Vitamin C and your health: C for crucial, C for controversial

Call it ascorbic acid, and it sounds like a fierce industrial solvent that should be stored under lock and key. Call it vitamin C, and it sounds like something that belongs in every man’s medicine chest. Call it an essential part of the human diet, and you’ll be right. Call it a superfluous supplement, and you’ll also be right. Call it what you will, but understand why vitamin C is essential for your health and why a good diet makes supplementary doses unnecessary.

Soluble C

Humans are unique members of the animal kingdom. Among other things, we are one of the few species that require vitamin C. That requirement was first demonstrated in 1747, but the vitamin itself was not discovered until 1932. Since then, scientists have learned an enormous amount about vitamin C, but they have not answered all the questions about it.

Vitamins are organic chemicals that are essential for the body’s metabolism. Because humans can’t produce any of the 13 recognized vitamins except vitamin D, vitamins must be obtained from food to prevent disease. Only tiny amounts are required, however, and a balanced diet can provide adequate doses of all the vitamins. The question is not whether men need vitamins (we do), but whether extra doses provide extra benefits.

Like the eight B vitamins, vitamin C is water soluble. It’s easily absorbed from food but can be removed from food by boiling, especially if large amounts of water are used; prolonged storage of fresh fruits and vegetables can also reduce their vitamin C content, but microwaving and cooking with small volumes of water won’t cut the C in food. Once in the body, vitamin C makes its way into the fluid component of all the tissues and cells. But unlike fat-soluble vitamins, it is not stored in the body to any appreciable degree. Instead, excessive amounts quickly pass out in the urine.

See what it can do

Vitamin C has many functions. It starts working right in the intestinal tract, where it promotes the absorption of iron. It helps produce healthy collagen, the protein that is the backbone of connective tissue. As a result, it is essential for healthy skin and blood vessels, good wound healing, and sound bones. And in the brain and nervous system, vitamin C is essential for the production of neurotransmitters, chemicals that convey messages between nerve cells. Vitamin C has a role in the immune system, especially by enhancing the function of the white blood cells that gobble up invading bacteria. In the endocrine system, it appears to improve glucose (sugar) metabolism. And it also affects prostaglandins and nitric oxide, chemicals that have major roles in blood clotting, vascular function, and lung function.

Any one of these roles would qualify vitamin C as essential. But the function that has attracted the most interest is vitamin C’s role as an antioxidant. In fact, it is one of the most powerful and versatile antioxidants in nature. Acting on its own, it can protect DNA from oxidative damage, perhaps reducing the risk of cancer, protecting against memory loss and various neurological diseases, and possibly even slowing the aging process itself. Vitamin C helps protect LDL (“bad”) cholesterol from oxidative damage—and since oxidation puts the “bad” into “bad cholesterol,” it might reduce the risk of heart disease, stroke, and peripheral artery disease. And
Vitamin C (continued)

vitamin C also helps regenerate vitamin E, boosting supplies of another powerful antioxidant.

It’s an impressive array of functions; still, vitamin C’s only proven therapeutic role is to prevent scurvy—but indirect evidence suggests it may do a lot more.

C on the high seas
Scurvy is rare in the Western world, but it wasn’t always that way. The disease was rampant in men who sailed the seas in the 15th–18th centuries, the great era of exploration. Accomplished seafarers, the British were particularly hard hit, developing the bleeding and rotten gums, skin rash, swollen joints, muscle weakness, and profound fatigue that characterize the disease. In 1740, for example, Admiral George Anson set out to circle the globe with six ships. He returned four years later with only one, having lost almost 1,400 men, many to scurvy.

