>
<tr>
<td>Baked potato, without skin, 1 medium</td>
<td>610</td>
</tr>
<tr>
<td>White beans, canned, 1/2 cup</td>
<td>595</td>
</tr>
<tr>
<td>Yogurt, plain, low-fat, 8 ounces</td>
<td>531</td>
</tr>
<tr>
<td>Halibut, cooked, 3 ounces</td>
<td>490</td>
</tr>
<tr>
<td>Soybeans, green (edamame), cooked, 1/2 cup</td>
<td>485</td>
</tr>
</tbody>
</table>

*Source: USDA National Nutrient Database for Standard Reference*
**High blood pressure**

Diets high in potassium reduce blood pressure compared with potassium-poor diets, according to a number of observational studies and randomized trials. The results of the Dietary Approaches to Stop Hypertension (DASH) trial lends further support for a potassium-rich diet's beneficial effect on blood pressure. The control diet contained an average of 3.5 daily servings of fruits and vegetables, which provided 1,700 mg of potassium per day, while there were two intervention diets: a fruit- and vegetable-rich diet that included an average of 8.5 daily servings of fruits and vegetables, providing 4,100 mg of potassium per day; and a “combination” diet that included the same 8.5 servings of fruits and vegetables and also included low-fat dairy products and reduced sugar and red meats. Overall, the fruit and vegetable-rich diet lowered blood pressure by 2.8 and 1.1 mm Hg in people with normal blood pressure, and by 7.2 and 2.8 mm Hg in people with high blood pressure, where the first number is systolic and the second is diastolic blood pressure, respectively. The “combination” diet lowered blood pressure even more, by as much as 12 mm Hg.

As we have learned for other supplements, the blood pressure effects of potassium supplements alone are much weaker than the effects of eating more fruits and vegetables. However, one meta-analysis that combined results from 33 small trials found that potassium supplements do lower blood pressure slightly, especially in people with high blood pressure or those whose diets include a lot of salt.

**Stroke**

High blood pressure is a leading risk factor for stroke, so it's no surprise that higher potassium is also associated with lower stroke incidence. One prospective study that followed more than 43,000 men for eight years found that men who consumed the highest amounts of dietary potassium (a median of 4,300 mg per day) were 38% less likely to have a stroke as those whose median intake was just 2,400 mg per day. However, a similar prospective study that followed more than 85,000 women for 14 years found a more modest association between potassium intake and the risk of stroke. Additional research has mostly upheld these findings, with the strongest evidence to support high dietary potassium seen in people with high blood pressure and in blacks, who are more prone to high blood pressure than whites.

**Recommendation**: Higher potassium consumption from foods, especially fruits and vegetables, lowers blood pressure and is linked to lower risk of heart disease and stroke. Never take potassium supplements without a doctor’s prescription, as this can easily cause high blood potassium levels that are dangerous.

**Selenium**

- **55 mcg**

Selenium is a trace mineral known for its antioxidant properties (see “Understanding antioxidants”), as
well as its role in regulating thyroid function and the immune system. Very low intakes cause selenium deficiency, and in very high doses, selenium is toxic. Both true selenium deficiency and toxicity are each rare in the United States.

The amount of selenium in foods varies widely, as it depends on the selenium content of the soil where plants are grown or animals are raised. For example, the high plains of northern Nebraska and the Dakotas are rich in selenium, and people living there have the highest selenium intakes in the United States. People who snack on Brazil nuts (found in some canned nut mixtures) may also have high selenium levels, because these nuts contain as much as 10 times the RDA for selenium—a value so high that you shouldn't eat them on a regular basis. Meats, breads, and other nuts are the most common sources of selenium in the American diet, and most people get the RDA. Selenium also comes in many subtypes, and these subtypes are far more diverse in the diet compared with the types commonly found in supplements.

To determine the degree to which factors beyond diet might influence selenium levels in the body, Harvard researchers examined various factors related to selenium measured in toenail clippings, a good biomarker of long-term selenium levels. Active cigarette smoking was related to lower selenium levels, with lowest levels amongst those who smoked the most cigarettes per day. People with higher body mass index (BMI) and those living in U.S. states with more selenium in the soil also had higher levels.

### Selected food sources of selenium

<table>
<thead>
<tr>
<th>Food</th>
<th>Micrograms (mcg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil nuts, 1 ounce</td>
<td>544</td>
</tr>
<tr>
<td>Tuna, light, canned in oil, 3 ounces</td>
<td>63</td>
</tr>
<tr>
<td>Beef, cooked, 3-1/2 ounces</td>
<td>35</td>
</tr>
<tr>
<td>Cod, cooked, 3 ounces</td>
<td>32</td>
</tr>
<tr>
<td>Chicken breast, roasted, 3½ ounces</td>
<td>20</td>
</tr>
<tr>
<td>Noodles, enriched, boiled, 1/2 cup</td>
<td>15</td>
</tr>
<tr>
<td>Egg, whole, 1 medium</td>
<td>14</td>
</tr>
<tr>
<td>Cottage cheese, 2% fat, 1/2 cup</td>
<td>12</td>
</tr>
</tbody>
</table>

**Source:** USDA National Nutrient Database for Standard Reference

### Cancer

High selenium intakes and high blood levels of selenium are associated with a lower than average risk of dying from cancer, including lung, colon, and prostate cancers, according to a handful of observational studies. And people who live in areas of the United States with low soil selenium levels have higher rates of nonmelanoma skin cancer. A study of people recruited from dermatology clinics who took 200 mcg of selenium daily found that while the supplement did not affect skin cancer recurrence rates, it did lower the
number of cases and deaths from all cancers combined. A 34-year follow-up of a Swedish cohort study, ULSAM, found that smokers with low selenium levels at age 50 had higher rates of prostate cancer.

However, the Selenium and Vitamin E Cancer Prevention Trial (SELECT) found no benefit from selenium supplements (see “Vitamin E”, for more details). In fact, the men who took selenium had slightly higher rates of diabetes than men taking a placebo.

**Diabetes**

In analyses from the SELECT trial and the Nutritional Prevention of Cancer trial, selenium supplements did not influence the future risk of diabetes. However, in a large observational analysis in two separate U.S. cohorts, higher selenium levels in toenails were linked to lower risk of diabetes. More research is needed to see whether these conflicting results are due to differences in the dosing, source (diet vs. supplements), underlying population risk, or residual confounding factors (unmeasured differences).

**Bottom line:** There are no known benefits to selenium supplements.

**Zinc**

- **Men:** 11 mg
- **Women:** 8 mg

Found in cells throughout the body, zinc helps your immune system fight off bacteria and viruses, which explains why it’s been investigated as a potential treatment for the common cold. Your body relies on zinc for wound healing as well your ability to taste and smell. Most Americans get the RDA for zinc from their diets, since the mineral is found in seafood, meat, poultry, dairy products, and nuts.

<table>
<thead>
<tr>
<th>Food</th>
<th>Milligrams (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oysters, cooked, 6 medium</td>
<td>76</td>
</tr>
<tr>
<td>Beef shank, cooked, 3 ounces</td>
<td>9</td>
</tr>
<tr>
<td>Crab, Alaskan king, cooked, 3 ounces</td>
<td>7</td>
</tr>
<tr>
<td>Turkey, dark meat, cooked, 3 ounces</td>
<td>3.8</td>
</tr>
<tr>
<td>Pork, cooked, 3 ounces</td>
<td>2.5</td>
</tr>
<tr>
<td>Yogurt, fruit, low-fat, 1 cup</td>
<td>1.6</td>
</tr>
<tr>
<td>Milk, nonfat, 1 cup</td>
<td>1</td>
</tr>
</tbody>
</table>

**Source:** USDA National Nutrient Database for Standard Reference
The common cold

After a 1984 study concluded that sucking on zinc lozenges could help snuff out the common cold, drug stores began stocking an array of these somewhat odd-tasting lozenges. Since the mid-1980s, the result of 14 double-blind, placebo-controlled trials has ended in a draw: half showed that zinc lozenges shortened the duration of the common cold, and half showed no effect. Following the recommended advice of a lozenge every two to three hours while you're awake will put you well above 40 mg, the safe upper limit for zinc, as many products contain between 13 to 23 mg per lozenge. High doses of oral zinc can cause gastrointestinal problems or mouth irritation. Avoid zinc nasal gels and nasal sprays: there have been several reports of people losing their sense of smell after using these products.

Cancer

An observational study among older men in Sweden found that high dietary zinc consumption was associated with a lower risk of death from prostate cancer among older men with diagnosed prostate cancer.

