

A Harvard Medical School Special Health Report

Healthy Eating

A guide to the new nutrition



In this report:

Food as preventive medicine

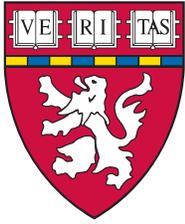
Rebuilding the food pyramid

Who needs vitamins?

Is your food safe?

SPECIAL BONUS SECTION

The food-health connection



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SPECIAL HEALTH REPORT

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Harvard Health Publications
HARVARD MEDICAL SCHOOL

Trusted advice for a healthier life

Dear Reader,

Healthy eating is far easier than you might think. Choosing healthy foods based on good science remains the best known way to reduce your chances of developing heart disease and diabetes and to help ward off hypertension, osteoporosis, and some forms of cancer.

We've known for many years that certain foods promote good health—especially fruits, vegetables, some oils and fats, and whole grains. But while “eat your vegetables” is a well-known refrain, it still surprises many people that some of the healthiest foods are fats. Maligned for many years as the bane of a healthy diet, some types of fat—mainly those from plants and fish—can help keep arteries clear and hearts beating normally, and inhibit some forms of cancer. Just as there are good fats, there are also good carbohydrates—mainly those that are least processed.

The mounting evidence is triggering changes behind the scenes to help support healthy eating habits. In 2005, experts revised the nutritional guidelines known as dietary reference intakes (DRIs). And the same year, the U.S. Department of Agriculture (USDA) revised its famous food pyramid to reflect the new emphasis on whole grains, healthy fats, and exercise, although there is still progress to be made here. The USDA also reworked its Dietary Guidelines for Americans to emphasize calorie control and exercise. The World Health Organization concurred and also urged people to reduce salt consumption.

Recently, we in the Nutrition Department of the Harvard School of Public Health had our fourth annual retreat with upper management in the food industry, hosted by the Culinary Institute of America in Napa Valley, Calif. The news was good. We talked about the many changes that have been made to improve the healthfulness of prepared foods and the ingredients that are available. The trans fat problem is nearly behind us. Improving quality of carbohydrate-rich foods and lowering salt content are gaining priority, and the foods you buy at the store or eat in restaurants are becoming healthier.

Last summer, as I bicycled with my Harvard colleagues on a coastal five-day trip that serves as a workshop for us to discuss and incubate the next year's projects, I noticed for the first time that every restaurant we visited had eliminated unhealthy trans fats and used healthy fats for frying. That made fried fish a healthy option for us for the first time. The pages that follow provide the information you'll need to choose safe, nutritious foods, avoid the junk food, and enjoy the vast array of delicious, convenient, healthy choices available to you—whether at home or on the road. Bon appétit!

Sincerely,

Frank M. Sacks, M.D.

*Medical Editor, Professor of Cardiovascular Disease Prevention, Nutrition Department,
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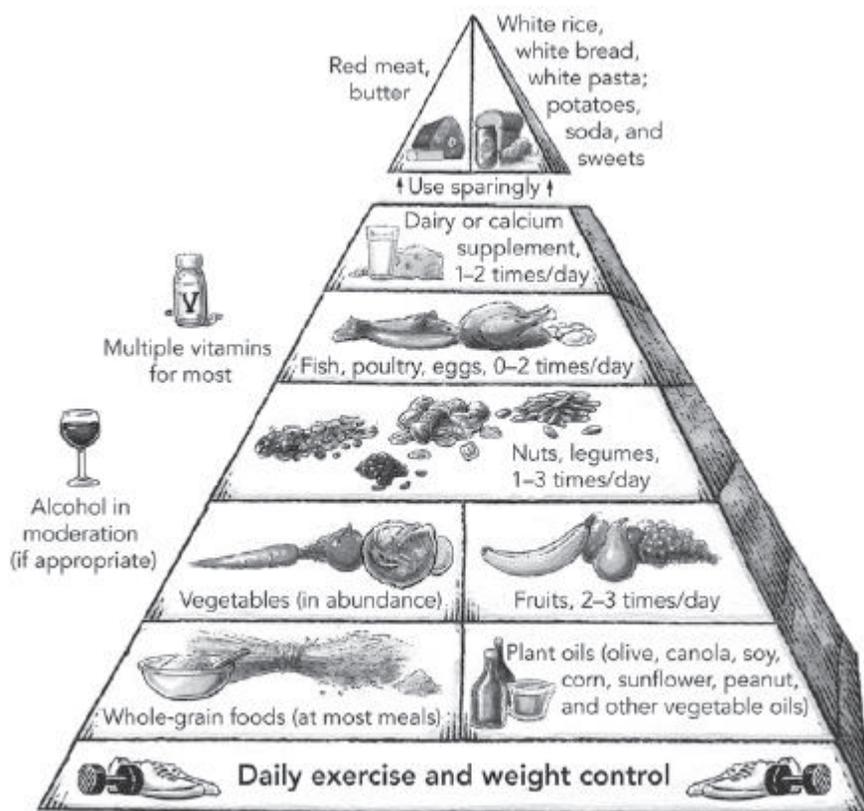
Eating for health

Not long ago, a healthy diet could be summed up in two simple concepts. One: Maintain a “balanced diet” of proteins, carbohydrates, and fats. Two: Get the recommended amounts of vitamins and minerals. Cover these bases, and you’d have enough energy to power your body’s cells and enough nutrients to prevent deficiency diseases.

The basic concepts of a healthy diet remain the same, but science has expanded on them. Everyone needs a mix of proteins, carbohydrates, and fats, but

we now know that some of the choices within these categories are better than others. There are good fats, which promote health, and bad fats, which increase your risk of illness. The same is true for carbohydrates and possibly for proteins. Regarding vitamins and minerals, the latest thinking goes beyond diseases caused by deficiency and now includes a knowledge of how these substances affect our health—from bone strength to birth defects, and from heart health to hypertension.

Figure 1 The Healthy Eating Pyramid



The Harvard Healthy Eating Pyramid represents the latest nutritional science. The widest part at the bottom is for things that are most important. The foods at the narrow top are those that should be eaten sparingly, if at all. This Healthy Eating Pyramid shows daily exercise and weight control in the widest, most important category. Fats from healthy sources, such as plants,

are in the wider part of the pyramid. Refined carbohydrates, such as white bread and white rice, are in the narrow top. Red meat should also be eaten sparingly, while fish, poultry, and eggs are healthier choices.

Adapted from *Eat, Drink, and Be Healthy: The Harvard Medical School Guide to Healthy Eating*, by Walter Willett, M.D. (Simon & Schuster, 2005).

The food pyramid

It's a clever idea: organize foods into a pyramid with the healthy foods at the wide bottom, to indicate these should form the foundation of the diet, and put unhealthy foods at the narrow top, to suggest you should eat only small amounts. The USDA developed its first food pyramid in 1992, and chances are it is still hanging in many classrooms and doctors' offices around the country. But nutrition information has changed a great deal since then. Not only did the USDA revise its pyramid in 2005, but other experts, including those at Harvard, have come up with their own versions.

Harvard's Healthy Eating Pyramid

Harvard nutrition experts were among the first to challenge the USDA pyramid, saying that by placing all fats in the small top of the pyramid, it falsely implied that all fats are bad. Experts now know that most fats from plants and fish (unsaturated fats) are good for you, while those from animals (saturated fats) and in many processed foods (trans fats) are unhealthy.

Look at the Healthy Eating Pyramid (see Figure 1) and you'll see that the largest part, the foundation, consists of daily exercise and weight control. Although good food choices will improve the health of overweight and obese people, to be truly healthy it is important to maintain a normal weight and stay physically active. Physical activity and weight control help prevent several serious illnesses.

The next level attempts to distinguish good fats from bad fats and good carbohydrates from bad ones. This category tells you that the most important foods to eat are whole-grain foods (good carbohydrates) and plant oils (good fats).

Next come fruits and vegetables, followed by nuts and legumes. The Healthy Eating Pyramid places nuts and legumes in their own category instead of lumping them with meat and fish to form one "protein" category. This reflects findings that some forms of protein are healthier than others (see "Update on protein," page 12).

Fish, poultry, and eggs make up the next step on the pyramid, followed by dairy products or calcium supplements. At the very top are the foods you should eat least frequently: refined starches and sweets (bad

Healthy eating in a nutshell

Regardless of which pyramid you use, you can simplify the process of healthy eating and get going in the right direction using these basic steps.

- Get five servings of fruits and vegetables in your diet every day—one with each meal and two snacks daily.
- Plan your fruit and vegetables first when preparing a meal.
- Buy whole-grain bread instead of white bread, and choose whole-grain cereals.
- Plan a meal with fish at least once a week.
- Try whole-grain pasta or brown rice at least once a week.

Exercise completes the picture

For general health and to prevent many diseases and cancer, experts recommend at least 30 minutes a day of moderate-intensity exercise, and ideally 60 minutes. Exercise works in other ways as well, such as training muscles to respond better to insulin and take in more blood sugar.

carbohydrates) and red meat and bad fats, including saturated fats from animal products like butter and trans fats found in many processed foods.

In doing the research for the Healthy Eating Pyramid, Harvard scientists examined the diets of more than 100,000 female nurses and male health professionals taking part in two long-term studies. They found that men whose diets most closely followed the Healthy Eating Pyramid lowered their overall risk of major diseases by 20% over eight to 12 years, compared with men whose diets scored lowest on the healthy eating recommendations. Women in the study who followed the Healthy Eating Pyramid lowered their overall risk by 11% compared with those who scored lowest. The big wins came with cardiovascular disease. The top nutritional scorers among both men and women cut their risk by one-third or more. Healthy diet and lifestyle lowered the risk of heart attacks even in people who were taking medications for high cholesterol or high blood pressure, showing that good nutrition has its own benefits independent of medications.