Dr. James Lind, a Scottish ship’s surgeon, set out to rectify this problem. While sailing aboard HMS Salisbury in May 1747, he conducted the first controlled clinical trial in medical history. The subjects were 12 sailors who all had “putrid gums, the spots and lassitude, with weakness of their knees”—in other words, scurvy. Lind divided the sailors into six groups of two and gave each pair a different daily supplement: A quart of cider, two spoonfuls of vinegar before each meal, half a pint of sea water, elixir of vitriol, a paste of garlic, mustard seeds, and herbs, or one lemon and two oranges. Within just six days, the sailors who ate the citrus fruits were fit enough to return to duty. But despite his success, Dr. Lind experienced the same frustration as many of today’s scientists: It took 48 years for the bureaucrats of the British Admiralty to add citrus fruits to ships’ rations.

Does high C help?
It doesn’t take much vitamin C to prevent scurvy. That’s why many countries recommend as little as 30 mg a day, a third of the amount recommended for American men. And even though vitamin C isn’t stored in the body, people who have been getting even modest dietary amounts have enough in their systems to prevent any signs of deficiency for at least two weeks of complete vitamin C deprivation.

A little vitamin C is more than good, it’s essential. But is more better?
That depends on your standards. Population surveys from around the world have studied the relationship between vitamin C and disease. Some estimate vitamin C consumption; others measure the actual amount of the vitamin in the blood. Although there are some dissenting results, many of the studies link high levels of vitamin C to a reduced risk of heart attacks, strokes, memory loss and dementia, and impaired lung function in smokers. The results of cancer studies are more variable. For example, in 2006 the Prostate, Lung, Colorectal and Ovarian
Cancer Screening Trial reported that a high consumption of vitamin C did not protect men from prostate cancer. All in all, however, a high consumption of vitamin C has generally been associated with reduced mortality rates.

Studies like these have made vitamin C a best-selling supplement. But they don’t prove vitamin pills are helpful. Far from it. For one thing, the dissenting research includes some large studies such as Harvard’s Health Professionals’ Follow-Up Study as well as a 2004 trial that linked a high consumption of vitamin C from supplements to an increased risk of heart disease in diabetics. More important, the hopeful results are all derived from observational studies, not clinical trials. Observational studies can never establish a cause-and-effect relationship—and they can sometimes be wrong. For example, observation suggested that hormone replacement therapy could help post-menopausal women and that vitamin E and beta carotene could help both men and women—but randomized clinical trials showed just the opposite.

It seems likely, even probable, that a high level of vitamin C is a marker for a good diet and a healthy lifestyle, but it is not necessarily protective in its own right. Fruits and vegetables are the main dietary sources of vitamin C, but they provide other beneficial nutrients as well. People who eat lots of fruits and vegetables also tend to eat fewer high-fat, high-salt, animal-based and processed foods, which have a negative impact on health. And since smoking reduces vitamin C levels, the diseases linked to low levels may result from tobacco, not deficiencies of the vitamin.

To date, no clinical trials of vitamin C and heart disease or cancer have been completed, though several are in progress. And the trials of vitamin C and respiratory infections have been negative.

Until scientists finish the randomized trials started by Dr. Lind more than 250 years ago, we can conclude that a high consumption of vitamin C from foods is very beneficial (see table), and that supplementary doses are unlikely to help people who eat well.

### Should C cause concern?

Small amounts of vitamin C are essential for good health, but are large amounts harmful? High doses increase the urinary levels of oxalate and uric acid, two chemicals that can cause kidney stones. It’s a theoretical risk, but actual cases of vitamin C-related stones are rare and have been limited to people with kidney disease. Large doses of vitamin C can cause nausea, indigestion, and diarrhea, but these side effects are uncommon and temporary. People with a certain enzyme deficiency (glucose-6-phosphate dehydrogenase, or G6PD) can develop anemia from high doses, but this, too, is uncommon. A much more common, but much less serious, problem is that large amounts of vitamin C can inter-

