Scurvy is a disease you learn about in history books, not on the evening news. We’ve all heard the tale of 18th century British sailors who had no fruits and vegetables on long voyages. Starved for vitamin C, their bodies began to break down until eventually they died out on the open sea. The problem ended when ships began stocking limes and other fresh fruit for the sailors to eat, earning them the nickname “Limey” ever since.

Here in modern America, people have access to a variety of fresh fruits and vegetables all year long. In the lineup of nutritional problems, we pay attention to osteoporosis and iron-deficiency anemia. Nobody worries about scurvy. Maybe we should.

Nutrition researcher Carol Johnston measured blood levels of vitamin C among Phoenix area Cigna HMO members. The Arizona State University scientist found that six percent of her subjects were vitamin C deficient. In other words, one in 16 people showed the biochemical signs of scurvy (a physical exam is required to actually diagnose the disease).

An additional 30 percent of the sample was vitamin C depleted, meaning that they did not meet the U.S. Recommended Daily Allowance (RDA) for the nutrient.
"There’s no public health concern at all about vitamin C," says Johnston. "I did a Medline search just to look at the cases of vitamin C deficiency reported in the medical literature. It was more than you see with iron deficiency, more than vitamin B12 deficiency—these nutrients that we accept as a problem. Vitamin C deficiency is even more pronounced and doctors are not addressing it."

Even worse, patients who visit their doctors with symptoms of scurvy are likely to be misdiagnosed. If you look at case reports, people will tell their doctors that they have bruising; they’re always tired, and they have trouble walking. Doctors diagnose the problem as vasculitis or even as polio," Johnston says. "You wouldn’t believe how many misdiagnoses appear in these case reports. Physicians are not trained to know what scurvy is, because it supposedly doesn’t happen."

Vitamin C is involved in the production of collagen, which is used in forming gums, skin, blood vessels, ligaments and tendons. Early symptoms of scurvy include joint pain, bruising, receding gums and loose teeth, all due to low collagen production.

Left untreated, scurvy is deadly. "Eventually you can’t walk because your bones rub against one another. You die of cerebral hemorrhaging or massive blood loss," explains Johnston.

Death from scurvy isn’t really a problem in the industrialized world. Even people who don’t consume the RDA for vitamin C (currently 70 milligrams for women and 95 mg for men) generally eat enough to keep them alive. However, they probably suffer other symptoms like fatigue, bleeding gums, bruising, or frequent colds. "Let’s say you go to the gym and get on the treadmill," Johnston says. "You might say, ‘I just don’t feel like doing this,’ so you get off and walk away. It happens to all of us, that kind of vague, general feeling of not being well."

That feeling might have more to do with lack of vitamins than lack of motivation. Johnston’s research has linked vitamin C depletion to low levels of muscle carnitine, a substance the body uses to produce energy from fat. She has also shown that people who receive vitamin C supplements perform better on treadmill tests than people who are vitamin C depleted.

Getting the recommended dose of vitamin C can prevent these kinds of problems. But even people who meet the RDA may be missing out on other benefits of the nutrient, according to Johnston.

Her research findings indicate that higher doses of vitamin C—about 1,000 mg per day—may offer health benefits that you can’t get from smaller amounts. "There’s been a lot of controversy over how much vitamin C we need. The RDA is very low and still prevents scurvy. But is the prevention of disease the optimum goal? Are there other physiological functions that we’re not optimizing?" Johnston asks.

Compared with humans, other animals and plants maintain much higher levels of vitamin C. "Vitamin C is unique because almost all species make their own vitamin C. Except for humans," explains Johnston. "Hunters and gatherers probably consumed 600 mg or more of vitamin C a day because half their diet was foliage, such as kale. Not iceberg lettuce. We’re so far removed from eating that way."

There is one group of modern humans that routinely consumes high levels of vitamin C—breastfed babies. "Nutritionists often look at breast milk as the perfect nutrient. Physiology has dictated how much of each nutrient appears in the milk. A breastfed baby gets a plasma saturation level of vitamin C. We need to figure out what function is being promoted in rats and in wild primates and in breastfed babies to dictate maintaining a blood level that high."
During the past several years in three separate studies, Johnston has shown that high doses of vitamin C lower blood histamine levels. Histamine is the substance that causes allergy symptoms, bringing on the congestion, sneezing, and itching that plague sufferers.

When your body is stressed, histamine levels go up. And the reason histamine goes up is because it makes you more alert, ready to fight. Johnston explains: “But in our society we’re under chronic stress. We have chronically elevated histamine. It’s not doing us any good because we don’t need this fight or flight process going. Your body gets all revved up and the histamine goes up. But it suppresses your immune system.”

