VITAMINS & MINERALS:
HOW MUCH IS TOO MUCH?

Pick up any vitamin or mineral supplement. The label tells you roughly how much of each nutrient you need. But it doesn’t say how much is too much.

For the first time, the National Academy of Sciences has issued Tolerable Upper Intake Levels, or ULs, to tell people how much is a safe upper limit for nearly two dozen nutrients. The Academy has also updated the Recommended Dietary Allowances (RDAs) and other advice on how much of each vitamin and mineral the average healthy person needs.

The Center for Science in the Public Interest, publisher of Nutrition Action Healthletter, wants the Food and Drug Administration to require ULs on at least some supplement labels over the next few years. But you needn’t wait that long to find out what they are.

NAH’s Bonnie Liebman spoke by phone with researcher and physician Robert Russell, who served on two of the four panels that came up with the new RDAs and ULs.

Q: What are ULs?
A: The UL is the highest level of a vitamin or mineral that can be safely taken without any risk of adverse effect. Just going a little bit above the UL is not going to harm most people, but as you get higher and higher, you’re increasing your risk of side effects.

Q: So a person who consumes the UL is not in danger?
A: No. But to protect the population as much as possible, we don’t advise taking more than the UL on a daily basis. We’re not talking about the occasional time when you might exceed it. That’s not something we worry about. Nor do we worry about people who take more than the UL under a doctor’s supervision or as part of a clinical trial.

And for the most part, we’re not talking about toxicity from food. With the possible exception of vitamins A and D, almost all of the cases of toxicity are based on taking supplements or fortified foods.

Q: How did the panels come up with the ULs?
A: We studied toxicity reports in the literature. We tried to get them as clean as possible. For example, if you’re looking at liver toxicity, you want to make sure that the patients did not also have alcohol abuse or hepatitis. You want to rule those things out as much as possible, so you can attribute the adverse effect to the large doses of the nutrient and nothing else.

Q: And you set the ULs well below those levels?
A: Yes. Wherever possible, we’d start with a No Observed Adverse Effect Level, or NOAEL. If you know that people took X amount—say, 100 milligrams—and there was no toxicity in any individuals, that would be a NOAEL.

If you had NOAEL, you could use a Lowest Observed Adverse Effect Level, or LOAEL. If several people had some sign of toxicity at 100 milligrams, that would be a LOAEL. With a LOAEL, we’d use a greater safety factor to bring the level down further.

Q: So there’s always a safety margin.
A: Yes. The so-called “uncertainty factor” is built into the UL to protect almost all of the population. We divide the NOAEL or LOAEL by the uncertainty factor. So if a study finds a LOAEL of 100 mg, and you use an uncertainty factor of two, the UL would be 50 mg.

If you have only a few case reports of toxicity instead of a whole series of people, you would use a larger safety factor, because you don’t really have a good handle on what the upper level should be.

Q: Why are some ULs based on relatively minor side effects, like diarrhea for vitamin C?
A: ULs are based on the earliest side effects to occur—not necessarily the most serious one. But that doesn’t mean that there are no serious side effects. For example, flushing is the most sensitive indicator on niacin excess. But if people take a much higher dose—like 3,000 to 5,000 mg of niacin a day—to lower their cholesterol, they can get severe liver disease.

We use the most conservative indicator because the ULs are meant to protect the general population. Then we can feel confident that if you take that level on a daily basis, it’s safe.

Getting Too Much

Q: Which nutrients most concern you?
A: The UL for vitamin A from retinol is 10,000 IU. You can find single-nutrient...
supplements with 25,000 IU of vitamin A in any health-food store. You can put yourself in danger by taking those on a daily basis. And children are better off with a daily multivitamin that has no more than the UL for vitamin A, which is 3,000 IU for 4- to 8-year-olds and 2,000 IU for younger children.

Those ULs assume that all of the vitamin A in the supplement comes from retinyl palmitate or other forms of retinol, not from beta-carotene or other carotenoids, which have no UL because there is insufficient evidence of toxicity.

Q: What does too much vitamin A do?

A: In women who are capable of becoming pregnant, the risk is birth defects. In the rest of the population, it’s irreversible liver disease. We’re talking about severe, fibrotic, cirrhotic liver disease, not just elevated liver enzymes.

Q: Are the elderly at greater risk?