### Food sources of vitamin C

<table>
<thead>
<tr>
<th>Food (portion size)</th>
<th>Vitamin C (mg)</th>
<th>Food (portion size)</th>
<th>Vitamin C (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fruit</strong></td>
<td></td>
<td><strong>Vegetables</strong></td>
<td></td>
</tr>
<tr>
<td>Cantaloupe (¼ medium)</td>
<td>60</td>
<td>Asparagus, cooked (½ cup)</td>
<td>10</td>
</tr>
<tr>
<td>Fresh grapefruit (½ fruit)</td>
<td>40</td>
<td>Broccoli, cooked (½ cup)</td>
<td>60</td>
</tr>
<tr>
<td>Honeydew melon (¼ medium)</td>
<td>40</td>
<td>Brussels sprouts, cooked (½ cup)</td>
<td>50</td>
</tr>
<tr>
<td>Orange (1 medium)</td>
<td>70</td>
<td>Cabbage, raw, chopped (½ cup)</td>
<td>20</td>
</tr>
<tr>
<td>Strawberries (1 cup, sliced)</td>
<td>95</td>
<td>Cauliflower, raw or cooked (½ cup)</td>
<td>25</td>
</tr>
<tr>
<td>Tangerine or tangelo (1 medium)</td>
<td>25</td>
<td>Pepper, red or green, raw (½ cup)</td>
<td>65</td>
</tr>
<tr>
<td>Watermelon (1 cup)</td>
<td>15</td>
<td>Pepper, red or green, cooked (½ cup)</td>
<td>50</td>
</tr>
<tr>
<td><strong>Juice</strong></td>
<td></td>
<td>Potato, baked (1 medium)</td>
<td>25</td>
</tr>
<tr>
<td>Grapefruit (½ cup)</td>
<td>35</td>
<td>Snow peas, fresh, cooked (½ cup)</td>
<td>40</td>
</tr>
<tr>
<td>Orange (½ cup)</td>
<td>50</td>
<td>Snow peas, frozen, cooked (½ cup)</td>
<td>20</td>
</tr>
<tr>
<td><strong>Fortified juice</strong></td>
<td></td>
<td>Sweet potato, baked (1 medium)</td>
<td>30</td>
</tr>
<tr>
<td>Apple (½ cup)</td>
<td>50</td>
<td>Sweet potato, canned, syrup-packed (1 cup)</td>
<td>20</td>
</tr>
<tr>
<td>Cranberry juice cocktail (½ cup)</td>
<td>45</td>
<td>Tomato, raw (½ cup)</td>
<td>15</td>
</tr>
<tr>
<td>Grape (½ cup)</td>
<td>120</td>
<td>Tomato, canned (½ cup)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tomato, juice (6 fluid oz.)</td>
<td>35</td>
</tr>
</tbody>
</table>

Exercise and your arteries

More than 300 years ago, the great English physician Thomas Sydenham observed, “A man is as old as his arteries.” It’s as true today as it was then. And in a 21st-century update on 17th-century wisdom, we might add: Your heart’s job is to pump blood to all parts of your body. The main pumping chamber, the left ventricle, delivers blood to the aorta, the largest and strongest of the arteries. Like the limbs of a tree, the aorta divides into arteries that grow progressively smaller as they branch from the main trunk. Ultimately, the smallest arteries lead into capillaries, the tiny vessels with filmy walls only one cell thick that allow oxygen to pass freely to the tissues while collecting carbon dioxide and other waste products that pass into the blood for disposal by the lungs, kidneys, and liver.

Exercise changes the way your circulation distributes blood to your body. Your digestive tract, liver, and kidneys get less blood, but your exercising muscles get much more as millions of capillaries open up to feed the muscle cells. As you overheat, the blood flow to your skin increases as well. Like your exercising muscles, your heart needs more oxygen, so it gets more blood. But even though exercise is a smart thing to do, your brain’s blood flow remains relatively constant.

Your arteries

A regular exercise program has a major effect on the health of your arteries. Doctors used to think of arteries as passive conduits for blood, working for your body the way a garden hose works for your lawn. Wrong! In fact, arteries are complex structures with crucial regulatory functions, and they are in the front line of the battle for cardiovascular health.