The Healthy Eating Pyramid isn't set in stone. As nutrition researchers turn up new information over time, it will change to reflect important new evidence. And it's not the only pyramid. If you'd like to check out some other healthy eating pyramids adapted to Mediterranean, Latin American, Asian, and vegetari-

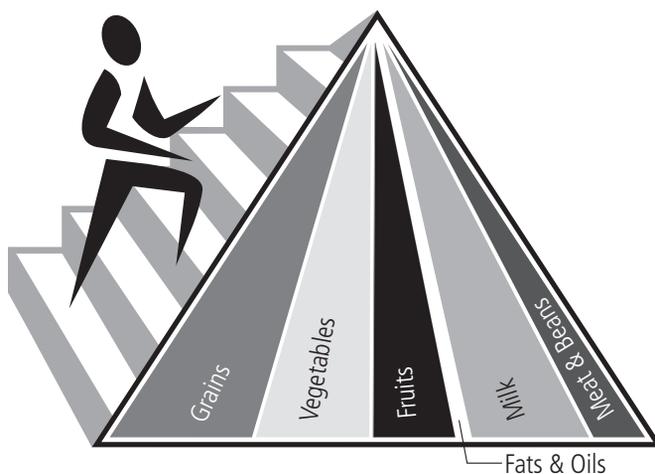
an foods, go to the Web site for Oldways, the respected nutrition think tank, at <http://www.oldwayspt.org>.

The USDA “My Pyramid”

The government has updated its traditional food pyramid and now calls it “My Pyramid” (see Figure

Figure 2 The USDA “My Pyramid”

The government pyramid turns the traditional pyramid on its side to describe the different categories of foods.



Grains: Make half your grain whole. Eat at least 3 oz. of whole grain cereals, breads, crackers, rice, or pasta every day.

Vegetables: Vary your vegetables. Eat more dark green vegetables like broccoli and spinach. Eat more orange vegetables like carrots and sweet potatoes. Eat more dry beans and peas.

Fruits: Eat a variety of fruits. Choose fresh, frozen, canned, or dried fruit. Go easy on fruit juices, which have high sugar content without much fiber.

Milk: Eat calcium-rich foods. Choose low-fat or fat-free dairy products. If you don't drink milk or eat dairy products, choose lactose-free products or other calcium sources such as fortified foods and drinks.

Meat and beans: Eat lean proteins. Choose low-fat or lean cuts of meat and poultry. Bake, broil, or grill your meats. Eat more fish, beans, peas, nuts, and seeds.

2). You can review it in detail at the Web site www.mypyramid.gov, where an interactive tool allows you to customize the recommendations based on your age and level of activity. My Pyramid is an improvement over the old USDA food pyramid because it includes exercise. Still, it doesn't differentiate between types of carbohydrates and proteins, two categories with important health implications (see “Fats, carbs, and proteins” at right).

In My Pyramid, the food groups are represented by vertical bands of color, which vary in width depending on how much people should eat. Along the side of the pyramid is a staircase, to remind us that exercise and fitness go hand in hand with nutrition for optimal health. The food pyramid is really a teaching tool: kids learn about it in school, and health care providers use it to teach people how to eat.

Despite some drawbacks, the major points of the USDA's updated recommendations are worth noting:

- Eat more vegetables and fruits. Go for those with deep, bright color.
- Add more whole grains. Whole grains pack more nutritional punch and fiber than refined grains. They also help maintain a normal blood sugar level and prevent diabetes.
- Reduce serving size. A portion should be the size of your palm. Alternatively, you could follow the updated USDA recommendations that go by measuring cup size per week.
- It's not fat, but the kind of fat. Oil is okay if you use vegetable oils such as olive, canola, or sunflower oil. Avoid butter, and don't use margarine unless it has no trans fats listed on the label.
- Include exercise. You are what you eat... and how much you exercise. You can't think of one without the other.
- Limit salt. Salt contributes to high blood pressure. ♥

Fats, carbs, and proteins

It used to be so simple. Fats were the villains, and carbohydrates were the heroes. More protein was good. But that simplified thinking has changed. Fats, carbohydrates, and proteins, known as macronutrients, are the basic categories of nutrients that humans need. They provide the body with energy, and they enable the body to carry out many normal biological functions. A healthy diet consists of a mix of foods from each of these three macronutrient categories, although not in equal amounts.

A panel of U.S. and Canadian scientists backed by the National Academy of Sciences' Institute of Medicine has set dietary reference intakes (DRIs) for macronutrients based on new research on diet and health (see “How much of each?” at right). The DRIs set forth the range of macronutrients you should eat daily to maintain a healthy weight and to prevent serious conditions such as heart disease, cancer, hypertension, and diabetes. The DRIs also provide guidelines for fiber (a form of indigestible carbohydrate that serves several functions in the body) and vitamins and minerals.

All about fat

Fat now makes up about one-third of the average American's diet. At one time, experts encouraged people to eat less fat. These days, experts are more concerned about the type of dietary fat, especially for heart health, thanks in part to decades of studies at the Harvard Medical School and the Harvard School of Public Health. This changed concept was supported in 2006 by the Women's Health Initiative, a study of about 49,000 women, which showed that a low-fat diet did not significantly reduce the women's risk of heart disease, breast cancer, or colon cancer.

The body needs fat. It's a major energy source and also helps you absorb certain vitamins and nutrients. Only some fats are bad for you: saturated fats (found mainly in meat, butter, whole milk, and cheese) and

trans fatty acids, or trans fats (which come mostly from the partially hydrogenated oils used in restaurant fryers, many margarines, and packaged snacks and baked goods, and in lesser amounts from dairy products and meats). These bad fats boost your chances of developing heart disease by increasing blood levels of two of its main risk factors, LDL cholesterol and triglycerides. Trans fats also lower levels of the protective HDL cholesterol.

Unsaturated fats—which come from fish and such plant sources as vegetable oils, nuts, and whole grains—are good for you. There are two types of unsaturated fats: polyunsaturated fats and monounsaturated fats. These good fats can help lower LDL, prevent abnormal heart rhythms, and prevent heart disease. (For more information on fats and specific illnesses, see “Special section: The food-health connection,” page 23.)

How much of each?

Following are the dietary reference intakes (DRIs) for fats, carbohydrates, and proteins—the amounts needed daily to meet nutritional needs for adults while minimizing risk for disease.

Fats: 20%–35% of daily calories (restrict saturated fats to no more than 10% and keep trans fats as low as possible)

Protein: 10%–35% of daily calories

Carbohydrates: 45%–65% of daily calories (no more than 25% from added sugar)

Fiber (indigestible carbohydrate): 14 grams per every 1,000 calories, which works out to about 21 to 38 grams a day based on age and sex, as follows:

- men ages 50 and younger: 38 grams/day
- women ages 50 and younger: 25 grams/day
- men over age 50: 30 grams/day
- women over age 50: 21 grams/day.

Dietary Reference Intakes: *The Essential Guide to Nutrient Requirements*, Institute of Medicine (National Academy of Sciences, 2006).

The DRI for fat gives considerable leeway: 20% to 35% of your daily calories can come from fat. This means you can get up to 35% of your calories from fat and still have a diet that's good for your heart, helps reduce your risk of hypertension, and lets you maintain your weight or even lose weight. Even more may be fine, as shown by the OmniHeart study (see "Healthy diets from the OmniHeart trial," page 27), so long as it's mostly healthy fats from fish and vegetables. Unfortunately for lovers of red meat, butter, cheese, and ice cream, these foods should be avoided or limited to occasional treats. The 2005 Dietary Guidelines for Americans recommend no more than 10% of total daily calories from saturated fats. For trans fats, there is no safe level, and the guidelines recommend eating as little as possible.

A low-fat diet is no guarantee of good health. In fact, a diet with only 20% of calories from fat can be virtually a junk-food diet if you make up for the lost fat calories with sugary foods such as soft drinks, non-fat cookies, and high-starch carbohydrates such as white bread and potatoes. An overabundance of these foods increases the risk for heart disease and diabetes (see "What about carbohydrates?" on page 8).

What's the difference between a good fat and a bad fat? All fats have a similar chemical structure: a chain of carbon atoms bonded to hydrogen atoms. What differs is the length and shape of their carbon chains and the number of hydrogen atoms connected to the carbon atoms. Seemingly slight differences in structure translate into crucial differences in the body.

Bad fat

The two forms of unhealthy fat, saturated and trans fats, share a physical trait: they are solid at room temperature. Think of butter, shortening, or the marbled fat in a steak. But bad fats abound in some liquids, too, including whole milk, cream, and coconut oil. These fats drive up your total cholesterol, in particular tipping the balance toward LDL cholesterol, the destructive type that promotes the formation of blockages in the coronary arteries, the hallmark of heart disease. The expert panel of the National Cholesterol Education Program recommends cutting back on the bad fats as a means of preventing and controlling heart disease.

■ **Saturated fats.** The word "saturated" here refers to the number of hydrogen atoms these fats have. In a saturated fat, the chain of carbon atoms holds as many hydrogen atoms as possible, making it literally saturated with hydrogen atoms. Each carbon atom in the chain is connected to the next by a single bond, leaving the maximum number of bonding points available to hold hydrogen. By contrast, in unsaturated fats, the carbon atoms have fewer than the maximum number of hydrogens.

There are about 24 different saturated fats. Not all of them are equally bad for your health. The saturated fat found in butter, whole milk, cheese, and other dairy products increases LDL levels the most, followed by the saturated fat in beef. Curiously, the saturated fat called stearic acid, found in pure chocolate, is more like unsaturated fat in that it lowers LDL levels, unlike other, more common saturated fats. Some vegetable oils, such as palm oil and coconut oil, contain some saturated fat. It is not possible to avoid saturated fat entirely because even the healthiest oils contain a small amount of it.

■ **Trans fats (partially hydrogenated oils).** Big change is happening with these mainly man-made fats, which used to be in everything from commercial cookies to fast food fries. Trans fats were created in the laboratory to provide cheap alternatives to butter. Food chemists learned how to solidify vegetable oil by heating it in the presence of hydrogen and a heavy-metal catalyst such as palladium. The process, called hydrogenation, gives the carbon atoms more hydrogen atoms to hold, making polyunsaturated fat (a good fat) more like saturated fat in structure. That's how solid vegetable fats such as shortening and margarine came into being. Trans fats are often listed as "partially hydrogenated oil" on the ingredients list.

Trans fats are even worse for you than saturated fats. Not only do they increase your LDL cholesterol, but they also reduce your beneficial HDL cholesterol. The Institute of Medicine expert panel stated that trans fats have no known health benefits and that there is no safe level of consumption.