**Recommendation:** If you try zinc lozenges to shorten the duration of a cold, read the label to be sure you’re not taking more than the RDA. Most multivitamins contain the RDA for zinc.

SPECIAL SECTION: Does your diet deliver the daily recommended dose?

It’s easy to look up the RDA for every vitamin and mineral based on your age and gender (see Tables 1 and 2, or use the searchable database at www.ahealthyme.com/Library/NutritionFacts/). But how much of each of these nutrients are you actually getting from the foods you eat every day—and do they meet your RDA?

Focus on food

There are several ways to approach the question of healthy eating. One is the relaxed way—that is, not worrying too much about the details and focusing instead on the big picture: eating a balanced diet that contains a variety of colorful fruits and vegetables, whole grains, beans, nuts, dairy products, seafood, lean meats, and poultry. When choosing what to eat, emphasize nutrient-dense foods, which are packed with vitamins and minerals and have relatively few calories (see "Some nutrient-dense foods").

Some nutrient-dense foods
These foods have a lot of nutrients per calorie.

- Avocados
- Chard, collard greens, kale, mustard greens, spinach
- Bell peppers
- Brussels sprouts
- Mushrooms (crimini and shiitake)
- Potatoes (white or sweet)
- Cantaloupe, papaya, raspberries, strawberries
- Yogurt
• Eggs
• Seeds (flax, pumpkin, sesame, sunflower)
• Beans (garbanzo, kidney, navy, pinto)
• Lentils, peas
• Almonds, cashews, peanuts
• Barley, oats, quinoa, brown rice
• Salmon, halibut, cod, scallops, shrimp, tuna
• Lean beef, lamb, venison
• Chicken, turkey

Try the Mediterranean diet

Another approach is to use the Mediterranean diet as your guide to healthy eating (see “Mediterranean quiz”). This eating pattern, with its emphasis on vegetables, fruits, whole grains, fish, yogurt, beans, and nuts (plus wine in moderation) provides a wide array of vitamins and minerals. Numerous studies affirm the disease-fighting powers of this approach. The first U.S.-based study of the diet confirmed that the more closely people followed the Mediterranean eating style, the lower their risk of dying from either heart disease or cancer. A 2009 study examining the relative importance of each component of the diet found that its life-extending benefits stemmed mainly from drinking wine with meals, eating little meat, and eating lots of vegetables, fruits, nuts, olive oil, and legumes. Another bonus: a two-year-long study found that dieters lost more weight on a Mediterranean diet than a low-fat diet.

Mediterranean quiz

Vegetables (other than potatoes), 4 or more servings a day.
Fruits, 4 or more servings a day.
Whole grains, 2 or more servings a day.
Beans (legumes), 2 or more servings a week.
Nuts, 2 or more servings a week.
Fish, 2 or more servings a week.

How Mediterranean is your diet? Give yourself one point for each “Yes.” If you score 6 or higher, you’re eating like an Aegean.
How Mediterranean is your diet? Give yourself one point for each “Yes.” If you score 6 or higher, you’re eating like an Aegean.

Red and processed meat, 1 or fewer servings a day.

Dairy foods, 1 or fewer servings a day.

More unsaturated fat (olive oil and other liquid vegetable oils) than saturated fat (butter, palm oil, bacon fat, etc.).

Alcohol, 1/2 to 1 drink a day for women, 1 to 2 for men.

### Making healthful food choices

Some essential nutrients are packed into every food group, and certain foods—such as flour, cereal, and salt—are fortified with specific nutrients as well. Vitamin and mineral supplements from a bottle cannot encompass all the biologically active compounds teeming in a well-stocked pantry. A simple apple or piece of broccoli could have plenty of nutrients besides vitamins and minerals that might interact to improve your health. For example, broccoli contains isothiocyanates, which may have anti-tumor properties.

It also pays to remember a few other helpful pieces of advice:

**Limit liquid sugars.** Liquid sugars, which are found in soft drinks, sports drinks, iced teas, and sweetened waters, have no benefits for health and are clearly linked to higher risk of obesity, diabetes, and perhaps heart disease. There is no reason to include these in your diet. Skip the sugary drinks and have some unsweetened tea or sparkling water instead.

**Minimize refined carbohydrates.** Highly processed wheat, rice, and other grains have the same effects in the body as table sugar. So minimize your intake of white bread, French fries, most breakfast cereals, and most high-carbohydrate packaged and processed foods, such as pretzels and chips. Instead, choose whole grains, high-fiber breakfast cereals, brown rice, steel-cut oats, and fruits and vegetables. When choosing carbs, a good rule of thumb is to be sure that they have no more than 10 grams of carbohydrate for every gram of dietary fiber (maximum 10-1 carbohydrate-to-fiber ratio). Even better, if possible, aim for no more than 5 grams of carbohydrate for every gram of dietary fiber (maximum 5-1 carbohydrate-to-fiber ratio).

**Choose healthy fats.** Fish, nuts, and vegetable oils contain healthy monounsaturated and polyunsaturated fats, which help lower heart disease risk. Eat these foods regularly and in moderation. Don't get caught up in the “low-fat” craze (for example, low-fat salad dressing) as you will be limiting your intake of these good fats and will likely instead be eating a diet high in refined carbohydrates. Limit consumption of saturated fat and cholesterol, and especially avoid eating trans fat, found in partially hydrogenated vegetable oils (often used in spreads, baked goods, and fast foods).

**Don't forget fiber.** Eat plenty of foods that contain dietary fiber (the edible, indigestible parts of plant foods). Good sources include fruits, vegetables, whole grains, nuts, and dark chocolate. Fiber from grains helps lower the risk of heart disease. Your daily fiber goal depends on your age and sex, as follows:

- men ages 50 or younger: 38 grams
- men over 50: 30 grams
- women ages 50 or younger: 25 grams
- women over 50: 21 grams.

**Balance energy intake and output.** The energy you take in should equal the energy you use. That means if you are sedentary and 5 feet 4 inches tall, you need far fewer calories to remain at your current weight than an active person who is 6 feet tall.

Most Americans don't eat nearly the recommended amounts of fruits and vegetables (see Figure 6). Preparation time, unfamiliarity, and old habits are common hurdles. Here are some suggestions to break these barriers and boost your intake.

![Figure 6: A diet out of balance](image)

- **Set a goal.** Start by eating one extra fruit or vegetable a day. When you’re used to that, add another and keep going. For example, add fruit to your breakfast cereal every morning. Then try eating a piece of fruit for an after-lunch snack. Next, add at least one vegetable to your dinner plate.

- **Be sneaky.** Adding finely grated carrots or zucchini to pasta sauce, meat loaf, chili, or a stew is one way to get an extra serving of vegetables.

- **Try something new.** It’s easy to get tired of apples, bananas, and grapes. Try a kiwi, mango, fresh pineapple, or some of the more exotic choices now found in many grocery stores.
Blend in. A fruit smoothie (see “Simple fruit smoothie”) is a delicious way to start the day or tide you over until dinner.

Be a big dipper. Try dipping vegetables into hummus or another bean spread, some spiced yogurt, or even a bit of ranch dressing. Slather peanut butter on a banana or slices of apple. Dip fresh or dried fruit in melted dark chocolate.

Spread it on. Try mashed avocado as a dip with diced tomatoes and onions, or as a sandwich spread, topped with spinach leaves, tomatoes, and a slice of cheese.

Start off right. Ditch your morning donut for an omelet with onions, peppers, and mushrooms. Top it with some salsa to wake up your palate. Or boost your morning cereal or oatmeal with a handful of strawberries, blueberries, or dried fruit.

Drink up. Having a 6-ounce glass of low-sodium vegetable juice instead of a soda gives you a full serving of vegetables and spares you 10 teaspoons or more of sugar. You can also make your own vegetable juice with a blender or juicer.

Simple fruit smoothie

This is a great way to use bananas that are beginning to get too ripe. (You can always cut ripe bananas into thick slices, freeze in a plastic bag, and thaw when you’re ready to make another smoothie.)

Makes 1 serving

3/4 cup plain yogurt

1/2 cup berries (fresh or frozen strawberries, blueberries, or other berry of your choice)

1/2 ripe banana

1/2 cup pineapple juice

Optional: 1 tablespoon ground flaxseed (for healthy omega-3 fats)

Put all ingredients in a blender or food processor and blend to combine. You can branch out by adding a dash of ground cinnamon, a splash of vanilla, some mint, or another flavoring.

Give them the heat treatment. Roasting vegetables is easy and brings out new flavors. Cut up onions, carrots, zucchini, asparagus, turnips—whatever you have on hand—coat with olive oil, add a dash of balsamic vinegar, and roast at 350° until done. Grilling is another way to bring out the taste of vegetables. Use roasted or grilled vegetables as a side dish, put them on sandwiches, or add them to salads.