Every artery has three layers in its wall (see figure, page 5). The inner layer, or intima, is composed of a thin layer of endothelial cells that are in direct contact with the bloodstream. The middle layer, or media, is composed chiefly of smooth muscle cells and elastic fibers. The outermost layer, or adventitia, is made up of supporting tissues that are dense and strong in larger arteries but nearly absent in the delicate blood vessels of the brain.

Endothelial cells have a crucial role in vascular health, and exercise has an important effect on endothelial cells. If all the endothelial cells in your body were placed side by side, they would cover an area the size of a tennis court. Exercise further improves the function of these cells.

Exercise and your arteries

American team reported that high levels of vitamin C have a powerful antioxidant action, large amounts may promote oxidative damage. In a well-publicized experiment, British scientists gave a daily dose of 500 mg of vitamin C to 30 volunteers; after six weeks, their blood cells showed increased traces of oxidative damage to DNA. Similarly, an American team reported that high levels of vitamin C enhance the production of DNA-damaging substances called genotoxins. And several small studies have linked high doses of supplements to an accelerated thickening of the carotid artery, a marker of atherosclerosis; other studies, however, show the reverse.

All this research is preliminary, and none of it proves that vitamin C is harmful, even in large amounts. But it does provide some support for that common-sense standby, moderation.

Counting Cs

After reviewing the latest information about vitamin C, in 2000 the National Academy of Sciences revised the recommendations that had been in effect since 1989. They increased the recommended daily allowance (RDA) from 60 mg a day to 90 mg for men and 75 mg for women. They also suggested an extra 35 mg for smokers of either gender. Finally, the panel set 2,000 mg a day as the maximum safe daily dose of vitamin C.

It’s the new standard, but it doesn’t mean you should settle for 90 mg a day, much less push to 2,000 mg. Experts from the National Institutes of Health suggest that 200 mg a day is the best amount—and they also suggest you get it from foods rather than supplements. In fact, the widely publicized five servings of fruits and vegetables a day should do the trick. A simple daily multivitamin that provides 100% of the RDA for vitamin C is surely safe. Doses above 500 mg a day may be unwise, especially for people with excessive iron levels, kidney disease, or kidney stones. And since vitamin C can mask blood in the stool, you should cut down on it for three days before if you’re having fecal occult blood tests to screen for colon cancer.

Vitamin C is crucial for good health. A diet that includes lots of fruits and vegetables is the best way to get the C you need. Although the jury is still out, modest supplementary doses appear safe but are unlikely to help, and large doses may do more harm than good. This advice cuts through the confusion and controversy. As usual, your mother got it right: Eat your fruits and vegetables.

Harvard Men’s Health Watch June 2006
MENSTRUATION

Menstruation is the monthly shedding of the lining of the uterus. The lining, or endometrium, thickens in preparation for implantation of a fertilized egg. If the egg is not implanted, the endometrium begins to break down. The breakdown is accompanied by bleeding, which is menstruation.

The menstrual cycle is about 28 days long in women. During the menstrual phase, the endometrium is shed. After menstruation, the endometrium begins to grow again. The amount of blood loss during menstruation varies from woman to woman. Menstrual cramps and other symptoms may also vary.

MEDICAL DISCLAIMER

The information contained in this online site is intended to provide accurate and helpful health information for the general public. It is made available with the understanding that the author and publisher are not engaged in rendering medical, health, psychological, or any other kind of personal professional services on this site. The information should not be considered complete and does not cover all diseases, ailments, physical conditions or their treatment. It should not be used in place of a call or visit to a medical, health or other competent professional, who should be consulted before adopting any of the suggestions in this site or drawing inferences from it.

The information about drugs contained on this site is general in nature. It does not cover all possible uses, actions, precautions, side effects, or interactions of the medicines mentioned, nor is the information intended as medical advice for individual problems or for making an evaluation as to the risks and benefits of taking a particular drug.

The operator(s) of this site and the publisher specifically disclaim all responsibility for any liability, loss or risk, personal or otherwise, which is incurred as a consequence, directly or indirectly, of the use and application of any of the material on this site.