Happily, it's getting easier in many places to avoid trans fats in your food. Since 2006, the FDA has required trans fat content to be listed as a separate line

item on food labels. The result is that the food industry has taken steps to eliminate or reduce trans fats in their foods and even local governments have legislated against trans fats in restaurant foods. Trans fats may truly be on the way out. That changes some formerly poor food choices, such as many fried foods, into potentially good ones as long as they are fried in unsaturated oil. Unfortunately, those home fries cooked in bacon grease still don't make the grade!

Good fat

Good fats come mainly from vegetable, nut, and fish products. They differ from bad fats by having fewer hydrogen atoms bonded to their carbon chains. They are liquid, not solid, at room temperature. There are two broad categories of beneficial fats: polyunsaturated and monounsaturated.

■ **Polyunsaturated fats.** When you pour liquid cooking oil in a pan, there's a good chance you're using polyunsaturated fat. Corn oil, sunflower oil, and safflower oil are common examples. (The exceptions are sunflower and safflower oils labeled "high-oleic," which come from crops intentionally bred to produce mostly monounsaturated fats.) Polyunsaturated fats are essential fats. That means that they are required for normal body functions, but your body can't manufacture them and so must get them from food. Polyunsaturated fats help build cell membranes, the exterior casing of each cell, and the sheaths surrounding nerves. They're vital to blood clotting, muscle contraction and relaxation, and inflammation. They reduce LDL more than other types of fats, improving your cholesterol profile. Even better, they also lower triglycerides.

A polyunsaturated fat has two or more double bonds in its carbon chain. There are two types of polyunsaturated fats: omega-3 (n-3) fatty acids and omega-6 (n-6) fatty acids. (The numbers refer to the distance between the end of a carbon chain and the first double bond.) Both types offer health benefits.

Research has shown that omega-3s in dietary fish and fish oil supplements help prevent and even treat heart disease and stroke. The reasons are several: these fats help reduce blood pressure, raise HDL, lower triglycerides, and—perhaps most importantly—prevent lethal heart-rhythm disorders. Evidence also suggests

they may help reduce the need for corticosteroid medications in people with rheumatoid arthritis and may help with non-Alzheimer's dementia. But most of the other studies linking omega-3s to a wide range of other health improvements are inconclusive, and some of them have major flaws, according to a systematic review of the evidence by the Agency for Healthcare Research and Quality.

Omega-3s come mainly from fish, but they are also found in flaxseeds, walnuts, canola oil, and unhydrogenated soybean oil. Fatty fish such as salmon, mackerel, and sardines are especially good sources of omega-3s. The DRI for alpha-linolenic acid, the omega-3 in vegetable oils, is 1.6 grams per day for men and 1.1 for women.

Omega-6 fatty acids are even more protective against heart disease. High levels of linoleic acid, an omega-6, are in such vegetable oils as safflower, soybean, sunflower, walnut, and corn oils. (Be aware, however, that high-oleic safflower and sunflower oils, often used in chips, have much lower omega-3 and omega-6 content.) The DRI for linoleic acid is 17 grams per day for men ages 19 to 50 and 12 grams for women in this age group. For adults ages 51 to 70, the DRI is 14 grams for men and 11 grams for women.

■ **Monounsaturated fats.** When you swab your bread in olive oil at an Italian restaurant, you're getting mostly monounsaturated fat. Unlike a polyunsaturated fat, which has two or more double bonds of carbon atoms, a monounsaturated fat has just one. The result is that it has more hydrogen atoms than a polyunsaturated fat, but fewer than a saturated fat. Although there is no DRI for monounsaturated fats, the Institute of Medicine recommends using them as much as possible along with polyunsaturated fats to replace the bad saturated fats and trans fats. Good sources of monounsaturated fats are olive oil, peanut oil, canola oil, avocados, and most nuts, as well as high-oleic safflower and sunflower oils.

The discovery that monounsaturated fat could be healthful came from the Seven Countries Study during the 1960s. This study revealed that people in Greece and other parts of the Mediterranean region enjoyed both a low rate of heart disease and a high-fat diet. The fat in their diet, however, was not the animal fat

common in other countries with higher rates of heart disease: it was olive oil, which has mainly monounsaturated fat. This finding produced a surge of interest in olive oil and the “Mediterranean diet,” a style of eating regarded as a healthful choice today.

What about carbohydrates?

Carbohydrates encompass a broad range of foods, including table sugar, fruits and vegetables, and grains such as rice and wheat. The DRI for carbohydrates is 45% to 65% of your daily calories. But, as the Healthy Eating Pyramid shows, most of these carbohydrates should come from whole-grain foods, vegetables, and

► Eight principles of low-glycemic eating

1. Eat a lot of non-starchy vegetables, beans, and fruits such as apples, pears, peaches, and berries. Even tropical fruits like bananas, mangoes, and papayas tend to have a lower glycemic index than typical desserts.
2. Eat grains in the least-processed state possible: “unbroken,” such as whole-kernel bread, brown rice, and whole barley, millet, and wheat berries; or traditionally processed, such as stone-ground bread, steel-cut oats, and natural granola or muesli breakfast cereals.
3. Limit white potatoes and refined grain products such as white breads and white pasta to small side dishes.
4. Limit concentrated sweets—including high-calorie foods with a low glycemic index, such as ice cream—to occasional treats. Reduce fruit juice to no more than one cup a day. Completely eliminate sugar-sweetened drinks.
5. Eat a healthful type of protein, such as beans, fish, or skinless chicken, at most meals.
6. Choose healthful fats, such as olive oil, nuts (almonds, walnuts, pecans), and avocados. Limit saturated fats from dairy and other animal products. Completely eliminate partially hydrogenated fats (trans fats), which are in fast food and many packaged foods.
7. Have three meals and one or two snacks each day, and don’t skip breakfast.
8. Eat slowly and stop when full.

Adapted from *Ending the Food Fight*, by David Ludwig with Suzanne Rostler (Houghton Mifflin, 2008).

fruits. If most of the carbohydrates you eat are bad carbohydrates (white bread, white potatoes, white rice, and other refined starches or sugars found at the top of the Healthy Eating Pyramid), you could end up gaining weight and putting yourself at risk for disease.

The list of bad carbohydrates may come as a surprise. Why are potatoes bad for you? They’re vegetables, after all. Why are they in the same category as sweets? To answer these questions, you have to consider the glycemic index of a food.

■ **Glycemic index.** The glycemic index reflects the spike in blood sugar caused by eating a certain amount of a particular food compared with that of white bread or pure sugar. In general, healthy carbohydrate foods have a lower glycemic index. The term glycemic load is often a more useful term because it describes the amount of carbohydrate in a serving of food. The glycemic load is easy to grasp as simply the food’s glycemic index times the amount of carbohydrate in a serving. For example, a big slice of white bread will spike the blood sugar more than a little slice of the same bread. The glycemic index is the same for both pieces but the glycemic load is higher for the large piece. For menu-planning purposes, the glycemic load is more meaningful than the glycemic index because it is based on the portion of a particular food eaten.

Foods with a high glycemic index are digested more quickly than foods with a low glycemic index (see Table 1). Rapidly digested foods can be dangerous because they flood your bloodstream with sugar all at once. Sudden, high spikes of blood sugar trigger a gush of insulin to clear the sugar from your blood. The problem is that this quick surge of insulin can leave your blood sugar too low after just a few hours. When your blood sugar is too low, you feel hungry; if it’s low soon after a meal, you’re apt to overeat and possibly gain weight.

Another problem with a steady diet of high-glycemic meals is that over many years, your body’s system of responding to insulin could become impaired. This is called insulin resistance. When your cells are less responsive to insulin, the resulting overload of sugar in your bloodstream forces the pancreas to step up its production of insulin in an effort to move the sugar from the blood into the cells. This

Table 1 Choosing foods with a low glycemic index

LOW GLYCEMIC INDEX (BEST CHOICE)	MODERATE GLYCEMIC INDEX	HIGH GLYCEMIC INDEX
Vegetables		
asparagus, avocado, broccoli, carrots, celery, chard, lettuce, mushrooms, okra, onion, peppers, spinach, tomatoes, zucchini	beets, butternut squash, green peas, parsnips, plantain, pumpkin, sweet potato	corn, french fries, potato, potato chips
Fruits		
apples, berries, cantaloupe, cherries, grapefruit, grapes, kiwi, lemon, nectarines, oranges, peaches, pears, plums	applesauce, banana, dried fruit, mango, papaya, pineapple, watermelon	fruit juices and drinks
Nuts		
almonds, cashews, peanut butter (no added sugar), peanuts, pecans, pistachios, walnuts	peanut butter (with sugar)	—
Grains		
steel-cut oats	amaranth, barley, bread (whole-grain, minimally processed), breakfast cereal (high-fiber), brown rice (varies by type), buckwheat (kasha), bulgur, millet, pasta (not canned), quinoa, wheat berries, wild rice	bread (highly processed; including bagels, buns, corn bread, english muffins, pita, rolls, and white bread), breakfast cereals (low-fiber), couscous, crackers, pancakes, pasta (canned), pizza, popcorn, pretzels, rice cakes, stuffing, taco shell, tortilla, waffles, white rice
Dairy		
cheese, milk, yogurt (no added sugar)	—	—
Source: <i>Ending the Food Fight</i> , by David Ludwig with Suzanne Rostler (Houghton Mifflin, 2008). See www.glycemicindex.com to look up more foods.		

itself will further reduce the response of muscles to insulin to take up sugar from the blood. As this situation worsens, blood sugar rises chronically to an abnormal level defined as type 2 diabetes, the type that often develops in older adults. If the pancreas is forced into overdrive for a sustained period, it may wear down and eventually lose some of its ability to produce insulin, leading to insulin deficiency and worsening of type 2 diabetes. Insulin resistance can also cause other problems, including heart disease and perhaps some cancers.

Good carbs, bad carbs

The high-carbohydrate foods that are good for you can help protect against these health problems in part because they have a relatively low glycemic load. They are digested slowly, which means they cause a gradual rise in blood sugar. You can estimate whether a carbohydrate is good or bad based on these characteristics:

- **How heavily processed is the food?** One factor in a grain product's glycemic load is its degree of refinement. In general, the smaller the pieces, the faster they are digested. This is one reason finely ground wheat flour is digested faster than coarsely ground (sometimes called "stone-ground") wheat flour. It's the same with steel-cut oats compared with instant oatmeal.