A: We can’t say for certain. When the elderly consume vitamin A, they clear it from the blood and store it in the liver less efficiently than younger people. And we have customarily taken those higher blood levels as a sign of overload, so it makes sense that the elderly would be more prone to toxicity. But we don’t have evidence that they actually develop liver toxicity more often.

Q: What other nutrients might we get too much of?

A: Some single-nutrient supplements exceed the UL for zinc. And we’re a bit worried about excess folic acid. You wouldn’t get it from a single supplement, but if you were also eating a number of fortified foods, you might exceed the UL for folic acid, which is 1,000 micrograms a day. That could cover up or precipitate a vitamin B-12 deficiency.

Q: Can’t a blood test tell people if they’re low in B-12?

A: Yes, but from a public health point of view, we don’t want to depend on that. There is actually a debate over whether to fortify the food supply with vitamin B-12, which would help prevent deficiencies. There are no reports of B-12 toxicity, so there’s no UL. It’s safe.

Q: Can people take unlimited quantities of nutrients that have no ULs?

A: No. It may just mean that the data don’t exist. For example, there’s no UL for arsenic, which may be a nutrient we need in tiny quantities. We know that some kinds of arsenic are poisonous and that the kind found in drinking water may raise the risk of cancer. But there’s no data on toxicity from the kind of arsenic found in food.

Getting Too Little

Q: The Academy also updated the Recommended Dietary Allowances. Why is the new RDA for B-12 so low?

A: I used to recommend 25 micrograms a day to play it safe for people with atrophic gastritis, a problem for 10 to 30 percent of people older than 50. They produce too little stomach acid to extract B-12 when it’s bound to proteins in food. We now know that most people with atrophic gastritis can absorb enough B-12 by taking 2.4 micrograms a day, the new RDA, as long as it’s in an unbound form—that is, in a fortified food or a supplement.

Q: B-12 is the first supplement the Academy has told people to take?

A: Yes. If you’re older than 50, you need at least 2.4 mcg of B-12 from a supplement or a fortified food like breakfast cereal.

Q: Most multivitamins have less than the RDA for vitamin K. Is that a problem?

A: It’s too early to say. The question is how vitamin K affects bone. We know that certain markers in the blood go up in people who are vitamin-K-deficient, but there just wasn’t enough evidence to say if that raises their risk of bone fracture. The beauty of these new RDAs is that once a critical mass of evidence comes in, they can be revised. We used to have to wait 10 to 15 years.

The RDA for vitamin D, for example, might be raised fairly soon for people over 70. Even though their RDA is high—600 IU a day—that may not be sufficient.

Q: Why?

A: The skin of older people is much less able to make vitamin D. People in their 70s make roughly half as much vitamin D as children can make from the same ultraviolet sun exposure. And older people’s bodies are less able to convert vitamin D to the active form. Plus the older gut has fewer vitamin-D receptors, so you have a malabsorption problem. All that adds up to a significant increase in an older person’s requirement.

Q: And the RDA assumes that you get no vitamin D from the sun?

A: Yes. Some people may get enough from sunlight. But the RDAs are meant to protect the entire population. And in northern latitudes—say, in Boston—the sun isn’t strong enough in the winter for your body to make enough vitamin D. That’s true across the northern states and Canada.

In the southern states, older people may go out into the sun more. But many don’t, and many use sunscreen, which blocks the UV rays. So they may need to take vitamin D anyway.

Q: Yet the National Academy of Sciences didn’t recommend that older people take a supplement?

A: No, but its report definitely implies that you need one for both vitamin D and calcium. Even when older people eat a healthy diet, they’re not likely to meet those requirements. That’s particularly true for vitamin D. It would take a quart and a half of milk a day to meet the current RDA for people over 70, which is 600 IU. Nobody’s going to drink that much.

You won’t see RDAs on food and supplement labels, because the numbers vary for men and women, young and old. Instead, labels list Daily Values (DVs), though supplements can also call them U.S. Recommended Daily Allowances (or USRDAs). For each nutrient, the DV (or USRDA) is a single number that is set high enough to protect almost everyone.

