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Vitamins

"Vitamin trouble," Stuart replied. "She took vitamin D when she needed A. She took vitamin B when she was short of C, and her system became overloaded with riboflavin, thiamine hydrochloride, and pyridoxine, the need for which in human nutrition has not yet been established." --From Stuart Little, by E.B. White (1945)

Dietary Insurance: A Daily Multivitamin

If you eat a healthy diet, do you need to take vitamins? Not long ago, the answer from most experts would have been a resounding "no". Today, though, there's good evidence that taking a daily multivitamin makes sense for most adults.

What's changed? Not only have scientists determined why we need pyridoxine (vitamin B6), but they are also accumulating evidence that this vitamin and others do much more than ward off the so-called diseases of deficiency, things like scurvy and rickets. Intake of several vitamins above the minimum daily requirement may prevent heart disease, cancer, osteoporosis, and other chronic diseases.

This summary will focus on vitamins with newly recognized or suspected roles in health and disease. It will present some of the evidence about vitamins' possible new roles, point out how to get more of these in your diet, and assess the value of taking a daily multivitamin.

Vitamin A:

Vitamin A does much more than help you see in the dark. It stimulates the production and activity of white blood cells, takes part in remodeling bone, helps maintain the health of endothelial cells (those lining the body's interior surfaces), and regulates cell growth and division. This latter role had researchers exploring for years whether insufficient vitamin A caused cancer. Several studies have dashed this hypothesis,⁽¹⁾

What, Exactly, Are Vitamins?

Nutrition textbooks dryly define vitamins as organic compounds that the body needs in small quantities for normal functioning. Here's the translation:

Vitamins are nutrients you must get from food because your body can't make them from scratch.

You need only small amounts (that's why they are often referred to as **micronutrients**) because the body uses them without breaking them down, as happens to carbohydrates and other **macronutrients**. So far, 13 compounds have been classified as vitamins. Vitamins A, D, E, and K, the four fat-soluble vitamins, tend to accumulate in the body.

as have randomized trials of supplements containing beta carotene, a precursor of vitamin A.

Although it's relatively easy to get too little vitamin A, it's also easy to get too much. Intake of up to 10,000 IU, twice the current recommended daily level, is thought to be safe.

However, there is some evidence that this much preformed vitamin A might increase the risk of hip fracture (2) or some birth defects.(3)

Optimal Intake: The current recommended intake of vitamin A is 5,000 IU for men and 4,000 IU for women. Many breakfast cereals, juices, dairy products, and other foods are fortified with vitamin A. Many fruits and vegetables, and some supplements, also contain beta-carotene and other vitamin A precursors, which the body can turn into vitamin A.

The 3 Bs: Vitamin B6, Vitamin B12, and Folic Acid

One of the advances that changed the way we look at vitamins is the discovery that too little folic acid, one of the eight B vitamins, is linked to birth defects such as spina bifida and anencephaly. Fifty years ago, no one knew what caused these birth defects, which occur when the early development of tissues that eventually become the spinal cord, the tissues that surround it, or the brain goes awry. Twenty five years ago, British researchers found that mothers of children with spina bifida had low vitamin levels.(4) Eventually, two large trials in which women were randomly assigned to take folic acid or a placebo showed that getting too little folic acid increased a woman's chances of having a baby with spina bifida or anencephaly and that getting enough folic acid could prevent these birth defects.(5,6)

Enough folic acid, at least 400 micrograms a day, isn't always easy to get from food. That's why women of childbearing age are urged to take extra folic acid. It's also why the US Food and Drug Administration now requires that folic acid be added to most enriched breads, flour, cornmeal, pastas, rice, and other grain products, along with the iron and other micronutrients that have been added for years.(7)

The other exciting discovery about folic acid and two other B vitamins is that they may help fight heart disease and some types of cancer. It's too early to tell if there's merely an *association* between increased intake of folic acid and other B vitamins and heart disease or cancer, or if high intakes prevent

Vitamin C and the eight B vitamins—biotin, folate, niacin, pantothenic acid, riboflavin, thiamin, vitamin B6, and vitamin B12—dissolve in water, so excess amounts are excreted.