Let someone else do the work. If peeling, cutting, and chopping aren’t your thing, food companies and grocers offer an ever-expanding selection of prepared produce, from ready-made salads to frozen stir-fry mixes and take-along sliced apples and dip.

Improve on nature. Don’t hesitate to jazz up vegetables with spices, chopped nuts, balsamic vinegar, olive oil, or a specialty oil like walnut or sesame oil. Most grocers carry several spice blends made specifically for vegetables. Even a dash of grated Parmesan cheese can liven up the blandest green beans.

Decoding your diet: Dietitian or DIY

If you’re really curious to know how your diet stacks up nutrition-wise, you have two options: hire a professional or do it yourself. To scrutinize your current diet and to set up a plan that precisely meets your nutritional needs, consult a registered dietitian, who can take into account your food preferences and allergies or other health issues (such as lactose intolerance). Many dietitians have access to computer programs and databases that ease the most difficult calculations, such as nutrient analyses of menus. You can ask your clinician for a referral (check to see if your insurance covers the cost of nutritional counseling),
or ask at a local hospital or medical center.

But if you have the time and the inclination to do the work yourself, there are free tools and calculators on the Web that can help. Here are some questions you'll need to ask and some of the Web sites where you can find the answers:

**How many calories do I need?** It depends on your age, height, weight, and activity level. You can get a rough estimate of how many calories you need each day to maintain your weight by simply multiplying your weight by 15. For a more precise figure, which takes into account your activity level, try the calculators at nutritiondata.self.com/tools/calories-burned or www.freedieting.com/tools/calorie_calculator.htm.

In the United States, the average man is 5 feet 9 inches tall and weighs 195 pounds, while the average woman is 5 feet 4 inches tall and weighs 165 pounds. To give an example, an average 50-year-old woman would need 1,914 calories to maintain her weight if she is sedentary (does no exercise whatsoever), but 2,425 calories per day if she is active (exercises moderately for at least half an hour most days of the week).

**Getting the most from foods**

Whether you're a gourmet chef or a novice in the kitchen, you can learn to squeeze the most nutritional benefit from your diet. Choosing nutritious foods is most important, but how you prepare them counts, too. To preserve the nutritional content of foods, try the following:

**Don't forgo frozen or canned.** The fruits and vegetables stocked in supermarket freezer aisles are usually picked ripe and flash frozen, which captures their flavor and seals in nutrients. And larger stores carry everything from old standards like frozen blueberries or chopped broccoli to newer additions like frozen turnip greens, gooseberries, and plantains. Canned fruits and vegetables are also a good alternative, but make sure to choose products that are canned in water and low in salt.

**Steam, stir-fry, grill, or roast vegetables.** Don't get caught up in little details of the “best” way to prepare vegetables. The key step is to buy them and eat them —you'll be doing your body a favor no matter how you prepare them.

**Wrap it up.** Cover any cut fruits or vegetables with airtight wrapping. Cap juice bottles. Refrigerate unused portions.

**Cook it well.** Foods such as meat, fish, and poultry must be cooked well in order to destroy dangerous microorganisms. And cooking can have other benefits, too. Cooking tomatoes, for example, breaks down cell walls, freeing the carotenoid lycopene (see “Vitamin A and carotenoids”) and making it available to the body.

**What do I eat?** For a list of nutrient-dense foods you can incorporate into your meal plan, go to www.whfoods.com/foodstoc.php. To look up the nutrient and calorie content of specific foods—or to find out which foods contain specific nutrients—go to the USDA National Nutrient Database for Standard Reference at ndb.nal.usda.gov/. Another good source of information on specific foods (including brand-name and fast-food items) is CalorieKing, www.calorieking.com. To get an idea of how much you'll need daily from each of the basic food groups, see Table 3.

**Table 3: Daily amounts of basic food groups meeting recommended nutrient intakes at four different calorie levels**

<table>
<thead>
<tr>
<th>Calorie Level</th>
<th>Daily Amounts of Basic Food Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,200 calories</td>
<td>1 cup of whole milk, 1 slice of whole-grain bread, 1 small serving of lean meat, fish, or poultry, 1 serving of vegetables, 1 serving of fruit, 1 tablespoon of vegetable oil, 1 teaspoon of fat-free or low-fat milk.</td>
</tr>
<tr>
<td>1,500 calories</td>
<td>1 cup of whole milk, 1 slice of whole-grain bread, 1 small serving of lean meat, fish, or poultry, 1 serving of vegetables, 1 serving of fruit, 1 tablespoon of vegetable oil, 1 teaspoon of fat-free or low-fat milk.</td>
</tr>
<tr>
<td>2,000 calories</td>
<td>1 cup of whole milk, 1 slice of whole-grain bread, 1 small serving of lean meat, fish, or poultry, 1 serving of vegetables, 1 serving of fruit, 1 tablespoon of vegetable oil, 1 teaspoon of fat-free or low-fat milk.</td>
</tr>
<tr>
<td>2,500 calories</td>
<td>1 cup of whole milk, 1 slice of whole-grain bread, 1 small serving of lean meat, fish, or poultry, 1 serving of vegetables, 1 serving of fruit, 1 tablespoon of vegetable oil, 1 teaspoon of fat-free or low-fat milk.</td>
</tr>
</tbody>
</table>
How do I know if my diet provides what I need? You can track your daily intake and have it analyzed by the USDA’s SuperTracker, at www.supertracker.usda.gov/foodtracker.aspx. (This program is free, but you’ll need to register first.) Entering everything you eat can be cumbersome, but if you try it for just a few days, you’ll learn a lot about food quality and how to get the best nutritional return on the calories you consume.

A typical diet vs. a nutrient-dense diet

Presented below is a hypothetical daily menu from a middle-aged woman, provided by Ellen di Bonaventura, a clinical dietitian at the Harvard-affiliated Massachusetts General Hospital in Boston. Notice that this menu meets the recommended amounts for only about half the vitamins and minerals (10 of 21). That’s because it includes less than half of the recommended amount of vegetables and no fruit at all. This woman could meet her daily needs by popping a multivitamin, or she could add a few pieces of fruit and another cup of vegetables, which would give her the added benefit of fiber and phytonutrients—compounds found in plants thought to have a role in health.

Can you really get all your nutrients from food? Yes. Below, you’ll also find di Bonaventura’s healthy sample

<table>
<thead>
<tr>
<th>Calorie level</th>
<th>1,200</th>
<th>1,800</th>
<th>2,400</th>
<th>2,800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits</td>
<td>1 cup</td>
<td>1.5 cups</td>
<td>2 cups</td>
<td>2.5 cups</td>
</tr>
<tr>
<td>Vegetables</td>
<td>1.5 cups</td>
<td>2.5 cups</td>
<td>3 cups</td>
<td>3.5 cups</td>
</tr>
<tr>
<td>Grains</td>
<td>4 1-ounce equivalents*</td>
<td>6 1-ounce equivalents</td>
<td>8 1-ounce equivalents</td>
<td>10 1-ounce equivalents</td>
</tr>
<tr>
<td>Lean meat and beans</td>
<td>3 1-ounce equivalents**</td>
<td>5 1-ounce equivalents</td>
<td>6.5 1-ounce equivalents</td>
<td>7 1-ounce equivalents</td>
</tr>
<tr>
<td>Dairy (choose fat-free or low-fat)</td>
<td>2 cups***</td>
<td>3 cups</td>
<td>3 cups</td>
<td>3 cups</td>
</tr>
<tr>
<td>Oils</td>
<td>17 grams</td>
<td>24 grams</td>
<td>31 grams</td>
<td>36 grams</td>
</tr>
<tr>
<td>Discretionary calories</td>
<td>171</td>
<td>195</td>
<td>362</td>
<td>426</td>
</tr>
</tbody>
</table>

*1-ounce equivalent = 1/2 cup cooked rice, pasta, or cooked cereal; 1 ounce dry pasta or rice; 1 slice bread; 1 small muffin; 1 cup ready-to-eat cereal flakes.

**1-ounce equivalent = 1 ounce lean meat, poultry, or fish; 1 egg; 1/4 cup cooked dry beans or tofu; 1 tablespoon peanut butter; 1/2 ounce nuts or seeds.