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<th>Nutrient (other names)</th>
<th>Recommended Dietary Allowance (RDA)</th>
<th>Daily Value (DV)</th>
<th>Good Sources</th>
<th>Upper Level (UL)</th>
<th>Selected Adverse Effects</th>
<th>Nutrition Action Comments</th>
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</table>
| **Vitamin A** (retinol) | Women: 700 mcg  
Men: 900 mcg | 5,000 IU¹ (1,500 mcg) | Liver, fatty fish, fortified foods (milk, breakfast cereals, etc.) | 10,000 IU  
(3,000 mcg) | Liver toxicity, birth defects. Inconclusive: bone loss | The body turns some carotenoids into vitamin A. |
| Carotenoids  
(alpha-carotene, beta-carotene, beta-cryptoxanthin, lutein, lycopene, zeaxanthin) | None. (NAS advises eating more carotenoid-rich fruits and vegetables) | None | Orange fruits & vegetables (alpha- and beta-carotene, green leafy vegetables (beta-carotene and lutein), tomatoes (lycopene).) | None. Panel said don't take beta-carotene, except to get RDA for vitamin A. | Smokers who took high doses of beta-carotene supplements (33,000-50,000 IU a day) had higher risk of lung cancer. | Lutein may lower risk of cataracts and degeneration of the retina. Lycopene may lower risk of prostate cancer. |
| **Thiamin** (vitamin B-1) | Women: 1.1 mg  
Men: 1.2 mg | 1.5 mg | Breads, cereals, pasta, & foods made with "enriched" or whole-grain flour; pork. | None | None | None reported. |
| **Riboflavin** (vitamin B-2) | Women: 1.1 mg  
Men: 1.3 mg | 1.7 mg | Milk, yogurt, foods made with "enriched" or whole-grain flour | None | None reported | May lower risk of cataracts. |
| **Niacin** (vitamin B-3) | Women: 14 mg  
Men: 16 mg | 20 mg | Meat, poultry, seafood, foods made with "enriched" or whole-grain flour. | 35 mg² | Flushing (burning, tingling, itching, redness); liver damage. | Cholesterol-lowering doses of niacin should only be taken under a doctor's supervision. |
| **Vitamin B-6** (pyridoxine) | Ages 19-50: 1.3 mg  
Women 50+: 1.5 mg  
Men 50+: 1.7 mg | 2 mg | Meat, poultry, seafood, fortified foods (cereals, etc.), liver | 100 mg | Reversible nerve damage (burning, shooting, tingling pains, numbness, etc.) | May lower risk of heart disease (by lowering homocysteine levels). |
| **Vitamin B-12** (cobalamin) | 2.4 mcg | 6 mcg | Meat, poultry, seafood, dairy foods, fortified foods (cereals, etc.) | None | None reported | People over 50 need a supplement or fortified food. |
| **Folate** (folacin, folic acid) | 400 mcg | 400 mcg (0.4 mg) | Orange juice, beans, other fruits & vegetables, fortified cereals, foods made with "enriched" or whole-grain flour. | 1,000 mcg² (1 mg) | Can mask or precipitate a B-12 deficiency, which can cause irreversible nerve damage. | Reduces risk of birth defects. May lower risk of heart disease, cervical and colon cancer, and depression. |
| **Vitamin C** (ascorbic acid) | Women: 75 mg  
Men: 90 mg  
(Smokers: add 35 mg) | 80 mg | Citrus & other fruits, vegetables, fortified foods (cereals, etc.) | 2,000 mg | Diarrhea. | High doses (1,000 mg a day) may shorten colds. |
| **Vitamin D** | Ages 19-50: 200 IU²  
Ages 51-70: 400 IU²  
Over 70: 600 IU³ | 400 IU | Sunlight, fatty fish, fortified foods (milk, breakfast cereals, etc.). | 2,000 IU | High blood calcium, which may cause kidney and heart damage. | Deficiency can cause bone loss and may raise risk of osteoporosis. |
| **Vitamin E** (alpha-tocopherol) | 15 mg (33 IU—natural)  
(22 IU—synthetic) | 30 IU (synthetic) | Oils, whole grains, nuts. | 1,000 mg² (1,100 IU—synthetic)  
(1,500 IU—natural) | Hemorrhage. | May lower risk of heart disease, prostate cancer, cataracts; may slow Alzheimer's. |
| **Vitamin K** (phyloquinone) | Women: 90 mcg³  
Men: 120 mcg³ | 80 mcg | Green leafy vegetables, oils | None | Interferes with coumadin & other anti-clotting drugs. | May lower risk of bone fractures. |
## MINERALS