Some scientists think that the glycemic load of the average American diet has increased because we're eating greater amounts of heavily processed carbohydrates. Processing removes the fibrous casing from grains. This casing is good for you because it slows digestion and contains a host of nutrients that may lower the risk of some diseases. Studies show that whole-grain foods such as brown rice and barley, which have their fibrous casing intact, are healthier than the more heavily processed refined grains. In results from two large ongoing studies, the Nurses' Health Study and the Health Professionals Follow-up Study, people who

Table 2 Good sources of fiber

FOOD	FIBER CONTENT IN GRAMS*
Split peas, cooked, 1 cup	16.3
Red kidney beans, boiled, 1 cup	13.1
Raspberries, raw, 1 cup	8.0
Whole-wheat spaghetti, 1 cup	6.3
Oat-bran muffin, medium	5.2
Pear, medium with skin	5.1
Broccoli, boiled, 1 cup	5.1
Apple, medium with skin	4.4
Oatmeal, quick, regular, or instant, cooked, 1 cup	4.0
Green beans, cooked, 1 cup	4.0
Brown rice, cooked, 1 cup	3.5
Popcorn, air-popped, 2 cups	2.3
Whole-wheat bread, one slice	1.9

*Fiber content can vary among brands and varieties.
Source: USDA National Nutrient Database for Standard Reference, 2007.

ate the most whole grains (four slices of whole-wheat bread daily) were less likely than other people to develop type 2 diabetes, heart disease, and several types of cancer, including cancer of the mouth, stomach, colon, gallbladder, and ovary.

■ **Is it really whole grain?** Not all foods in the grocery store that claim to be “whole-grain” really are. “Whole-wheat” bread may include a lot of refined white flour. Look for labels that say “100% whole wheat” (or oats or rye). Read the ingredients list to make sure that the first ingredient is a whole grain. Some whole-grain foods can be easily spotted by their color. Brown rice is a whole grain (it’s brown because its casing is intact), but white rice isn’t. Oats and oatmeal are whole grains with fiber, but oatmeal is usually processed for quick cooking, and that gives it a high glycemic load. The best choice is steel-cut oats or some less processed oatmeal.

■ **How much fiber is in the food?** Fiber is the indigestible part of grains, vegetables, and fruits. Its effect is to delay the time it takes for the food to be digested. Whole-grain foods have more fiber than refined foods (see “Fiber: The workhorse,” at right).

■ **How much fat is in a meal or snack?** The blood sugar rise from carbohydrates can be reduced by combining the food with protein or fats. Because fats take longer to digest than carbohydrates, the more fat a meal or snack has, the more slowly it will be digested and, possibly, the less detrimental an effect it will have on your blood sugar. Just make sure that the fat or protein is a healthful one. A handful of cashews or other nuts is a better snack than a cookie made with butter or trans fats.

Fiber: The workhorse

Fiber is a form of indigestible carbohydrate found mainly in plant foods. Over the years, fiber has been hailed as a potential weapon against colon cancer, high cholesterol, and heart disease. Fiber’s vaunted health benefits were diminished slightly by findings that it doesn’t prevent colon polyps (precursors of colon cancer). But fiber slightly reduces LDL cholesterol, improves insulin resistance, and is linked to a lower rate of heart disease. It is considered one of the most important health attributes of foods.

Fiber slows the digestion of foods and therefore lowers their glycemic load, which likely helps to prevent diabetes. By increasing the bulk of foods and creating a feeling of fullness, fiber may also help you avoid overeating and becoming overweight. There is also some evidence that fiber might reduce the risk for duodenal ulcers, breast cancer, and ovarian cancer.

Studies such as the Nurses’ Health Study and the Health Professionals Follow-up Study have found that people with the lowest rates of heart disease and heart attack have the highest intakes of fiber. These studies formed the basis for the DRIs for fiber.

The DRI for fiber is 38 grams for men up to age 50 and 25 grams for women in this age group. For pregnant women, the DRI is 28 grams, and for breast-feeding women, 29 grams. DRIs are lower for people over age 50: 30 grams for men, 21 grams for women. That’s because older people tend to eat less food. On average, Americans eat only about 15 grams of fiber a day.

One of the main sources of fiber is cellulose, which comes from plants’ tough cell walls. Cellulose can occur naturally in the foods you eat, or manufacturers can add it to foods in a powdered form during

manufacturing. Pectin, another common fiber source, is a common ingredient in fruits. Manufacturers often add pectins to foods to make them jell. Fiber can also take the form of supplements that you can buy over the counter. These fiber sources come in pill and powder forms and provide the same benefits as fiber in foods. Take them with plenty of water to get the full benefit.

You can probably identify some high-fiber foods, such as bran cereals and whole-grain bread (see Table 2). But not all foods billed as “high-fiber” really have much fiber; read the labels on packaged foods to see the number of grams of fiber they contain. You can be sure of getting fiber if you eat fruits, vegetables, and whole-grain foods such as whole-wheat bread, brown rice, bran, or oats each day. Here are some ways to make sure that your diet meets the DRI for fiber.

► Soy: A wonder food?

Soy has received much attention as a meat substitute and health food. As an alternative to eating lots of red meat, it is a good dietary choice. But thus far, there is not much evidence that soy has the many health benefits sometimes attributed to it. The attention has focused mainly on isoflavones, components of soy that sometimes act like the hormone estrogen and sometimes inhibit it. Such plant estrogens, or phytoestrogens, are strong biological agents.

Is soy good for the heart? As a means of lowering your consumption of heart-damaging saturated and trans fats, yes. But there is no scientific basis to believe that the phytoestrogens in soy are heart-protective. Regarding heart disease risk factors, soy protein, unlike other proteins, may lower LDL cholesterol a little bit; however, the large amount of soy protein required to produce this effect makes it less than practical. One thing that’s clear from the many studies on soy is that the isoflavones in soy do not lower cholesterol.

What about breast cancer? Some experts have suggested that soy may help prevent breast cancer because studies have demonstrated that Japanese women, who eat a great deal of soy, have low rates of breast cancer. In laboratory experiments, substances in soy protein inhibit the growth of breast cancer cells. But dietary soy, in some cases, may promote breast cancer. In one study, 48 women just found to have a suspicious breast lump were randomly assigned either to take a daily soy supplement containing 45 milligrams (mg) of isoflavones for 14 days or not to take the supplement. All the women continued to follow their usual diets. Breast biopsies of the women taking the soy supple-

■ **Eat whole-grain cereal for breakfast.** Oats are an excellent choice, particularly steel-cut oats, which have the most fiber and the lowest glycemic index. If you prefer cold cereal, choose products that contain bran or list whole wheat, oats, barley, or another whole grain first on the list of ingredients.

■ **Choose whole-grain breads.** As with cereals, true whole-grain breads list a whole grain first in the ingredients. Whole-grain sliced bread, pita bread, and rolls are equally good.

Skip the french fries and baked potatoes. Instead of white potatoes, eat sweet potatoes or yams. Instead of white rice, eat brown rice or another intact grain as a side dish. Good choices are buckwheat (kasha), bulgur, millet, quinoa, and barley.

■ **Try whole-wheat pizza and pasta.** Prepared pizzas made with whole-wheat crust are joining whole-wheat

ments showed tissue with much more cell growth and division than the biopsies of the other women. The finding suggests that soy may have promoted the cell growth, an effect seen in some animal studies.

The phytoestrogens in soy sometimes have estrogen-like effects in the body, and we know that estrogen can promote breast cancer, as is the case with postmenopausal hormone therapy. Despite considerable speculation around a biologically plausible interaction of soy with breast cancer development, sparse and inconsistent studies have provided insufficient data to reach a conclusion one way or the other, according to the 2007 global report on “Food, Nutrition, Physical Activity, and the Prevention of Cancer,” from the World Cancer Research Fund and the American Institute for Cancer Research.

Hot flashes? There is some evidence that menopausal symptoms, such as hot flashes, seem to improve with soy isoflavone supplements, but other studies didn’t find benefit. In any event, comparing soy isoflavones to placebo, the benefit, if it exists, is slight.

Soy’s possible effect on bone density has also been studied. Some studies show that isoflavones in soy can slow bone loss and therefore might help prevent osteoporosis.

The bottom line: There is no reason to take supplements of soy protein or isoflavones until the questions about their potential benefit and harm are resolved. Until more is known, you’re best off eating soy as part of your diet—where it remains a healthy alternative to red meat—rather than taking it as a supplement.

pastas on supermarket shelves. Whole-wheat pasta is a great choice, but if it doesn't appeal to you, try mixing whole-wheat pasta with white pasta.

■ **Cook with whole-wheat flour.** You can make breads, muffins, and other home-baked goods healthier if you mix whole-wheat flour with white flour. Because whole-wheat flour is heavier than white flour, a straight substitution won't work for every recipe. Try starting with a ratio of one part whole wheat to three parts white to see if you like the results. If you think the dish could stand a heavier, grainier texture, try increasing the share of whole-wheat flour. You may need to increase the amount of liquid at the same time. Many stores sell a multigrain pancake mix you can use for pancakes or waffles.

Update on protein

How much protein do you need? That question has been the subject of debate for decades, and the range set by the DRIs is wide: 10% to 35% of your daily calories can come from protein. You're better off, however, if you choose proteins from foods like fish, skinless chicken, beans, soy, and nuts rather than foods laden with saturated fats, like red meat and cheese. Reach for the beans, not the burgers.

Protein is everywhere in your body. It's in your muscle, bone, skin, and nearly every other body part or tissue. It has many functions, including building the enzymes that trigger many of the important chemical reactions in the body. Providing the raw material for the body's proteins are about 20 amino acids. Following genetic instructions, the body strings together these amino acids into chains to make the specific proteins the body needs. The body stores amino acids in muscle protein, and mobilizes them continuously by breaking down muscle. This happens every day as our metabolism moves from fed to fasting. In the morning, the body is using its muscle for amino acids.

Ideally the body needs a daily supply of amino acids to make new proteins. This supply comes from the protein in food. Dietary proteins are as essential as calcium and vitamin D for bone health and osteoporosis prevention, according to a recent review in the *Journal*

What to do about mercury in fish

Fish are an excellent source of protein. However, nearly all fish and shellfish contain traces of mercury. Large deep-ocean fish tend to contain the most. Parents and pregnant women need to be aware that some fish and shellfish contain higher levels of mercury that may harm a developing fetus or a young child's developing nervous system. The FDA and the Environmental Protection Agency (EPA) advise women who may become pregnant, pregnant women, nursing mothers, and young children to avoid some types of fish and to eat fish and shellfish that are lower in mercury. The following guidelines are for pregnant women but can be used by anyone who is particularly concerned about the levels of mercury in fish.