***1 cup = 1 cup milk or yogurt, 1.5 ounces natural cheese, or 2 ounces processed cheese.

diet, which meets the daily vitamin and mineral needs of a 50-year-old woman without relying on fortified foods or a supplement. Because many weight-conscious women try to limit their calories (either to maintain their weight or to lose weight), the menu provides just 1,200 calories—a level often recommended for female dieters. This leaves some discretionary calories for additional nutrient-dense foods and a treat—say, a piece of chocolate, a dish of sorbet, or a glass of wine. Notice that the menu provides more than 1,200 mg of calcium, the amount recommended for women over age 50—thanks to the calcium in nutrient-dense foods such as nonfat dairy products and bok choy (Chinese cabbage).

**Nutrient content of two sample diets**

The menus below compare the vitamin and mineral content in a day's worth of food from two different diets. Sample menu 1 was based on a typical food report from a 50-year-old woman who consulted a dietitian. It provides about 2,000 calories, which many middle-aged women consume daily.

Sample menu 2 represents a diet created by dietitian Ellen di Bonaventura designed specifically to meet the daily DRIs for a 50-year-old woman without relying on fortified foods or supplements. This diet provides a little less than 1,200 calories, an amount often recommended for women who are trying to lose weight.

The box below each menu lists the vitamins and minerals provided by the diet, with the DRIs listed in parentheses. Notice that even though sample menu 1 contains far more calories, it meets the DRIs for only about half of the vitamins and minerals (bold entries signal the vitamins and minerals that AREN't met by the diet). Sample menu 2 meets all the DRIs, thanks to an abundance of nutrient-dense foods.

**Sample menu #1**

**Breakfast**
- 1 whole wheat bagel
- 2 tablespoons light cream cheese
- 10 ounces coffee
- 2 ounces skim milk
- 6 ounces nonfat strawberry yogurt

**Lunch**
- 2 slices oatmeal bread
- 1 tablespoon light mayonnaise
- 4 ounces tuna, canned in water
- 1 ounce chips
- 12 ounces diet cola

**Snack**
- 1 oat and honey granola bar
- 6 ounces black tea with 1 teaspoon milk and 1/2 teaspoon sugar

**Dinner**
- 5 ounces grilled chicken marinated in 2 tablespoons Italian dressing
- 1/2 cup white rice
• 1 tablespoon margarine
• 1 cup broccoli florets
• 5 ounces white wine

**Dessert**

• 1/2 ounce dark chocolate
• (2 small pieces)

**Menu provides 1,959 calories**

• 32% from fat
• 43% from carbohydrate
• 20% from protein
• 5% from alcohol

**Sample menu #2**

**Breakfast**

• 8 ounces nonfat yogurt
• 1/2 cup sliced papaya
• 1/2 cup sliced kiwi
• 1 ounce (14 halves) walnuts
• 4 ounces skim milk

**Lunch**

• 1 small whole-wheat pita
• Green salad (1 cup dark green lettuce, 1 red or orange pepper, 1 cup grape tomatoes, 1/2 cup edamame beans, 1 tablespoon unsalted sunflower seeds)
• Salad dressing made with 1 tablespoon olive oil, balsamic vinegar, and pepper

**Dinner**

• 4 ounces broiled wild salmon and yogurt sauce (1 tablespoon Greek-style nonfat yogurt, 1 teaspoon lemon juice, 1 clove chopped garlic)
• 1/4 cup cooked barley and
• 1/4 cup cooked lentils with spices to taste
• 1 cup steamed baby bok choy

**Menu provides 1,155 calories:**

• 33% from fat
• 40% from carbohydrate
27% from protein

Should you take supplements?

In the 1980s, many nutritionists and some physicians began to recommend (and take) vitamin supplements. However, as described in “Cast of Characters: Vitamin A to zinc”, the evidence for the health benefits of most supplements is not strong. Notable exceptions are fish oil for cardiovascular disease and vitamin D for bone health. Although foods that contain vitamin A and beta carotene, as well as vitamins B, C, and E, are clearly good for health, taking supplements of these vitamins has no proven health benefits.

Many people who take supplements subscribe to the idea that “more is better” without carefully considering the arguments for or against their choices. They may take a handful of other supplements along with their multivitamin. At best, they may be wasting their money. At worst, they may be endangering their health....It's generally safest to wait for evidence to accumulate before jumping on the supplement bandwagon. Consider the potential risks, possible benefits, and costs.

What about a simple multivitamin? These pills (which usually also contain multiple minerals) are the most popular among all dietary supplements—50% of Americans take them on a regular basis, shelling out more than $20 billion annually on these products. On an individual basis, a daily multivitamin won't set you back that much: a year’s supply of many popular brands costs about $30.

However, despite widespread belief that multivitamins will prevent chronic diseases such as cancer and heart disease, there's no evidence to support such claims. The National Institutes of Health convened a meeting on multivitamin and mineral supplements in May 2006. The “state of the science” statement it issued was extremely cautious: present evidence is “insufficient to recommend either for or against the use of multivitamin/multimineral supplements by the American public to prevent chronic disease.” The experts noted that the heaviest users of vitamin and mineral supplements are Americans who probably need them the least: people who are well educated, have higher incomes, exercise, and already have healthy diets. A 2008 study in Archives of Internal Medicine that tracked nearly 162,000 participants in the Women’s Health Initiative found that multivitamins have no effect whatsoever in 10 health-related categories, including cancer, heart attack, and stroke. Supplement takers didn't live any longer, either.

Still, old habits die hard, and many nutrition experts still recommend taking a multivitamin daily as a form of nutritional insurance. Multivitamins are already part of some official recommendations. The federal government's 2005 Dietary Guidelines for Americans suggests that people older than 50 take them as a way to ensure adequate vitamin B12 intake (see “B vitamins”). And the Centers for Disease Control and Prevention advises all women of childbearing age to take folic acid—and a multivitamin is also a good way to do that—because doing so lowers the risk of birth defects (see “Folic acid”). That leaves men ages 50 and under as the only adult group not covered by this advice.

When choosing a multivitamin, look for an inexpensive preparation that contains 100% of the DV for vitamin D, vitamin B6, vitamin B12, and folic acid. Extra vitamin D is harmless—as noted earlier, many experts recommend 1,000 IU, which is roughly twice the DV (see Figure 7). But extra amounts of other vitamins may do more harm than good. That's particularly true of vitamin A, since studies show that doses above 3,000 IU a day, which were previously considered safe, can increase the risk of hip fractures (see “Vitamin A and carotenoids”).

Don't waste your money on high potency, all-natural, or designer vitamins. Above all, remember that your daily multivitamin is just an insurance policy—a supplement, not a substitute, for a healthful diet.
Potential pitfalls

Shopping for any kind of supplement can be confusing. A staggering array of multivitamins and other supplements crowd the shelves of pharmacies, grocery stores, and specialty stores, and many more are now available over the Internet. Before you buy, it's wise to realize that some of these products may offer much more—or possibly less—than you really need to enhance your health.

Dietary supplements may legally contain vitamins, minerals, herbs, amino acids, enzymes, organ tissues, and a few other substances—in short, practically any ingredient promoted as a way to bolster your diet and, presumably, your health. The FDA does not certify supplements for safety or effectiveness the way it monitors drugs. Under the Dietary Supplement Health and Education Act of 1994, the FDA cannot approve supplements or demand that manufacturers undertake rigorous studies to prove their worth. The FDA doesn't set potency or dosage standards, either. Manufacturers are left to police themselves. And before a worrisome supplement can be pulled off the market, the FDA has to prove that it creates a significant health risk.

This can be a problem, as is made clear by a January 2009 ConsumerLab report. The consumer watchdog organization tested the quality and contents of 29 of the leading multivitamin and multimineral products for adults and children sold in the United States and Canada. Eight products did not meet claims stated on their labels or had other quality issues, while another 12 provided levels that may be too high for healthy people. For example, one men's multivitamin supplement contained just over 2,000 mcg of folic acid, which is twice the safe upper limit for that vitamin (see “Folic acid”).

While supplement manufacturers can't legally claim to prevent, treat, or cure specific diseases, they can come pretty close. They are allowed to make “structure-function” claims that sound impressive to most consumers. A product may “build strong teeth” or “improve memory” or “boost the immune system.” Manufacturers can make these assertions without supplying a stitch of proof to any agency. Your cue for healthy skepticism should be the words printed alongside: “This statement has not been evaluated by the Food and Drug Administration.”

Certain health claims backed by substantial scientific agreement and not limited to particular brands can appear on supplement bottles. For example, supplement manufacturers can advertise that “Calcium helps...
protect against osteoporosis” and “Folic acid may prevent neural tube defects in fetuses,” because these statements are borne out by science and have been carefully evaluated.

More isn’t always better

Many people who take supplements subscribe to the idea that “more is better” without carefully considering the arguments for or against their choices. They may take a handful of other supplements along with their multivitamin. At best, they may be wasting their money. At worst, they may be endangering their health.