The "letter" vitamins sometimes go by different names. These include:

Vitamin **A** = retinol, retinaldehyde, retinoic acid
Vitamin **B1** = thiamin
Vitamin **B2** = riboflavin
Vitamin **B6** = pyridoxine, pyridoxal, pyridoxamine
Vitamin **B12** = cobalamin
Vitamin **C** = ascorbic acid
Vitamin **D** = calciferol
Vitamin **E** = tocopherol, tocotrienol
Vitamin **K** = phyloquinone

these chronic diseases.

B Vitamins and Heart Disease

In 1968, a Boston pathologist investigating the deaths of two children from massive strokes wondered if the high levels of a protein breakdown product called homocysteine in their systems could have been the reason their arteries were as clogged with cholesterol as those of a 65-year-old fast food addict.[\(8\)](#) Since then, some-but not all-studies have linked high levels of this breakdown product, called homocysteine, with increased risks of heart disease and stroke.[\(9,10\)](#)

Folic acid, vitamin B6, and vitamin B12 play key roles in recycling homocysteine into methionine, one of the 20 or so building blocks from which the body builds new proteins. Without enough folic acid, vitamin B6, and vitamin B12, this recycling process becomes inefficient and homocysteine levels increase. Several observational studies show that high levels of homocysteine are associated with increased risks of heart disease and stroke. Increasing intake of folic acid, vitamin B6, and vitamin B12 decreases homocysteine levels. And some observational studies show lower risks of cardiovascular disease among people with higher intakes of folic acid, those who use multivitamin supplements, or those with higher levels of serum folate (the form of folic acid found in the body). However, other prospective studies show little or no association between homocysteine and cardiovascular disease. Ongoing randomized trials, such as the Women's Antioxidant Cardiovascular Study[\(11\)](#) and the Vitamin Intervention in Stroke Prevention Study[\(12\)](#) should yield more definitive answers regarding homocysteine, B vitamins, and cardiovascular risk.

Folic Acid and Cancer

In addition to recycling homocysteine, folate plays a key role in building DNA, the complex compound that forms our genetic blueprint. Observational studies show that people who get higher than average amounts of folic acid from their diets or supplements have lower risks of colon cancer[\(13\)](#) and breast cancer.[\(14\)](#) This could be especially important for those who drink alcohol, since alcohol blocks the absorption of folic acid and inactivates circulating folate. An interesting observation from the Nurses' Health Study is that high intake of folic acid blunts the increased risk of breast cancer seen among women who have more than one alcoholic drink a day.[\(14\)](#)

Optimal Intake: The definition of a healthy daily intake of B vitamins isn't set in stone, and is likely to change over the next few years as data from ongoing randomized trials are evaluated. Because only a fraction of U.S. adults currently get the recommended daily intake of B vitamins by diet alone, use of a multivitamin supplement will become increasingly important.

Folic Acid: The current recommended intake for folic acid is 400 micrograms per day. There are many excellent sources of folic acid, including prepared breakfast cereals, beans, and fortified grains.

Vitamin B6: A healthy diet should include 1.3 to 1.7 milligrams of vitamin B6. Higher doses have been tested as a treatment for conditions ranging from premenstrual syndrome to attention deficit disorder and carpal tunnel syndrome. To date, there is little evidence that it works.

Vitamin B12: The current recommended intake for vitamin B12 is 6 micrograms per day. Barely 100 years ago, a lack of vitamin B12 was the cause of a common and deadly disease called pernicious anemia. Its symptoms include memory loss, disorientation, hallucinations, and tingling in the arms and legs. Although full-blown pernicious anemia is less common today, it is still often diagnosed in older people who have difficulty absorbing vitamin B12 from food. It's also possible that some people diagnosed with dementia or Alzheimer's disease are actually suffering from the more reversible vitamin B12 deficiency.