- Do not eat shark, swordfish, king mackerel, tilefish, and some kinds of tuna because they contain high levels of mercury.
- Eat up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury.
- Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish.
- Another commonly eaten fish, albacore ("white") tuna, has more mercury than canned light tuna. So, when choosing your fish and shellfish, eat no more than 6 ounces (one average meal) of albacore tuna per week.
- Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters, but don't consume any other fish during that week.
- Follow these same recommendations when feeding fish and shellfish to your young child, but serve smaller portions.

of the American College of Nutrition. A lack of protein in the diet can slow growth, reduce muscle mass, lower immunity, weaken the heart and respiratory system, and even cause death. These problems are more likely to arise in people in poorer countries; most people in the United States and other industrialized countries eat plenty of protein.

So how much protein should you eat? In establishing the upper limit of 35%, the Institute of Medicine cautioned against exceeding that amount because some studies show that high-protein diets may promote some diseases, such as osteoporosis. When you

eat a lot of protein, your body draws some calcium out of your bones to help neutralize the acids that digest protein. Going on a high-protein diet for a few weeks probably won't weaken your bones, but doing so for longer could begin to take a toll on them.

Eating a lot of protein also can reduce heart disease. In the Nurses' Health Study, the women who ate the most protein—which in this analysis was about 25% of their daily calories—were 25% less likely to have had a heart attack or to have died of heart disease than the women who ate the least protein, 15% of their calories. This finding agrees with the OmniHeart Study (see “Healthy diets from the OmniHeart trial,” page 27), which showed that increasing dietary protein from 15% to 25% lowered blood pressure, LDL cholesterol, triglycerides, and estimated risk of heart disease.

What kind of protein is best?

When it comes to foods that prevent or promote disease, experts know less about dietary protein than they do about fats and carbohydrates. Still, large ongoing studies have revealed some connections between the type of protein people eat and their risk for particular illnesses. And other studies are under way to find out whether some sources of protein are especially good for you.

Of particular interest is whether protein from vegetable sources—such as soy, lentils, beans, and nuts—is healthier than protein from meat, which is a major source of protein in the Western diet. Some evidence suggests that eating a lot of vegetable protein may lower the risk for heart disease. In an analysis of Nurses' Health Study data, a low-carbohydrate diet moderately lowered the risk of coronary heart disease, but only

Table 3 Good sources of protein

Foods with lots of protein and little or no unhealthy fat.	
Food	Percentage of calories from protein
Fish	87%
Tofu	53%
Skim milk	39%
Low-fat yogurt	33%
Broccoli	28%
Kidney beans	27%
Lentil soup	25%
Peanuts	18%
Source: U.S. Department of Agriculture	

when the fat and protein came from vegetable sources, according to an article published in 2006 in *The New England Journal of Medicine*. When it comes to bone health, on the other hand, there seems to be no consistent evidence for superiority of vegetable over animal proteins on calcium metabolism, bone loss prevention, or reduced risk of bone fractures.

There isn't enough scientific evidence to state definitively that vegetable protein in itself is better for you than meat protein, but there are still reasons to favor protein-rich vegetables. In particular, vegetable protein comes in healthier packages than meat protein (see Table 3). Meats may have large amounts of protein, but they also contain large doses of saturated fat and some trans fats. If you do eat meat for protein, eat only small portions, and choose lean cuts. Another reason to opt for vegetable protein sources is that they provide fiber, which has several health benefits (see “Fiber: The workhorse,” page 10). ♥

Fruits and vegetables

Your mother was right: fruits and vegetables are good for you. We've known for decades that fruits and vegetables contain important vitamins, minerals, and other nutrients. Science has more recently established that eating lots of fruits and vegetables can help prevent some life-threatening diseases.

Even now, researchers are coming to understand that the key to this advice is the phrase “fruits and vegetables.” While a diet high in fruits and vegetables is healthful, that doesn't mean taking pills and supplements that contain individual nutrients will do the same thing. Out of hundreds of studies that have tried to separate individual components of foods and determine their specific health effects, only a tiny handful have produced convincing results. Many have fallen flat. Remember when everyone was taking vitamin E for everything from heart disease to memory loss? How about vitamin C to prevent colds? Or antioxidants to prevent cancer? Promising early

evidence has often failed to pan out for taking nutrients in pill form.

Fruits and vegetables contain hundreds of components known as phytochemicals, the majority of which have yet to be identified. These phytochemicals appear in a vast number of combinations in the plants found in nature. In addition to phytochemicals, fruits and vegetables are a valuable source of fiber. Fiber serves many functions in the body. In particular, it keeps the digestive system running smoothly and may reduce the risk of heart disease and some gastrointestinal problems, diabetes, and possibly some cancers. Finally, fruits and vegetables are high in beneficial minerals such as potassium, which lowers blood pressure.

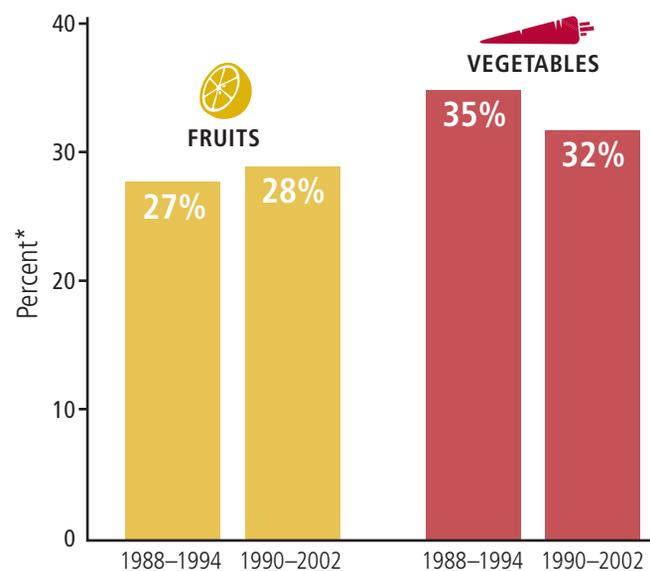
Major studies such as the Nurses' Health Study and the Health Professionals Follow-up Study have shown that a diet rich in fruits and vegetables can help lower the risk of hypertension, heart disease, and stroke, and that people who follow such a diet live longer than those who don't. The DASH (Dietary Approaches to Stop Hypertension) study directly tested a diet high in fruits and vegetables, and showed a significant blood pressure reduction. People over age 45 had an especially good response to the diet—an important finding because hypertension and its consequences increase with age.

Studies also show that such a diet may reduce the risk of some forms of cancer—probably esophageal, stomach, and lung cancers, according to a review of hundreds of studies by the International Agency for Research on Cancer—as well as diverticulitis, a painful intestinal condition (see “Special section: The food-health connection,” page 23).

Research also suggests that people who eat plenty of fruits and vegetables are less likely than others to develop macular degeneration, an eye disease that impairs vision. Such findings give fruits and vegetables a prominent place in the Healthy Eating Pyramid, which recommends eating fruit two to three times a day and eating vegetables “in abundance.”

Figure 3 Fruit and vegetable consumption

Fruit consumption is going up, vegetable consumption is going down.



* percentage of people who met consumption guidelines

Does “sustainable” mean healthy?

You might have noticed the buzz about “sustainable agriculture” and “buying local” these days. These terms are popping up in new books, food labels, and even presidential debates. Long familiar in ecological circles, the term “sustainable agriculture” has moved into the popular culture thanks to such writers as Michael Pollan of the University of California, Berkeley. His best-selling book *The Omnivore’s Dilemma* advocated for a more traditional, organic cycle of agriculture in which animals naturally fertilize the land and then consume plants grown there.

Sustainable agriculture employs traditional means to make the farm a self-contained ecosystem that produces food by eliminating artificial fertilizers and pesticides, thereby supporting the environment while encouraging rural farmers’ way of life. Sustainable agriculture cuts down on farms’ heavy petroleum use by setting limits on how far food can be trucked from the farm to market. It also reduces petroleum use by growing crops without pesticides and fertilizers, most of which are derived from oil. For example, one bushel of corn grown on an industrial farm requires one-quarter to one-third of a gallon of oil, according to Pollan, an impressive figure considering the United States produced 13.1 billion bushels of corn in 2007. Sustainable cattle graze on grass on open pasture, reducing the need for the antibiotics heavily used for cattle living in tight quarters. The heavy use of antibiotics breeds powerful strains of resistant microbes, thereby increasing antibiotic resistance in general.

These are positive benefits. But is food produced this way more nutritious? While research in this area is growing, results are preliminary, sometimes conflicting, and currently inconclusive. A few small studies have reported that crops and animals from organic and sustainable sources contain more nutrients and antioxidants than other foods. But these differences may not be sufficient to actually benefit human health, according to Harvard Medical School’s Bruce Bistrian, Chief of Clinical Nutrition at Beth Israel Deaconess Medical Center. “It is hard to imagine that marginal differences in lycopene, vitamin C, or flavonoids that might be possible with organic or sustainable foods could be shown to alter health outcomes,” he said.

While any nutritional benefits of sustainable agriculture remain unproven, its eco-friendly effects are well established, according to the American Dietetic Association’s 2007 position paper. The ADA encourages “environmentally responsible practices that conserve natural resources, minimize the quantity of waste generated, and support the ecological sustainability of the food system—the process of food production, transformation, distribution, access, and consumption.”

Dr. George Blackburn, Director of the Center for the Study of Nutrition Medicine at Harvard, aligns himself with the ADA’s position, adding: “We all want food from a sustainable source. It is worth a premium price. We should support consumption of sustainable food because it is good for Mother Earth, not because the alternative is toxic.”

Yet while 50% of Americans know they need to eat five or more servings a day, 90% do not eat the recommended amount. A new public health campaign, “Fruits & Veggies—More Matters,” aims to close that gap. The campaign, a joint project launched in March 2007 by the Produce for Better Health Foundation and the Centers for Disease Control and Prevention, suggests eating more fruits and vegetables at every sitting. For more information, see the campaign’s Web site at www.fruitsandveggiesmorematters.org.