Take vitamins C and A, for example. Once your blood level of vitamin C reaches the saturation point—which occurs if you take about 200 mg per day—your body usually excretes the excess. That’s why vitamin C toxicity rarely occurs. However, people who consistently take too much vitamin A won’t be as fortunate. Because fat-soluble vitamins remain in the body, they can more easily build to toxic levels. A pregnant woman who takes too much vitamin A risks birth defects to her fetus. Excess vitamin A also compromises bone health and blood clotting, and it can overstimulate your immune system.

Many consumers are spurred to take excessive doses by overenthusiastic news stories on the potential benefits of certain vitamins and minerals. Remember, though, that the good news from the latest study may eventually prove true, or it may be refuted by other studies. Often, promising test-tube and animal studies don’t pan out in people. And certain types of human studies offer more definitive information than others (see “Making sense of scientific studies”). Sometimes, exciting results from initial observational studies aren’t confirmed by randomized controlled trials, which are considered the gold standard of research. And even these studies often have their limitations.

It’s generally safest to wait for evidence to accumulate before jumping on the supplement bandwagon. Consider the potential risks, possible benefits, and costs.

Specialized supplements for women, men, and older adults

What about supplements aimed at women, men, and seniors? While some of these supplements may be helpful in certain cases, others are merely marketing gimmicks designed to enhance profits rather than your health. Products vary widely; read the labels to make sure you get what you need while staying within safe limits.

Although a June 2002 report in The Journal of the American Medical Association concluded that there is limited evidence for tailored supplements, a mild argument can be made in favor of some products designed for women and men.

Formulas for women

If you’re a woman, which vitamins and minerals are most helpful to you? That depends partly on your age and on childbearing concerns.

All women. Osteoporosis affects more women than men: about 80% of the 10 million Americans with osteoporosis are women. That’s why it’s especially important for women to get enough bone-building calcium and vitamin D. Some multivitamins supply relatively little calcium—typically only 40 mg to 160 mg, which is far below the daily requirement of 1,000 mg to 1,200 mg. And depending on your age, standard multivitamins may or may not meet your vitamin D needs, which increase as you get older. Vitamin and mineral supplements formulated for women usually supply more, although not all, of your daily calcium requirements and may have additional vitamin D, too. Although dietary sources of calcium and vitamin D are best, supplements can help make up the difference. You need 1,000 mg of calcium daily if you’re between 19 and 50 years old, and 1,200 mg of calcium after that. As for vitamin D, some experts advise getting 1,000 IU from supplements.

Women of childbearing age. Folic acid supplements are necessary if there is a chance you could become pregnant, and iron is important for you if you are still menstruating. It’s essential that you get enough folic acid to prevent birth defects called neural tube defects, which develop in the earliest days and weeks of
pregnancy. Because not every pregnancy is planned, most experts suggest that all women capable of becoming pregnant take a daily multivitamin that has at least 400 mcg of folic acid. (Your doctor may suggest taking more than that amount if you plan to get pregnant and have previously had a child with a neural tube defect.)

To replace iron lost during monthly periods, you need a multivitamin or women's supplement with iron. Iron deficiency saps your energy, eventually leaving you weak and tired. In the United States, one in 10 women and girls who menstruate is deficient in iron. The recommended daily amount of iron for adult women ages 19 to 50 is 18 mg.

**Pregnant women.** If you're pregnant, you need larger amounts of certain vitamins and minerals, particularly iron and folic acid. Prenatal vitamins, which can be purchased by prescription or over the counter, meet these needs. It is important not to take other supplements unless specifically advised by a qualified health care provider. The earliest weeks of pregnancy are crucial in the fetus' development, so the sooner in pregnancy you start taking a prenatal vitamin, the better.

If you plan to get pregnant or learn that you are, talk with your doctor right away to find out which prenatal supplement would be best for you to take. During pregnancy, your iron requirement increases to 27 mg and your folic acid requirement to 600 mcg. The calcium RDA remains at 1,000 mg for women ages 19 and over, although some clinicians suggest adding calcium during pregnancy for extra insurance.

Guidelines from the World Health Organization also recommend that pregnant and nursing women consume an average of 300 mg per day or more of DHA (see “Fish oils”) either by eating fish or taking fish oil supplements.

**Women who have reached menopause or have had a hysterectomy.** In these cases, unless your doctor advises otherwise, you can switch to a supplement that reduces or eliminates iron. Diet alone should supply enough iron and prevent a possible iron overload. Iron overload can damage the liver and other body tissues, making diabetes, heart disease, arthritis, and liver cancer more likely. Supplements designed for older women typically have little or no iron and more calcium and vitamin D. After menopause or hysterectomy, you need only 8 mg of iron daily.

**Multivitamins for men**

Many experts shy away from any iron supplementation for men. That's because men—like women who no longer menstruate—aren't typically losing much iron. For that reason, supplements aimed specifically at men generally reduce iron or drop it from the formula. This can help prevent iron overload, which can stem from taking more iron than necessary through supplements. Iron overload may also occur because of a common genetic defect that occurs more often in men than women. Iron overload can damage the liver and other body tissues, raising the risks for diabetes, heart disease, arthritis, and liver cancer.

Men's multivitamin and mineral formulations typically add or increase selenium and lycopene, too, which may protect against prostate cancer and other types of cancer. Some drop calcium entirely. Formulas with low or no calcium are fine for men, as long as they get adequate amounts of calcium in their diets to prevent osteoporosis. Exercise, coupled with vitamin D and vitamin K, is more important for bone health in men.

**Products for older adults**

Products aimed at older people tend to boost the amounts of certain B vitamins, partly because many elderly men and women have trouble absorbing vitamin B12. These products also tend to add antioxidants and, often, vitamin D and selenium.

There is little evidence to support the value of antioxidant supplements (see “Understanding antioxidants”). Some experts recommend getting at least 2,000 IU of vitamin D daily after age 70. As you age, your skin loses some of its ability to produce vitamin D from sunlight, and many older people do not spend much time in the sun. As for selenium, evidence suggests no benefit to this mineral (see “Selenium”). Until more information is available—or unless your doctor gives you other advice—a daily multivitamin
should offer enough B vitamins. However, if you are over 70 and get little sun exposure, you may need to add a separate vitamin D supplement.

Do your homework

Tailored formulas often add herbal boosters that are reputed to benefit certain populations—for example, soy for women and saw palmetto for men. Research suggests that saw palmetto can reduce benign enlargement of the prostate gland, called benign prostatic hyperplasia. While the estrogen boost of soy products may be helpful to some women, particularly those with symptoms of menopause, it may actually be harmful to other women. And evidence in favor of using many of the other substances—such as green tea or ginseng—is slim or controversial.

Your first line of defense should be through food. Rearrange your diet to include more sources of the nutrients you’re lacking. For those nutrients that may be hard to get through food, such as vitamin D and calcium, consider purchasing separate supplements.

Before you buy, consider your particular nutrient needs. Then do a little sleuthing. Start by checking the label of your multivitamin supplement, looking at the recommended amounts listed in Tables 1 and 2 and assessing your diet (see “Decoding your diet: Dietitian or DIY”). Are you getting too little vitamin D? Need extra calcium? Looking for lutein or other potentially beneficial phytochemicals? Your first line of defense should be through food. Rearrange your diet to include more sources of the nutrients you’re lacking. For those nutrients that may be hard to get through food, such as vitamin D and calcium, consider purchasing separate supplements.

Advice on choosing a supplement

Buying supplements can raise many questions. Should you buy supplements derived from natural ingredients? Do brand-name supplements have any advantage over less expensive store brands? Are the health claims plausible? Are the suggested dosages safe? The following advice should help answer these questions and guide you as you make your choices.

Look for a seal of approval. Choose products that bear the U.S. Pharmacopeia Dietary Supplement Verification Program (USP-DSVP) mark, which indicates that the supplement manufacturer has complied with certain standards. Supplements vetted by the USP-DSVP should contain the ingredients noted on the label in the amounts and strengths stated. The product should dissolve within 30 to 45 minutes so that the nutrients enter your bloodstream, rather than passing through your body intact. It shouldn’t contain more than allowable levels of contaminants. Other product safety organizations include ConsumerLab.com, which ranks herbs and supplements based on quality and content, and NSF International, a nonprofit organization that develops standards and certifies products related to public health, safety, and environmental protection.