Vitamin C: Vitamin C has been in the public eye for a long time. Even before its discovery in 1932, nutrition experts recognized that *something* in citrus fruits could prevent scurvy, a disease that killed as many as 2 million sailors between 1500 and 1800.⁽¹⁵⁾ More recently, Nobel laureate Linus Pauling promoted daily megadoses of vitamin C (the amount in 12 to 24 oranges) as a way to prevent colds and protect the body from other chronic diseases.

There's no question that vitamin C plays a role in controlling infections. It's also a powerful antioxidant that can neutralize harmful free radicals, and it helps make collagen, a tissue needed for healthy bones, teeth, gums, and blood vessels.⁽¹⁶⁾ The question is, do you need *lots* of vitamin C to keep you healthy?

No. Vitamin C's cold-fighting potential certainly hasn't panned

out. Small trials suggest that the amount of vitamin C in a typical multivitamin taken at the start of a cold might ease symptoms, but there's no evidence that megadoses make a difference, or that they prevent colds.⁽¹⁷⁾ Studies of vitamin C and heart disease, cancer, and eye diseases such as cataract and macular degeneration also show no clear patterns.

Optimal Intake: The current recommended dietary intake for vitamin C is 90 mg for men and 75 mg for women (add an extra 35 mg for smokers). There's no good evidence that megadoses of vitamin C improve health. As the evidence continues to unfold, 200 to 300 mg of vitamin C a day appears to be a good target. This is easy to hit with a good diet and a standard multivitamin. Excellent food sources of vitamin C are citrus fruits or citrus juices, berries, green and red peppers, tomatoes, broccoli, and spinach. Many breakfast cereals are also fortified with vitamin C.

Vitamin D: If you live north of the line connecting San Francisco to Philadelphia, odds are you don't get enough vitamin D. The same holds true if you don't, or can't, get outside for at least a 15-minute daily walk in the sun. A study of people admitted to a Boston hospital, for example, showed that 57% were deficient in vitamin D.⁽¹⁸⁾

Vitamin D helps ensure that the body absorbs and retains calcium and phosphorus, both critical for building bone. Laboratory studies also show that vitamin D keeps cancer cells from growing and dividing.

Some preliminary studies indicate that insufficient intake of vitamin D is associated with an increased risk of fractures, and that vitamin D supplementation may prevent them.⁽¹⁹⁾ Other early studies suggest an association between low vitamin D intake and increased risks of prostate, breast, colon, and other cancers.

Optimal Intake: The current recommended intake of vitamin D is 5 micrograms up to age 50, 10 micrograms between the ages of 51 and 70, and 15 micrograms after age 70. Very few foods naturally contain vitamin D. Good sources include dairy products and breakfast cereals (which are fortified with vitamin D), and fatty fish such as salmon and tuna. For most people, the best way to get the recommended daily intake is by taking a multivitamin.

Vitamin E: For a time, vitamin E supplements looked like an

easy way to prevent heart disease. Promising observational studies, including the Nurses' Health Study(20) and Health Professionals Follow-up Study,(21) suggested 20% to 40% reductions in coronary heart disease risk among individuals who took vitamin E supplements (usually containing 400 IU or more) for least two years.(22)

The results of several randomized trials have dampened enthusiasm for vitamin E's ability to prevent heart attacks or deaths from heart disease among individuals with heart disease or those at high risk for it. In the Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto miocardio (known as the GISSI Prevention Trial), more than three years of treatment with vitamin E had no effect on the rate of heart attacks, strokes, or deaths from any cause among 11,000 heart attack survivors, although it did appear to reduce sudden deaths and deaths due to cardiovascular disease.(23) Results from the Heart Outcomes Prevention Evaluation (HOPE) trial also showed no benefit of four years worth of vitamin E supplementation among more than 9,500 men and women already diagnosed with heart disease or at high risk for it.(24)

It's entirely possible that in secondary prevention trials, the use of drugs such as aspirin, beta blockers, and ACE inhibitors mask a modest effect of vitamin E, and that it may have benefits among healthier people. Ongoing randomized trials of vitamin E, such as the Women's Health Study (25) and will tell us more about its possible benefits in the coming years.