Vitamins and minerals in fruits and vegetables

Vegetables and fruits are chock-full of the phytochemicals better known as vitamins and minerals. Eating enough vegetables and fruits not only helps prevent vitamin and mineral deficiencies, but can actually stave off a variety of other health conditions as well.

■ **Folic acid.** One of the most firmly established links between a vitamin and disease prevention involves a B vitamin known as folic acid (also called folate), found in dark leafy greens, fortified breads and cereals, and vitamin supplements. Women who take folic acid are less likely to have babies with certain birth defects called neural tube defects. All women of childbearing age should take 400 micrograms (mcg) daily in fortified foods, or a daily multivitamin with 400 mcg, to guard against the possibility of birth defects.

Folic acid could have other health benefits as well. Studies have suggested it helps prevent heart disease and some cancers, including breast cancer and colon cancer. But when researchers have tested these ideas by giving subjects folic acid in supplement form, the supplement has not had the expected benefits. It is possible that folic acid is mainly a marker for other protective nutrients in fruits, vegetables, nuts, and other plant foods. So, eating dark green leafy vegeta-

bles rather than taking supplements is the best strategy to get the benefits from folic acid.

■ **Antioxidants.** Fruits and vegetables are the primary source for the broad category of nutrients known as antioxidants. This class of chemicals protects tissues, cells, DNA, and other important compounds in the body against free radicals, the destructive molecules believed to help induce heart disease, cancer, age-related eye diseases, arthritis, memory loss, and possibly aging itself. Antioxidant vitamins are vitamin C, vitamin E, and beta carotene and related carotenoids (a class of orange plant pigments). Antioxidant minerals are selenium and manganese. Many antioxidants are chemicals other than vitamins and minerals, including certain pigments and isoflavones. The package of antioxidants found in fruits and vegetables combined with the naturally occurring fiber and phytochemicals in these foods has a variety of healthful benefits, including lowering the risk of heart disease, diverticular disease, and many other conditions. But taking individual antioxidants in supplement form has not been proven to confer similar health benefits.

Long-term studies of thousands of people found that those whose diets were high in antioxidants or who took antioxidant supplements, particularly vitamin E, tended to have less heart disease. But newer, placebo-controlled studies (comparing antioxidants in supplement form against an inactive pill) did not show that vitamin E and other antioxidants protected against heart disease either for people with existing disease or for those at high risk for developing it. Trials of antioxidants and cancer have also been disappointing.

Given the conflicting results, it appears unlikely that taking antioxidants in supplement form will help protect against heart disease or cancer. It could be that

it's the orchestration of antioxidants naturally present in foods, rather than one or two vitamins in high doses, that can lower your risk of serious illnesses. It is also possible that some of these vitamins have features that may be more important to your health than their antioxidant activity, such as their ability to inhibit inflammation (important in controlling heart disease) and proliferation of cancer cells. So it's worthwhile to include antioxidants in your diet, but get them from foods—such as oranges, tomatoes, sweet potatoes, carrots, broccoli, whole grains, and nuts—and not from pills.

Color is key

The key to getting the greatest benefit from fruits and vegetables in your diet is to eat a variety of them on most days. And to get the most out of the fruits and vegetables you do eat, go for those with deep, rich colors; they contain the most powerful phytochemicals. That's because some of the pigments (chemicals that provide color) in fruits and vegetables are healthy phytochemicals.

No single type of fruit or vegetable can deliver all the beneficial phytochemicals and other substances. Try to get at least one serving daily from each of the following categories:

- dark green or leafy vegetables (dark lettuce, kale, spinach, broccoli)
- yellow or orange fruits and vegetables (squash, carrots, nectarines, cantaloupe)
- red fruits and vegetables (red peppers, tomatoes, strawberries)
- legumes (lentils and other beans)
- citrus fruits (oranges, grapefruits, lemons, limes). ♥

Vitamins and minerals

Determining just how much of various vitamins and minerals people need for good health is a tricky science. For more than half a century, federal Recommended Dietary Allowances (RDAs) aimed at preventing deficiency diseases in most people. But the DRIs from the Institute of Medicine, which replaced the familiar RDAs, ushered in considerable change. Whereas the RDAs were established to prevent deficiency diseases, the DRIs seek also to enhance health and lower the risk for chronic conditions such as heart disease and cancer. This shift reflects the fact that few people in industrialized countries today are deficient in nutrients, but many die from major diseases that could be prevented with better diets. The guidelines acknowledge that the need for certain nutrients varies with people's age, sex, and other important characteristics.

The basics

There are 13 vitamins, 16 minerals, and one additional dietary component that your body needs but cannot manufacture in sufficient amounts. Acting in concert, these essential vitamins and minerals help keep billions of cells healthy and encourage them to grow and reproduce. Some supply the keys to unlocking the energy in the carbohydrate, fat, and protein in the foods you eat.

These essentials are often called micronutrients because your body needs only tiny amounts of them. Yet failing to get even those small quantities virtually guarantees disease. Old-time sailors learned that living for months without fresh fruits or vegetables—the main sources of vitamin C—causes the bleeding gums,

listlessness, and serious debility of scurvy. In some developing countries, people still become blind from vitamin A deficiency. And even in the United States, some children develop the soft, deformed bones of rickets because they don't get enough vitamin D.

While the absence of key micronutrients hampers good health, their presence in sufficient quantities promotes it. Getting a full complement of iron helps proteins in your blood and muscles pick up and release the oxygen that's vital to all of your cells. It also fends off the absorption of lead, a heavy metal that can cause widespread damage. The B vitamin folic acid (see page 33) protects against birth defects. And a combination of calcium, vitamin D, vitamin K, magnesium, and phosphorus protects your bones against fractures (see "Beating bone loss," page 35).

Many of these micronutrients interact with one another. Vitamin D enables your body to pluck calcium from food sources passing through your digestive tract. Vitamin C helps you absorb iron.

Vitamins and minerals differ in basic ways. Vitamins can be broken down by heat, air, or acid. Minerals are chemical elements that do not change. That means the minerals in soil and water easily find their way into your body through the plants, fish, animals, and fluids you consume.

For most people who are not getting enough vitamins and minerals, it is a better idea to adjust your diet to include more nutrient-rich foods rather than to take supplements, which do not contain all the other healthy food components. There are likely many more beneficial components of healthy foods than the ones scientists have identified so far, as well as synergistic effects among them. ♥

Table 4 Vitamins and minerals with extra health benefits

VITAMIN OR MINERAL	BENEFITS	RECOMMENDED AMOUNT BY AGE	UPPER LIMIT (UL) PER DAY	GOOD FOOD SOURCES
Vitamin B₆ (pyridoxal, pyridoxine, pyridoxamine)	Helps lower homocysteine levels. Not clear whether it lowers heart disease risk. Helps make red blood cells. Influences cognitive abilities and immune function.	Age 31–50: Men: 1.3 mg Women: 1.3 mg Age 51+: Men: 1.7 mg Women: 1.5 mg	100 mg	Meat, fish, poultry, legumes, tofu and other soy products, potatoes, noncitrus fruits such as bananas and watermelons.
Vitamin B₁₂ (cobalamin)	Helps lower homocysteine levels. Not clear whether it lowers heart disease risk. Assists in making new cells and breaking down some fatty acids and amino acids. Protects nerve cells and encourages their normal growth. Helps make red blood cells.	Adult men and women: 2.4 mcg	Not known	Meat, poultry, fish, milk, cheese, eggs, fortified cereals, fortified soy milk. Vegetarians and vegans may need a multivitamin.
Vitamin D (calciferol)	Helps maintain normal blood levels of calcium and phosphorus, which strengthen bones. Helps form teeth and bones. Supplements can reduce the number of nonspinal fractures. May reduce risk of colon cancer.	Age 31–50: 5 mcg (200 IU) Age 51–70: 10 mcg (400 IU) Age 71+: 15 mcg (600 IU)	50 mcg (2,000 IU)	Fortified milk or margarine, fortified cereals, fatty fish. Most Americans, especially African Americans, don't get enough. The body uses sunlight to make vitamin D, but cannot make enough in people who don't spend much time in the sun.
Folic acid (folate, folacin)	Vital for new cell creation. Helps prevent brain and spinal birth defects when taken early in pregnancy. Can lower levels of homocysteine. May reduce risk for colon cancer. May offset breast cancer risk among women who consume alcohol.	Men and women: 400 mcg Pregnant women: 600 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.
Iron	Helps ferry oxygen throughout the body. Protects against toxic lead absorption. Needed for chemical reactions in body and for making amino acids, collagen, neurotransmitters, and hormones.	Age 31–50: Men: 8 mg Women: 18 mg Age 51+: Men: 8 mg Women: 8 mg Pregnant women: 27 mg	45 mg	Red meat, poultry, eggs, fruits, green vegetables, fortified bread, and grain products. Many women of childbearing age don't get enough.
Potassium	Balances fluids in the body. Helps maintain steady heart-beat and send nerve impulses. Needed for muscle contractions. Helps lower blood pressure.	Men and women: 2,000 mg	Not known	Meat, milk, fruits, vegetables, grains, legumes.

Note: For a complete list of vitamins and minerals, see the Harvard Health Publications Special Health Report, *Vitamins and Minerals*, available at www.health.harvard.edu.

Healthy snacks

For many people, the words “snack” and “healthy” don’t belong in the same sentence. It’s so easy to reach for the chips or candy bars that you might not realize that snacking and eating healthfully need not be mutually exclusive. There are plenty of healthy snacks that are quick and easy to eat, such as nuts or fruits. Even so, if you choose to snack between meals, don’t overdo it. Eating more calories than you burn each day will cause you to gain weight, and excess weight is a major risk factor for several life-threatening diseases.

To start snacking well, first survey what’s available. Some snacks are obviously bad for you. Chips and cheese twists are laden with salt, high-glycemic carbohydrates, and sometimes trans and saturated fat. Most cookies, snack bars, brownies, and muffins are also laden with bad fats and refined sugars. Candy is mainly sugar and bad fats. But what about all those fat-free vegetable chips, yogurt raisins, fruit leather, and organic candies sold in health-food stores—are they harmful?