Johnston’s research shows that people who consume 2,000 mg of vitamin C per day have a blood histamine level 40 percent lower than those who consume the RDA.

“People take antihistamines like they’re candy,” Johnston says. “Maybe the problem is we’re not eating right. Maybe we all are more fruits and vegetables and took vitamin C we wouldn’t have to be taking all these antihistamines.”

She is quick to add that she’s not opposed to antihistamines. “When I have a lot of congestion I take an antihistamine. Because it’s a quick relief,” she says. “Vitamin C doesn’t block the histamine receptors, which is what gives you the quick relief. What it does is lower the levels of histamines in the blood.”

In other words, vitamin C might help prevent or lessen allergy symptoms over the long term. It doesn’t act as a quick treatment for existing symptoms.

Vitamin C also functions as an antioxidant. Antioxidants play a crucial role in helping prevent many serious problems, including cancer.

Antioxidants reduce the damage from various environmental stressors. Ultraviolet radiation, pollutants, even the oxygen we breathe, all create oxidants in our bodies. Oxidants are damaging molecules because they want to steal electrons. To achieve stability, they “steal” electrons from other molecules. When these molecules are part of human cells, the theft of an electron can do serious damage.

“If it’s a DNA molecule you get a mutation which might lead to cancer. If it’s a lipid you get arterial plaque development. If it’s in the retina you get macular degeneration,” explains Johnston. “That’s where antioxidants come in. An antioxidant is a molecule that carries an extra electron. When it meets up with an oxidant, it donates that electron.

‘An oxidant will get its electron from whatever’s next to it. So if you have vitamin C and an oxidant is next to the vitamin C, then the vitamin C will donate its electron to the oxidant, because only land species use it. ‘In the ocean, nothing makes vitamin C. There’s no vitamin C in ocean water. Why on land but not in the ocean?’ she asks.

‘The difference is the environmental stressors. All living terrestrial animals and plants require vitamin C. The theory is that the vitamin C is there to protect the land plants from the insults of oxygen in the atmosphere, and from UV radiation, which causes tremendous oxidative stress,’” says Johnston.

“All this oxygen we breathe in, obviously it’s vital, but it causes tremendous damage. Maybe we need the high C to protect us from all this oxygen we’re consuming.”

“In my mind, we have something that we need here,” says Johnston. “Maybe we need to rethink how we look at it, because maybe the avoidance of disease is not all we should be looking at.”

Vitamin C research at ASU is funded through the ASU Foundation. For more information, contact Carol Johnston, Ph.D., CNS, RD, at 480.727.1713. Send E-mail to carol.johnston@asu.edu
The USDA recommends eating at least five servings of fruits and vegetables every day. But not all veggies are created equal. Although more Americans than ever are getting their daily five, the foods they choose are leaving them short on certain nutrients, especially vitamin C.

ASU nutrition researchers Jeffrey Hampl and Carol Johnston, and former ASU graduate student Christopher Taylor, have analyzed the types of fruits and vegetables most Americans eat. The most popular, in order of highest consumption, are lettuce, tomatoes, bananas, orange juice, apples, onions, carrots, and cucumbers.

“If you look at the most commonly consumed vegetables, they’re what’s found on a Big Mac,” Johnston says. “People are consuming fruits and vegetables as condiments.”

Potatoes didn’t make the list, but Hampl notes that french fries were not included in the count. If they were, potatoes probably would have appeared near the top of the list.

With the exception of orange juice, these foods are low in vitamin C as well as folate, one of the B vitamins. Johnston says that only 40 percent of Americans drink orange juice.

What foods offer a bigger dose of C?

Some of the most vitamin C-rich foods are listed at left. The U.S. Recommended Daily Allowance for vitamin C is 75 mg per day for women and 90 mg per day for men. Smokers should aim a little higher, between 110-125 mg per day.

—Diane Boudreau

Vitamin C amounts in milligrams (mg)

Sweet red pepper: 174 mg (1 cup raw, diced)
Grapefruit juice: 83 mg (1 cup)
Orange juice: 82 mg (1 cup)
Sweet green pepper: 82 mg (1 cup raw, diced)
Strawberries: 81 mg (1 cup whole)
Orange: 70 mg (1 medium)
Broccoli: 58 mg (1/2 cup cooked)
Kiwifruit: 57 mg (1 medium)
Grapefruit: 44 mg (1 half)
Watermelon: 27 mg (1 wedge)
Tomato: 23 mg (1 medium)
Potato: 20 mg (1 medium, baked)

Data from the USDA Nutrient Database for Standard Reference

WHAT ARE YOU EATING?

The best food source of vitamin C in the world is the half ripe fruit of the Camu Camu, a shrubby tree found in the Amazon rainforest. It provides 2,700 mg of C per 100 grams of fruit!