Consider safe levels. Supplements vary so widely, it’s essential to read the labels. Much like packaged foods, all dietary supplements have a “Supplement Facts” label that lists the DVs of nutrients in a single serving. It also notes the actual amount of each nutrient included. For trace minerals, such as iron, fluoride, and zinc, it’s safest not to exceed the DV at all. Some experts even recommend getting these micronutrients only through food. If you take individual supplements (such as extra vitamin D tablets) as well as a multivitamin, be sure to total up the amounts you’re getting from every source, including food. Fortified breakfast cereals can bump up your intake of vitamins and minerals considerably. A single serving of certain breakfast cereals can deliver as much as or more than your daily multivitamin. That may not be a problem with vitamin C, but it might pose health risks with iron or vitamin A.

Consider price. Compare active ingredients on the labels, then let price be your guide. Store brands spend less on advertising than nationally known brands and pass on the savings to the consumer.

Ignore marketing gimmicks. It doesn't matter whether vitamin C is derived from organic rose hips or synthesized in large batches in a laboratory; your body will use the resulting product similarly. In fact, your body absorbs certain micronutrients more efficiently in synthetic rather than natural forms. Vitamin K and
folic acid are two examples. If you're not sensitive to specific ingredients, such as wheat, rice, or lactose, there's no need to pay more for allergen-free products. “High potency” isn't a plus in cases when more is not better.

**Don't pay more for unproven extras.** Generally, if you're hoping for phytochemical benefits, you'll do better in the produce department than the supplement aisle. There is virtually no evidence that herbs and other nonvitamin ingredients added to supplements, such as echinacea, are essential for your health. Supplements that list substances such as PABA (para-aminobenzoic acid), bioflavonoids, and ubiquinone (coenzyme Q10) are trading on good press from research that shows them to be essential for growth in bacteria or other life forms, rather than substantial evidence from studies in people.

**Beware of potentially dangerous interactions.** Pay attention to warnings on the label, and tell your doctor and pharmacist what supplements you take (see “Medications and micronutrients”).

**Report any serious ill effects.** Let your doctor know about any side effects that you attribute to a supplement. He or she may pass along the information to FDA MedWatch, if appropriate. Or you can contact MedWatch directly at 800-FDA-1088 or through the MedWatch Web site at [www.fda.gov/medwatch/report/consumer/consumer.htm](http://www.fda.gov/medwatch/report/consumer/consumer.htm). Also inform the manufacturer or distributor and the store where you purchased it.

**Beyond vitamins: Fish oils and phytochemicals**

It's clear by now that a well-stocked refrigerator should be a big part of your first line of defense for staying healthy. Not only do the foods you eat supply essential vitamins and minerals, they also contain many other beneficial nutrients, including omega-3 fatty acids and phytochemicals.

**Fish oils**

Omega-3 fatty acids, which are abundant in certain fatty fish and other seafood, have favorable effects on a range of risk factors for heart disease, including blood pressure, heart rate, blood lipids, and inflammation, and possibly also help maintain normal blood vessel function and heart filling. In 1998, data from the Physicians’ Health Study showed that people who ate fish once a week were half as likely to die suddenly or from a heart attack compared with those who ate fish less than once a month. One year later, a report in *The Lancet* described a randomized controlled trial in which about 12,000 men who had suffered a heart attack received either a fish oil supplement, 300 mg of vitamin E, both, or neither. Those who received the fish oil supplement had significantly lower rates of heart attack, stroke, or death during the next three and a half years. Sudden death rates dropped by 45%.

People who use cholesterol-lowering statin drugs might further reduce their risk of heart problems by getting more omega-3s. In a large randomized study, around 19,000 Japanese people with elevated cholesterol levels were prescribed a statin, with or without an additional omega-3 fatty acid supplement. After four and a half years, the people who took the combination had 19% fewer coronary events, in particular unstable angina and nonfatal heart attacks, than those who took the statin alone.

Many observational studies provide additional support for heart benefits of consuming fish oils from fish or other seafood. This includes a report on nearly 80,000 women in the Nurses’ Health Study. This 14-year study found that women who ate fish at least twice a week were half as likely to suffer strokes caused by clots blocking an artery to the brain compared with those who ate fish less than once a month. The study also found that eating one to three servings of fish per month was associated with a 20% lower risk of heart disease.

However, a recent meta-analysis of 14 randomized, double-blind, placebo-controlled trials that included more than 20,000 patients with known cardiovascular disease has muddied the waters on the earlier findings concerning fish oil supplements and heart disease. The study found insufficient evidence that taking fish oil supplements reduces the risk of cardiovascular events such as heart attack, heart failure, or stroke. Notably, this analysis excluded three of the largest trials of fish or fish oil, which each had shown benefits, because although these studies were randomized, they were not “placebo-controlled.” In other words, in these three
trials, the intervention groups received fish oil plus other usual treatments, and the control group received usual treatments alone, but not a placebo. Another large trial of fish oil supplementation was recently reported, in which 12,536 patients with high blood glucose were randomized to 1 gram per day of fish oil or placebo, and followed for six years This study also found no evidence for benefits of fish oil supplements on heart disease risk in these patients.

There are several reasons why results from observational studies and the earlier trials of fish or fish oil might differ from these more recent results:

- Observational studies that suggested benefit could suffer from “confounding”—that is, people who ate more fish could have other healthy lifestyle factors that led to their lower risk, even though investigators tried to adjust for these factors.
- Three of the four randomized trials that showed benefit were not placebo-controlled, which means other changes in behavior or treatment could have led to lower risk in the patients treated with fish oil.
- In the more recent randomized trials, patients were more aggressively treated with multiple other heart drugs, including cholesterol-lowering statin drugs. It is possible that fish oil has less benefit in patients who are already taking multiple heart drugs.

As with other nutrients, it seems the best advice is still to get your omega-3s from fish and other seafood, rather than supplements alone. According to both the U.S. Dietary Guidelines and the American Heart Association, everyone should try to eat fish, especially oily fish like salmon, sardines, or herring, at least twice a week. If you don’t like fish and are concerned about your risk for heart disease, or just want to “play it safe” to be sure you’re getting adequate amounts of omega-3 fatty acids, there is no risk in taking a daily fish oil supplement. Typical over-the-counter fish oil supplements contain 200 to 400 mg of eicosapentaenoic acid (EPA) plus docosahexaenoic acid (DHA), the omega-3s found in fish.

In addition, people with very high levels of triglycerides (a type of fat in the blood that raises heart disease risk) might consider fish oil supplements in consultation with their physicians. To substantially lower elevated triglycerides, patients may need 2 to 4 grams of these omega-3s per day.

Several observational studies suggest that dietary omega-3 fatty acids might have other benefits, such as lowering the risk of stroke, slowing visual decline in people with retinitis pigmentosa, alleviating hot flashes, lowering risk of depression, and even slowing mental decline into dementia. However, none of these benefits are clearly established, and more research is needed.

DHA, one of the specific omega-3s found in seafood, is essential for optimal brain development in the fetus and during early childhood. The United Nations Food and Agricultural Organization recommends that pregnant women, nursing mothers, and children through age 2 consume at least 200 mg per day of DHA.

**Phytochemicals**

Even the most humble fruits and vegetables are replete with phytochemicals—chemical substances made by plants that affect their taste, color, scent, and other properties. The searing bite of hot peppers, the pungent whiff of garlic, the deep orange hue of carrots, and the red blush on tomatoes all owe a tip of the hat to different phytochemicals—in these instances, capsaicin, organosulfur compounds, and the carotenoids alpha carotene and lycopene. Spices, oils, wine, tea, and other plant-derived foods and beverages also contain a variety of phytochemicals, including flavonoids. Although plants develop phytochemicals partly as a defense against predators, some of these substances appear to be beneficial for people. Experts believe these substances might explain the many health benefits of eating fruits and vegetables, and perhaps nuts, whole grains, vegetables oils, and even dark chocolate (cocoa).

But simply identifying specific phytochemicals found in foods is a massive task. A stalk of broccoli may boast up to 10,000 different substances, each of which might be biologically active in the body. Teasing out individual effects is not currently possible. It is far easier to show how phytochemicals work under lab conditions than to winnow out their effects in the human body. And it takes years to accumulate evidence of
benefits by proceeding from laboratory studies to large-scale epidemiological studies—which in turn can only suggest, not prove, specific effects.

Overall, phytochemicals appear to be very important micronutrients that may contribute to health benefits of many of the foods that we eat. More research is needed to determine which phytochemicals and food sources are most relevant for which health conditions.

Getting too little

Serious deficiencies of most essential vitamins and minerals are relatively rare in America, although they do occur in some pockets of the country. More often, people get enough of the essential micronutrients to avoid overt deficiency ailments such as scurvy, night blindness, or rickets, but they get too little of some vitamins and minerals that can help ward off chronic health problems, such as osteoporosis, cardiovascular disease, and some types of cancer. Inadequate vitamin D may be the most hyped example of this potential problem, but most Americans are not eating healthy-enough diets to provide the optimal levels of a range of other vitamins, minerals, and micronutrients.