The answer, surprisingly, is that even snacks marketed as healthy or natural can be unhealthy. Fat-free chips and sweet snacks typically have a high glycemic load. Yogurt raisins can be packed with bad fats and sugar. Many baked or fat-free snacks have lots of salt. Eating these foods occasionally won’t hurt, but regular consumption can take its toll: foods with high glycemic load won’t keep you feeling sated for very long. So you run the risk of overeating, gaining weight, and possibly developing insulin resistance down the road. The same is true if you snack regularly on crackers and pretzels, normally made from refined flours. Additionally, all calorie-dense foods carry the risk of obesity if eaten regularly. Foods with high salt content can raise blood pressure, and foods laden with bad fats contribute to many health problems.

Good snack choices

What should you eat instead? As a start, try keeping some fresh fruit on your kitchen counter or even in your

desk drawer at work. This way, you’ll see it before reaching for the calorie-dense chips or cookies. Bring a banana to work. Keep a bowl of grapes or cherries on the table. Dried fruit can be a good choice so long as you keep portion size reasonable. Both fresh and dried fruits contain plenty of vitamins and fiber (see Table 5).

Next, try nuts. Almonds, walnuts, peanuts, cashews, hazelnuts, filberts, and other nuts are good for you for several reasons. They contain many beneficial nutrients and other substances, including vitamin E, folic acid, potassium, and fiber. And although some are high in fat, the fat is mainly unsaturated. Finally, unlike chips and other omnipresent high-carbohydrate snacks, nuts don’t leave you hungry right away, so you’re less likely to overeat. Nuts do have a lot of calories, so eat them instead of other snacks, not in addition to them. The Healthy Eating Pyramid recommends one to three servings of nuts and legumes a day in meals and snacks combined.

If you want to eat chips, look for brands that are free of trans fat and have unsaturated vegetable oils such as safflower, canola, sunflower, and peanut. Even better, choose brands that are “lightly salted” or unsalted. Some really taste great.

Granola is another good option, especially mixes that are rich in whole grains, nuts, polyunsaturated fats, and dried fruit and low in sugar.

Chocolate lovers can rejoice in the cardiovascular benefits of small amounts of the dark varieties rich in bitter flavanols. Sadly, people passionate about white and milk chocolate ingest only sugar and fat. Chocolate can look nutritiously dark but still be devoid of the healthful flavanols.

Foods to avoid

Are there foods you never should eat? Not really. No matter how laden with saturated or trans fats, how devoid of nutrients, or how high its glycemic load, there’s no food that you can’t eat occasionally. If you crave an

ice cream sundae every now and then, go for it. But don't make it a daily event. If you eat chips at your neighbor's backyard party, choose healthier snacks at home. Healthy eating is not like many of the popular weight-loss plans that require you to eliminate certain foods entirely. But there are some foods you should eat only rarely.

Harvard nutrition scientists have compiled the following list of foods to keep to a minimum because research strongly shows that regular consumption of these foods—more than other foods—can promote life-threatening illnesses such as cancer, heart disease, hypertension, and diabetes. (For details on the roles each of these foods plays in disease, see “Special section: The food-health connection,” page 23.)

With regard to cancer, the hazard from red meat may be not just the fat, but also the cooking method.

■ **Red meat.** Shun the cold cuts and “pigs in a blanket” when snacking at a party. Head instead for the vegetable plate. The sad news for meat lovers is that there really is no positive side to eating red meat. That includes beef, pork, lamb, and venison as well as cured meats such as ham, sausage, salami, and corned beef. Scientists have yet to discover any disease that red meat protects against, but they've found plenty that it promotes. People who eat the most red meat have the highest rates of heart disease, hypertension, colorectal cancer, prostate cancer, and osteoporosis. Research also suggests that eating a lot of beef increases the risk of breast cancer. Red meat has a lot of saturated fat and some trans fat, the two unhealthy types of fat. If you do eat red meat occasionally, select the leanest cuts (see “Choosing meat and fish,” page 46).

With regard to cancer, the hazard from red meat may be not just the fat, but also the cooking method. Browning meat by searing it on the grill or stovetop or under the broiler creates carcinogens. Beef is healthier when cooked in ways that don't char the meat, such as baking or stewing. Another advantage to stewing meats in liquid is that you can skim off the saturated fats that rise to the top.

■ **Dairy fat.** Ice cream, whole milk, and cheese contain a lot of saturated fat and some trans fat and therefore can increase the risk of the health problems traced to bad fats, notably heart disease. The healthiest milk and milk products are low-fat versions, such as skim milk, milk with 1% fat, and reduced-fat cheeses.

■ **Pastries.** The news that everyone knows but no one wants to hear is that pastries (cookies, pie, croissants, tarts, cake, and Danish) are unhealthful choices. Pastries are, by definition, baked goods made with high-fat dough. As any chef will tell you, it's the butter, lard (saturated fats), or shortening (trans fat) that's the key to making flaky crusts. And many pastries are topped or filled with buttercream, whipped cream, or icing—each packing a wallop of saturated fat and trans fat (especially in store-bought goods), sugar, and calories. A slice of cheesecake can have 800 calories or more—a large share of the 2,000 to 2,500 you need in a day.

You don't have to pass up apple pie on Thanksgiving or cake on your birthday, but for everyday eating, choose desserts with less fat than pastries. Go for the fruit plate or even biscotti, Italian almond cookies made without butter or oil. When you really must have the pecan pie or the pound cake, consider sharing a slice.

■ **Doughnuts.** Like pastries, doughnuts (which are cake fried in fat) have large amounts of saturated fat, trans fat, sugar, and calories. But doughnuts present additional problems. For one thing, they're often eaten for breakfast, replacing what could be a nutritious meal. Second, because doughnuts are often purchased by the dozen, you may be tempted to eat two or more in one sitting. If you're a doughnut lover, you can improve your diet by eating doughnuts only for dessert, limiting yourself to just one, and making them a very occasional treat. A single doughnut has around 250 calories with 40% from fat—mostly saturated and trans fats.

■ **Sugar.** Whether it's white granulated sugar, brown sugar, or honey, sugar contains no nutrients other than the sugar itself, pure carbohydrate. Sugar isn't dangerous per se, but a heavy sugar intake increases your diet's glycemic load, fills you up with empty calories, and keeps you from eating healthy foods that contain vitamins, minerals, and fiber. Want

Table 5 Simple switches for healthy eating

Here are some tips for painlessly improving the quality of your diet.

INSTEAD OF THESE FOODS:	TRY USING THESE FOODS:
Food preparation	
Butter, solid margarine, or lard	Olive oil, canola oil, or margarine without trans fats
Cream-based sauces	Tomato-based sauces
Whole eggs	Egg whites or egg substitute
Salt for seasoning	Herbs and spices
Canned vegetables	Fresh or frozen vegetables
Meals	
Cornflakes, Special K, or other refined-grain cereal	Cheerios, Wheaties, or other whole-grain cereal; some granolas are especially healthy because they have nuts and seeds, and less processed grains
Cream of Wheat	Oatmeal or Kashi steel-cut oats are best
White rice	Brown rice or other cooked whole grain
White pasta	Whole-wheat pasta
White bread	Whole-grain bread
Full-fat dairy foods	Skim or low-fat dairy foods
Red meat	Fish, chicken, beans, nuts
Fatty cuts of meat, such as prime rib	Leaner cuts, such as tenderloin (occasionally)
Smoked, cured, salted, or canned meat or fish	Fresh or frozen meat or fish, without added salt
Sugared soda or juice	Water, or juice mixed with sparkling water
Ice cream	Yogurt with fruit
French fries	Roasted vegetables
Snacks	
Candy	Fresh or dried fruit
Chips	Nuts, raisins, popcorn without butter (try olive or canola oil), raw vegetables
Soda crackers	Whole-grain crackers without trans fats
Dips high in saturated fats	Hummus, peanut butter, or seasoned low-fat yogurt
Baked goods containing butter or trans fats	Foods baked in healthy fats
Cookies	Graham crackers or oatmeal cookies with fruit
Dining out	
Super-size entrées	Small- or medium-size entrées
Fried foods	Grilled, broiled, steamed, poached, or roasted foods
General tips	
Skipping breakfast	Eating oatmeal, whole-grain breads, or bran cereals
Rushing through a meal	Eating slowly
Eating one or two big meals a day	Eating several smaller meals
Sitting on the couch after dinner	Taking a walk
Adapted from <i>Eat, Drink, and Be Healthy: The Harvard Medical School Guide to Healthy Eating</i> by Walter Willett, M.D., published by Simon & Schuster and Harvard Medical School (www.health.harvard.edu/nutrition).	

Three tips for reducing sodium

1. Choose foods low in sodium by reading food labels. Sodium is usually listed after total fat and cholesterol.
2. Limit the use of canned, processed, and frozen foods. Cooking from scratch lets you control the salt content.
3. When eating out, ask if items are prepared with salt; in fast-food restaurants, ask for a nutrition information sheet.

The good news for your taste buds is that in a study published in the September 2007 *Journal of the American Dietetic Association*, people liked foods with both the recommended dose (1.2 g) of sodium and the upper limit (2.3 g) at least as much as food with the common sodium overload (3.5 g).

evidence? Give a child a can of sugar-filled soda right before dinner, and most of dinner will stay on the plate. Cutting back on candy and soda is just half the battle, however. There's lots of hidden sugar in prepared foods, including fat-free snacks. Look for sugar in surprising places such as peanut butter, ketchup, and spaghetti sauce. Even prepared frozen dinner entrées have added sugars. What's more, snacks that contain good ingredients such as whole wheat, canola oil, and olive oil are no longer as healthy once they're loaded with sugar or honey.

The DRI for sugar is no more than 25% of calories per day, but it's fairly easy to exceed that threshold—which many health experts think is too high already.

Try not to add sugar or honey to tea, coffee, or cereal. Watch what you drink; have water or seltzer instead of sugary sodas or fruit drinks. Read the labels on packaged foods, and steer clear of foods that have sugar, honey, corn syrup, or fructose among the first three ingredients. Notice that food manufacturers often make sure sugar doesn't appear first on the ingredients list by using two or more types of sugar, listed separately; thus, when the ingredients are ranked in order of weight, other ingredients appear first.