Optimal Intake: The recommended daily intake of vitamin E from food now stands at 15 milligrams from food. That's the equivalent of 22 IU from natural-source vitamin E or 33 IUs of the synthetic form. Researchers are still writing the book on vitamin E. Evidence from observational studies suggests that at least 400 IU of vitamin E per day, and possibly more, are needed for optimal health. Since standard multivitamins usually contain around 30 IU, a separate vitamin E supplement is needed to achieve this level.

Vitamin K: Vitamin K helps make six of the 13 proteins needed for blood clotting. Its role in maintaining the clotting cascade is so important that people who take anticoagulants such as warfarin (Coumadin) must be careful to keep their vitamin K intake stable.

Lately, researchers have demonstrated that vitamin K is also involved in building bone. Low levels of circulating vitamin K

have been linked with low bone density, and supplementation with vitamin K shows improvements in biochemical measures of bone health.⁽²⁶⁾ A report from the Nurses' Health Study suggests that women who get at least 110 micrograms of vitamin K a day are 30% less likely to break a hip as women who get less than that.⁽²⁷⁾ Among the nurses, eating a serving of lettuce or other green leafy vegetable a day cut the risk of hip fracture in half when compared with eating one serving a week. Data from the Framingham Heart Study also shows an association between high vitamin K intake and reduced risk of hip fracture.⁽²⁸⁾

Optimal Intake: The recommended daily intake for vitamin K is 80 micrograms for men and 65 for women. Because this vitamin is found in so many foods, especially green leafy vegetables and commonly used cooking oils, most adults get enough of it. According to a 1996 survey, though, a substantial number of Americans, particularly children and young adults, aren't getting the vitamin K they need.⁽²⁹⁾

Antioxidants

Our cells must constantly contend with nasty substances called free radicals. They can damage DNA, the inside or artery walls, proteins in the eye--just about any substance or tissue imaginable. Some are made inside the body, inevitable byproducts of turning food into energy. Others come from the air we breathe and the food we eat.

We aren't defenseless against free radicals. We extract free-radical fighters, called antioxidants, from food. Fruits, vegetables, and other plant-based foods deliver dozens, if not hundreds, of antioxidants. The most common are vitamin C, vitamin E, beta-carotene and related carotenoids. Food also supplies minerals such as selenium and manganese, which are needed by enzymes that destroy free radicals.

During the 1990s, the term antioxidants became a huge nutritional buzz word. They were promoted as wonder agents that could prevent heart disease, cancer, cataracts, memory loss, and a host of other conditions.

It's true that the *package* of antioxidants, minerals, fiber, and other substances found in fruits, vegetables, and whole grains help prevent a variety of chronic diseases. Whether high doses of vitamin C, vitamin E, or other antioxidants can accomplish the same feat is an open question.

The evidence accumulated so far isn't promising. Randomized trials of vitamin C, vitamin E, and beta-carotene haven't revealed much in the way of protection from heart disease, cancer, or aging-related eye diseases. Ongoing trials of other antioxidants, such as lutein and zeaxanthin for macular degeneration and lycopene for prostate cancer, are underway.

The Bottom Line

A standard multivitamin supplement doesn't come close to making up for an unhealthy diet. It provides a dozen or so of the vitamins known to maintain health, a mere shadow of what's available from eating plenty of fruits, vegetables, and whole grains. Instead, a daily multivitamin provides a sort of nutritional safety net.

While most people get enough vitamins to avoid the classic deficiency diseases, relatively few get enough of five key vitamins that may be important in preventing several chronic diseases. These include:

- Folic acid
- Vitamin B6
- Vitamin B12
- Vitamin D
- Vitamin E

A standard, store-brand, RDA-level multivitamin can supply you with enough of these vitamins for under \$40 a year. It's about the least expensive insurance you can buy.

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