Are you deficient?

How can you tell if you could be compromising your health by not getting enough of these nutrients? While definitive proof is hard to come by, certain clues should encourage you to consider making appropriate changes.

Age. According to the Framingham Heart Study, 30% of people ages 67 and over lack adequate folic acid, 20% do not get sufficient vitamin B6, and 20% to 25% do not get enough B12. The Baltimore Longitudinal Study on Aging found that most older men and women are deficient in calcium, zinc, iron, magnesium, and vitamin D. Malabsorption, poor diet, or other causes may underpin this pervasive problem.

Sex. Women who menstruate need more iron compared with men, menopausal women, and women who've had a hysterectomy. Any woman who might get pregnant also needs folic acid. During the first three weeks of pregnancy, folic acid is essential in preventing birth defects of the brain and spine. Some research suggests that the daily dose for women of childbearing age should be 800 mcg, not the 400 mcg currently recommended for women of childbearing age and present in most multivitamins. Combining a healthy diet with a multivitamin should provide you with about 700 to 800 mcg a day.

Medical conditions. Gastric or ileal disease can block absorption of vitamin B12. Cystic fibrosis, chronic liver disease, and short-bowel syndrome can impair the absorption of fat-soluble vitamins, such as vitamin E. Liver disease, kidney disease, or malabsorption maladies can trigger a deficiency of vitamin K, which is essential for blood clotting and may help keep bones healthy. A lack of stomach acid—which often occurs among the elderly—makes it hard to absorb calcium and vitamin B12 from food. Crohn's disease and conditions that affect the small intestine can interfere with vitamin D absorption. In addition, medications for many health conditions can interfere with the absorption of some vitamins and minerals (see “Medications and micronutrients”).

Genes. People lacking a particular gene variant—which leads to having a less-active form of an enzyme that helps the body use folic acid—have a higher risk for colorectal cancer when they have a lower dietary intake of folic acid. Other genetic abnormalities hamper the body's ability to make and use vitamin D, thus increasing the risk for bone fractures.

Vegetarian and vegan diets. Unlike every other vitamin, B12 is almost exclusively found in animal products (eggs, milk, fish, poultry, and meat). Some vegans and strict vegetarians court a B12 deficiency, which can inflict neurological damage and contribute to heart disease. Taking a multivitamin or regularly having milk or eggs will solve the problem. People who adhere to a plant-based diet should also eat plenty of deep-hued vegetables and fruits, which are rich in carotenoids, to ensure that they get enough vitamin A.

Alcohol consumption. Heavy drinking is known to cause folic acid deficiency. And even moderate drinking—about one drink per day for women and two for men—may pose a problem. Women in the Nurses' Health
Study who drank moderate amounts of alcohol and took in little folic acid had a higher risk for breast cancer than their counterparts who took multivitamins containing folic acid. This combination—drinking alcohol and having low levels of folic acid—has been linked to colon cancer, too. Experts advise even moderate consumers of alcohol to step up their folic acid intake, for example by taking a regular multivitamin that contains folate. Heavy drinking can also contribute to deficiencies of other micronutrients, including vitamin A, thiamin, vitamin D, magnesium, calcium, and potassium. It may increase the need for niacin, vitamin C, and sometimes zinc. Tissue studies on people who are dependent on alcohol have noted lower concentrations of the antioxidants beta carotene, vitamins C and E, and selenium.

**Blood donation.** When you lose blood, you lose iron, too. If you are a frequent blood donor, you may need extra iron: an estimated 3 to 4 mg more per day for each unit of blood you donate during the course of a year. Talk with your doctor about this first to be safe, though.

**Medications and micronutrients**

Some medications can interfere with the absorption of certain nutrients or speed their excretion from the body. You’re more likely to suffer from nutrient depletion and worrisome interactions if you take several medications, regularly drink alcohol, eat poorly, or have health problems that increase your need for certain nutrients.

It’s also true that certain nutrients in food and supplements can interfere with the medications you take. Prime examples are calcium and iron, which bind to the antibiotic tetracycline so that both the nutrients and the drug simply pass through the body in an unusable form. Megadoses of vitamin C can acidify your urine, which curbs the excretion of acidic drugs, such as aspirin. That means the aspirin will stay in your body longer than usual.

Generally, when you begin using a medication, your pharmacist will warn you about any foods to avoid. But you should never take a dietary supplement without finding out whether it might interfere or interact with the medications you take. Ask your pharmacist or doctor—not the clerk at a health-food store—for this information. It helps to buy all your prescription drugs and supplements at one pharmacy, especially if the store maintains computerized customer records to track possible drug interactions.

The following classes of medications may cause nutrient depletion and, possibly, nutritional deficiencies. If you take any of these medicines, ask your doctor whether you should adjust your intake of any vitamins or minerals. Generally, occasional use will not matter, but long-term use can make a difference.

- antacids
- antibacterial agents
- antibiotics
- anticancer drugs
- anticoagulants
- anticonvulsants
- antidepressants
- antifungal agents
- anti-inflammatory agents
- antimalarials
- anti-ulcer drugs
- cholesterol-lowering medications
contraceptives  
corticosteroids  
diabetes medications  
diuretics  
laxatives  
tranquilizers

Getting too much

Certainly, getting too little of essential micronutrients can be harmful to your health, especially over the long haul. But getting too much can have equally worrisome effects, many of which show up more swiftly. Most troublesome are excesses of fat-soluble vitamins (vitamins A, E, and K; D is also fat-soluble, but doesn't usually cause problems) from supplements, which the body may stockpile to the point of reaching toxic doses.

High doses of supplements—usually from taking individual vitamin and mineral supplements in addition to a powerful multivitamin—are often at fault. It's much harder to get dangerous amounts of micronutrients from food, partly because of the body's natural checks and balances. When iron stores are full, for example, your body normally absorbs less iron from food unless a genetic disorder or other problem interferes. Your body also slows the conversion of beta carotene to vitamin A when it already has enough vitamin A from supplements or food sources. But it is still possible to overdo it.

Avoiding overload

Avoid taking more than the recommended dose of any micronutrient through supplements unless there is a valid reason to do so, such as specific advice from your doctor. It is especially important to avoid taking too much of the vitamins and minerals listed below.

Vitamin A

It can be easy to ingest more than 10,000 IU of vitamin A (more than three times the amount recommended for men and four times the amount recommended for women) if you eat a lot of fortified cereal and liver in addition to taking a multivitamin containing retinol or retinyl compounds every day.

Plenty of evidence from earlier research shows too much vitamin A can harm bones. Excess vitamin A can have other effects as well. Birth defects occur more often in fetuses when pregnant women take more than 10,000 IU of supplemental vitamin A. To protect yourself, get most or all of your supplemental vitamin A in the form of beta carotene, and try to adhere to the RDA for vitamin A (see Table 1).

Vitamin E

Despite evidence that vitamin E supplements don't help and may even be harmful (see “Vitamin E”), some people still take these supplements. If you take more than 800 mg per day, you risk side effects such as bleeding, headache, fatigue, and blurred vision. To be on the safe side, talk with your doctor before taking more than the RDA for vitamin E to avoid increasing your risk of bleeding, especially if you also take the blood thinner warfarin (Coumadin).

Vitamin K

Because vitamin K can influence blood clotting, it's important to keep your vitamin K intake consistent from day to day if you take warfarin. Discuss this with your doctor if you are taking this medication.

Calcium (for men)
There is good evidence that a high intake of calcium increases the risk of prostate cancer and may also increase heart attacks. One study found that men who consumed more than 2,000 mg of calcium daily were five times as likely to develop metastatic prostate cancer as those who consumed less than 500 mg of calcium per day. A large epidemiologic study found that intake of more than 1,500 mg of calcium per day might increase the risk of aggressive and fatal prostate cancer, but not the risk of less aggressive, localized cancer. So men should avoid taking calcium supplements.

Iron

Hemochromatosis is the medical term for iron excess. A common genetic glitch called hereditary hemochromatosis leaves about 1.5 million Americans prone to a glut of iron, although not automatically doomed to it. Large doses of iron supplements, multiple blood transfusions, alcohol dependence, and some rare metabolic disorders can also trigger an iron overload, which can damage body tissues and raise risks for infection, heart disease, liver cancer, and arthritis over time.