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<th>Nutrient (other names)</th>
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<tbody>
<tr>
<td>Calcium</td>
<td>Ages 19-50: 1,000 mg; Over 50: 1,200 mg</td>
<td>1,000 mg</td>
<td>Dairy foods, fortified foods, leafy green vegetables, canned fish (eaten with bones).</td>
<td>2,500 mg</td>
<td><em>High blood calcium</em>, which may cause kidney damage, kidney stones.</td>
<td>May lower risk of osteoporosis, colon cancer. High doses (2,000 mg a day) may raise risk of prostate cancer.</td>
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<tr>
<td>Chromium</td>
<td>Women: 20-25 mcg; Men: 30-35 mcg</td>
<td>120 mcg</td>
<td>Whole grains, bran cereals, meat, poultry, seafood.</td>
<td>None</td>
<td>Inconclusive: kidney or muscle damage.</td>
<td>May lower risk of diabetes</td>
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<tr>
<td>Copper</td>
<td>900 mcg</td>
<td>2 mg (2,000 mcg)</td>
<td>Liver, seafood, nuts, seeds, wheat bran, whole grains, chocolate.</td>
<td>10 mg (10,000 mcg)</td>
<td>Liver damage.</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>Women 19-50: 18 mg; Women 50+: 8 mg; Men: 8 mg</td>
<td>18 mg</td>
<td>Red meat, poultry, seafood, foods made with &quot;enriched&quot; or whole-grain flour.</td>
<td>45 mg</td>
<td>Gastrointestinal effects (constipation, nausea, diarrhea).</td>
<td>Gene raises risk of iron overload (hemochromatosis) in some people.</td>
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<tr>
<td>Magnesium</td>
<td>Women: 310-320 mg; MCN: 400-420 mg</td>
<td>400 mg</td>
<td>Green leafy vegetables; whole-grain breads, cereals, etc.: nuts</td>
<td>350 mg2</td>
<td>Diarrhea.</td>
<td>May lower risk of osteoporosis, heart disease, or high blood pressure.</td>
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<tr>
<td>Phosphorus</td>
<td>700 mg</td>
<td>1,000 mg</td>
<td>Dairy foods, meat, poultry, seafood, foods (processed cheese, colas, etc.) made with phosphate additives.</td>
<td>Ages 19-70: 4,000 mg; Over 70: 3,000 mg</td>
<td><em>High blood phosphorus</em>, which may damage kidneys and bones.</td>
<td>With phosphate additives on the rise, look for low-not high-phosphorus multivitamins.</td>
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<tr>
<td>Selenium</td>
<td>55 mcg</td>
<td>70 mcg</td>
<td>Seafood, meat, poultry; grains (depends on levels in soil).</td>
<td>400 mcg</td>
<td>Nail or hair loss or brittleness.</td>
<td>May lower risk of prostate, lung, colon cancer.</td>
</tr>
<tr>
<td>Zinc</td>
<td>Women: 8 mg; Men: 11 mg</td>
<td>15 mg</td>
<td>Red meat, seafood, whole grains, fortified foods (cereals, etc.).</td>
<td>40 mg</td>
<td>Lower copper levels, HDL (“good”) cholesterol, and immune response</td>
<td>The average person gets about a quarter of the UL from food.</td>
</tr>
</tbody>
</table>

**Recommended Dietary Allowance (RDA):** We list RDAs for adults only.

**Daily Value (DV):** These levels, also called U.S. Recommended Daily Allowances or (USRDAs), appear on food and supplement labels. Unlike the RDAs, there is only one Daily Value for everyone over age four.

**Tolerable Upper Intake Level (UL):** These levels are upper safe daily limits. We list ULs for adults only.

**Selected Adverse Effects:** What happens if you take too much. The UL is based on the adverse effect listed in italics. Inconclusive adverse effects are based on inconsistent or sketchy evidence.

**Other Tolerable Upper Intake Levels**
- Boron: 20 mg
- Choline: 3.5 grams
- Fluoride: 10 mg
- Iodine: 1,100 mcg (1.1 mg)

1. We get vitamin A both from retinol and carotenoids, but this number assumes that all of the vitamin A comes from retinol.
2. From supplements and fortified foods only.
3. Adequate Intake (AI). The National Academy of Sciences (NAS) had too little data to set an RDA.

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