In addition, taking high doses of vitamin C allows your body to absorb more iron than it normally would accept and releases more stored iron than necessary. This causes an upswing in free iron, which attacks DNA, cell lipids, and protein. Free iron also results when abnormally high levels of iron accumulate in the body for other reasons.

Excess iron is not easily shed. More men than women suffer from an overabundance of iron; in fact, men are twice as likely to have iron overload than iron deficiency.

Because most of the body's iron circulates in the blood as part of hemoglobin, menstruating girls and women lose larger amounts of iron during their monthly periods, which is why iron deficiency is a common problem for women of childbearing age. Still, for women ages 31 to 50, the recommended daily amount of iron is only 18 mg. For adult men of any age and for women starting at age 50 (or whenever menstruation ends), 8 mg a day is enough. The tolerable upper intake level for iron is 45 mg a day.

A child who takes as few as five pills each containing 200 mg of iron can die from poisoning. Any supplements that contain iron—especially chewable children's multivitamins that look like candy—should be stored well away from children.

Zinc

Getting enough but not too much of the trace mineral zinc is a bit of a high-wire act. The RDA for zinc is 8 mg for women and 11 mg for men. The IOM lists the UL for zinc as 40 mg for women and men. Yet levels not much higher than 15 mg can trigger side effects, such as a depressed immune system, poor healing, hair loss, and interference with the ability to taste and smell. That's why some experts suggest that it's best to get zinc from food sources rather than supplements. At the very least, make sure that your multivitamin provides no more than 15 mg of zinc.

Your overall diet affects how much zinc your body typically absorbs from food. Interestingly, you are likely to absorb less zinc if you choose a diet rich in healthy whole grains and with very little animal protein. Most North Americans probably absorb about 38% of available dietary zinc.

Resources

Organizations

American Dietetic Association (ADA)

120 S. Riverside Plaza, Suite 2000
Chicago, IL 60606
800-877-1600 (toll-free)

www.eatright.org
This national organization of food and nutrition professionals has an extensive Web site presenting nutrition information, including ways to meet recommendations for vitamin and mineral intake through healthy food choices. The ADA also provides consumer tips, nutrition fact sheets, and healthy recipes.

**ConsumerLab.com**

333 Mamaroneck Ave.

White Plains, NY 10605

888-502-5100 (toll-free)

[www.consumerlab.com](http://www.consumerlab.com)

This subscription service reviews herbs and supplements a bit like Consumer Reports reviews cars and other consumer products—with rankings and grades. It provides in-depth information about products, recalls and warnings, and summaries by particular medical condition.

**Food and Drug Administration (FDA)**

Center for Food Safety & Applied Nutrition

5100 Paint Branch Parkway

College Park, MD 20740

888-723-3366 (toll-free)

[www.fda.gov/AboutFDA/CentersOffices/OfficeofFoods/CFSAN](http://www.fda.gov/AboutFDA/CentersOffices/OfficeofFoods/CFSAN)

The consumer advice section of the FDA's Web site has information on dietary supplements and the Dietary Supplement Health and Education Act of 1994. The toll-free hotline offers information, including warnings and recalls, about dietary supplements and other products. Information specialists are available by phone from 10 a.m. to 4 p.m. EST, Monday through Friday.

**National Academy of Sciences/National Research Council (NAS/NRC)**

500 5th St., NW

Washington, DC 20001

202-334-2000

[www.nas.edu/nrc](http://www.nas.edu/nrc)

This is the umbrella group for the Institute of Medicine, which oversees dietary guidelines. The National Academy Press publishes reports on the dietary reference intakes that you can purchase or read for free online.

**National Center for Complementary and Alternative Medicine (NCCAM) Clearinghouse**

9000 Rockville Pike

Bethesda, MD 20892

888-644-6226 (toll-free)

[www.nccam.nih.gov](http://www.nccam.nih.gov)
Part of the National Institutes of Health, this government agency is an excellent source of publications and research on dietary supplements, including herbal medicines. You may speak to an information specialist from 8:30 a.m. to 5 p.m. EST, Monday through Friday, or request informational faxes by phone through an automated service.

**NSF International**

P.O. Box 130140
789 N. Dixboro Road
Ann Arbor, MI 48113
800-673-6275 (toll-free)

[www.nsf.org](http://www.nsf.org)

This nonprofit, nongovernmental organization develops standards and certifies products related to public health, safety, and environmental protection.

**Book**

**Eat, Drink, and Be Healthy: The Harvard Medical School Guide to Healthy Eating**

Walter C. Willett, M.D., and P.J. Skerrett

(Free Press, 2005)

The lead author, an investigator for the Nurses’ Health Study and the Health Professionals Follow-up Study, chairs the nutrition department at the Harvard School of Public Health. Based on research from these long-term studies and many others, his book offers timely advice on how and why to adopt a healthy, palate-pleasing diet. Recipes are included.

**Glossary**

**adequate intake (AI):**

An estimate for the nutritional needs of healthy people; used when there are not enough data to support an RDA.

**antioxidant:**

A substance that counteracts destructive free radicals and other unstable molecules by giving up electrons. Micronutrients with antioxidant properties include beta carotene and other carotenoids, vitamin C, and vitamin E.

**beta carotene:**

A precursor that can be converted by the body into vitamin A. Beta carotene acts as an antioxidant. It’s found in many green vegetables and dark yellow or deep orange fruits and vegetables.

**bioavailability:**

The speed and completeness with which a nutrient can be absorbed and used by the body.

**carotenoids:**

Plant and animal pigments that color many fruits and vegetables, including carrots and cantaloupe. Some carotenoids, such as beta and alpha carotene, can be converted to vitamin A in the body. Other common carotenoids include lutein, lycopene, and zeaxanthin.
Daily Value (DV):
A measurement, found on the “Nutrition Facts” labels of packaged foods, that reports the amounts of specific micronutrients and other key dietary components per serving, stated as a percentage of daily requirements. DVs do not take such factors as age or sex into account, but instead reflect the highest amount of a nutrient an individual might need.

dietary reference intakes (DRIs):
A comprehensive set of standards for essential vitamins and minerals based on evidence from scores of observational and clinical studies.

dietary supplements:
Vitamins, minerals, herbs, amino acids, enzymes, organ tissues, and a few other substances used to bolster diet. Unlike drugs, they are not regulated by the FDA.

free radicals:
Unstable molecules that are chemically active and can alter DNA, oxidize harmful LDL cholesterol, and damage cells and tissues throughout the body by stealing electrons. Free radicals are implicated in aging, cataracts, cancer, and heart disease, among other ills. However, they have beneficial functions as well.

hemochromatosis:
An inherited disease in which too much iron builds up in the body.

hemoglobin:
A protein in red blood cells that carries oxygen.

homocysteine:
A protein byproduct that appears to increase the risk for heart disease and strokes when present in the blood at high levels.

international unit (IU):
An internationally accepted amount of a substance based on its biological activity or effect; used as a measurement for fat-soluble vitamins.

microgram (mcg):
A unit of mass, equal to one-thousandth of a milligram.

micronutrients:
Nutrients such as vitamins and minerals that the body requires in fairly small quantities.

monounsaturated fat:
A healthful fat found in such foods as canola oil, peanuts, cashews and other nuts, and avocados.

omega-3 fatty acids:
Essential fatty acids found in large quantities in cold-water fish. Also found in plant foods and oils, such as walnuts, flaxseed, canola oil, and soybean oil.

phytochemicals:
Compounds in plants that affect their taste, color, scent, and other properties. Lycopene, found in tomatoes, is one phytochemical thought to have beneficial effects.

**polyunsaturated fat:**
A healthy type of fat found in corn, soybean, and other vegetable oils; also found in seeds, legumes, whole grains, and fatty fish such as salmon and tuna.

**precursor:**
A substance that the body can convert into the active form of a vitamin. One example is beta carotene, which the body can convert into vitamin A as needed.

**Recommended Dietary Allowance (RDA):**
The average daily amount of a micronutrient that will meet the nutritional needs of almost all (97%–98%) healthy people at specific stages of their lives.

**saturated fat:**
A type of fat found in animal foods that raises "bad" cholesterol levels.

**tolerable upper intake level (UL):**
The highest amount of a nutrient deemed likely to have no harmful health effects for almost all healthy people when taken consistently. When people take more than the UL, the risk for ill effects rises along with the dose.

**trans fatty acids (trans fats):**
An unhealthy processed fat found in hydrogenated vegetable oils and shortening. Hydrogenated oils are polyunsaturated fats that have been chemically altered to be made more like saturated fats.

Credits

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As described on Nutrition Facts panels, percent Daily Values are based on a 2,000-calorie diet. Your
Daily Values may be higher or lower depending on your calorie needs.