■ **Salt.** Salt contains sodium. Most people need just 1 to 1.5 grams of sodium a day, and the upper limit is 2.3 grams, but most of us get 3.4 grams (the amount in 1.5 teaspoons of table salt). People over age 50, African Americans, and women are particularly susceptible to getting high blood pressure from a salty diet. The best way to limit the amount of sodium in your diet is to cut back on the amount of salty processed foods that you eat. Three-quarters of the salt in your diet comes from processed foods, such as chips, processed cheese, and many canned and prepared foods. Just 15% of your salt intake comes from your salt shaker. Did you know that canned tuna contains added salt? Also, canned soups are notoriously high in salt. Choose low-sodium, low-salt, or unsalted versions.

■ **Muffins, croissants, crackers, bagels, and other baked goods made with white flour.** Unless you choose the whole-grain versions, these are among the bad carbohydrates because they have a fairly high glycemic load and very little fiber. ♥

The food-health connection

The foods you eat every day can have a tremendous effect on your health. Decades of research have produced study after study showing links between diet and serious illness. A healthy diet has the power to prevent heart disease, hypertension, diabetes, gastrointestinal disorders, some forms of cancer, blindness, and birth defects. It does matter whether your breakfast is a doughnut or a bowl of steel-cut oats, whether your sandwich is ham and cheese or hummus and tomato, and whether dinner is steak or salmon. Dozens of other food choices you make can affect how long—and how well—you live.

The following sections describe common health conditions that are most strongly influenced by your diet. For each disease, you'll find a list of foods and nutrients that can lower your risk of developing that disease as well as a list of foods or food components that can raise your risk.

Hindering heart disease and stroke

For many years, it was an article of faith that following a low-fat diet reduced your risk for heart disease and possibly stroke. Stroke, like coronary artery disease, is most often caused by a blockage of blood vessels delivering oxygen to vital

tissues. But further research has shown that certain healthy fats—mainly from vegetable sources and fish—can reduce your risk of heart attack and stroke. For people with heart disease, clinical trials show a heart-healthy diet that includes these fats saves as many lives as heart medication.

The first hint that the low-fat mantra for heart health was off-key came from the Seven Countries Study, an international diet survey conducted in the 1960s. This study produced the surprising news that the region with the lowest incidence of heart disease—Crete—also had the diet with the highest fat content—about 40% of calories.

In 1997, the Nurses' Health Study looked at the relationship between the diets of more than 80,000 women and the health problems they developed. There was absolutely no connection between how much total fat the women ate and whether they eventually developed heart disease. But the type of fat did make a difference. The women with the highest incidence of heart disease ate the most saturated and trans fats. Meanwhile, the women with the lowest incidence of heart disease had diets that were low in trans fat but relatively high in polyunsaturated fat, which comes primarily from vegetable oils. Again, in 2006, the Women's Health Initiative demonstrated that a diet low in total fat did not protect against heart disease.

Heart-healthy fats

Reach for the vegetable oils. Foods made with either polyunsaturated or monounsaturated fat are your best choice. On the other hand, saturated fat and trans fat increase your risk of heart disease by raising blood cholesterol, especially LDL cholesterol, the type that promotes

heart disease. They also boost the levels of triglycerides, another type of fat in your blood that is linked to heart disease. And even worse, trans fat lowers your levels of HDL cholesterol, the good cholesterol that helps protect against heart disease (see “All about fat,” page 5).

Choose a heart-healthy margarine made with little or no trans fat or saturated fat. Research shows that it’s healthier to replace bad fats with good fats (poly- and monoun-

saturated fats) than it is to cut back on all fats in your diet. That’s because simply reducing fats across the board lowers your healthy HDL cholesterol as well as the damaging LDL cholesterol, and it raises triglycerides. It’s like cutting down the whole tree just to get rid of some bad apples. Ideally, you want to keep LDLs low and HDLs high, and that’s what the good fats help do. When you replace unhealthy saturated and trans fats

with healthy monounsaturated and polyunsaturated fats, LDLs drop more than beneficial HDLs.

Other positive effects come specifically from omega-3 and omega-6 polyunsaturated fats, found in fish, many vegetable oils, and some nuts and seeds. These fats reduce triglycerides, prevent arrhythmias (abnormal heartbeats), lower blood pressure, and help prevent atherosclerosis. Omega-3s and omega-6s both reduce the

Healthy today, harmful tomorrow?

Good science nurtures hunches and takes chances. But even the most promising ideas must work their way through a hierarchy of studies before scientists can draw firm conclusions. To be considered reliable, findings must be reproduced by other studies and in different groups of people. 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. Gaining an understanding of the different types of research and which types are most trustworthy can help you decide how much weight to give reported studies on food and health.

One way to look at the scientific process is as a three-step ladder, with growing relevance to people with each step up the ladder of evidence.

1. On the lowest 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.
2. On the second rung of the ladder are **observational studies** of people, in which researchers follow large groups, often 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). Using questionnaires and other methods, scientists collect data at regular intervals as thousands of participants simply live their lives. Most risk factors cannot be tested directly in people, but by comparing those who stay healthy with those who fall ill, scientists try to identify factors that could account for the difference. This rung includes the types

of epidemiological studies called **cohort, longitudinal, prospective, and case-control** studies.

3. On the third rung of the ladder are **experimental studies** in people. In these, the researchers control what happens. In the case of nutrition and health studies, that usually means testing a diet or behavior change. Often called **clinical trials**, experimental studies start small and, if successful, are repeated with more and different groups of people. Within this category are **randomized controlled trials**. If conducted properly, these are considered the gold standard—the most credible studies of all. Volunteers participating in these trials are randomly assigned either to a group that tests an experimental drug, a food, a dietary supplement, or another treatment, or to a control group whose members receive a placebo or standard treatment or diet for comparison. If possible, both the volunteers and the researchers are “blinded,” meaning they don’t know who is in which group until the end of the study.

The media cover intriguing studies from every rung of the ladder, but reporters sometimes fail to put a study in context by explaining the type of research reported and what kind of questions it can honestly answer. Exciting new findings make headlines, often creating a misleading impression that the results are definitive. Also, studies often make the news precisely because they contradict a larger body of evidence, which may remain more convincing despite a single clashing new finding.

One helpful analysis growing more popular in nutrition studies is called a **systematic review**. In these, researchers conduct comprehensive searches of previous studies, evaluate the best-quality evidence, and summarize large amounts of information.

risk of heart disease and stroke. Fish, in particular, appears to offer potent protection against the most common type of stroke—*ischemic stroke*, which is caused by blockages in the arteries to the brain. In 2002, the Health Professionals Follow-up Study found that men who ate fish at least once a month were 43% less likely to have *ischemic strokes* compared with men who never ate fish. Women in the Nurses' Health Study who ate fish

were also less likely to have strokes than those who didn't.

Monounsaturated fats have not been shown to reduce the risk of heart disease, but they do lower LDLs, which means that they're good for the heart. The liberal use of olive oil in Mediterranean countries contributes to the very low rates of heart disease there.

What does all this mean for you? To reduce your risk of heart disease, replace dangerous saturat-

ed fats and trans fats with beneficial polyunsaturated fats including fish oil and monounsaturated fats. Try the high-unsaturated fat diet from the OmniHeart trial (see page 28). It not only reduces LDL cholesterol but also raises HDL cholesterol.

Carbs and fiber

When you cut down the saturated and trans fats in your diet, make sure you don't overeat carbohydrates to compensate for missing

They are published in journals and available from other sources, such as the Cochrane Library and the U.S. Agency for Healthcare Quality and Research. If the studies are similar enough, researchers may include a **meta-analysis**, which combines and reanalyzes the data from several studies.

Even when you do know which rung a study rests on, news articles may include 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:

Observational studies, from the second rung of the ladder, often suggest a link between a nutrient and a certain disease. But they cannot say whether the nutrient actually caused or prevented the disease. Beware of headlines that indicate otherwise: "Soy protects heart," "Red meat causes cancer," and so on. These results can be tainted by something called "recall bias." That is, 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. Routine questioning of the same people over time can avoid recall bias, but these studies require large numbers, take a long time, and sometimes rely on imprecise questionnaires. Also, a nutrient found to be related to disease may also be just a marker for another nutrient in the food that is more important. That is considered a potential explanation for why some supplements like antioxidant vitamins have failed to prevent disease when put to the test of a clinical trial, whereas there is better evidence for foods that just happen to be rich in these vitamins.

Metabolic studies, a type of clinical trial from the third rung of the ladder, 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. They show effects on risk factors like blood pressure and cholesterol, but are usually too brief to show actual prevention of disease.

Randomized controlled trials, at the top of the ladder, also have their potential problems. First, they may be too short to reveal a nutrient's long-term consequences. Also, these studies may involve participants who are in better or worse health than you are. And because of limited knowledge about a disease (for instance, cancer), randomized controlled trials may not introduce the dietary intervention when it could have done the most good. Last, these trials can be extremely difficult to conduct because researchers have to control the behaviors of large numbers of people, often for many years. If participants do not stay with the assigned treatment, findings could be blurred or even lost.

Systematic reviews often pool results of all available observational or experimental studies, but like other forms of research, they vary in quality. They are only as good as the studies that have been included. They can often answer only very narrow questions. And they may have personal or funding biases just like any other study. So, the bottom line is to read reports of nutrition news skeptically, and consider whether the weight of evidence from a series of solid studies warrants making any changes in your eating habits.

It's also important to consider whether the possible benefits to your health outweigh potential risks. Before making a change, get more information. Reputable sources of health information, such as the Harvard Health Publications newsletters (see inside front cover), put key studies in perspective for you. Your doctor's advice can be valuable, too.

Your Diet: Heart disease**GOOD CHOICES**

- Fruits and vegetables
- Monounsaturated fats
- Omega-3 and omega-6 polyunsaturated fats
- Fish
- Whole grains

RISKY CHOICES

- Fatty meat, butter, and full-fat dairy products
- Trans fats (partially hydrogenated oils)
- Salt
- Dietary cholesterol
- Excess intake (more than 65% of calories) of carbohydrates with a high glycemic load

fat calories. If you fill up on rapidly digested carbohydrates such as sugar, white bread, potatoes, or white rice, not only can this contribute to weight gain, but over time it can cause a dangerous rise in triglycerides in your blood.

Instead, keep carbohydrates at a moderate level and eat more good fats and proteins. Get most of your carbohydrates from whole-grain foods, such as whole-wheat cereals and breads, as well as fruits and vegetables. Whole grains clearly protect against heart disease and stroke, perhaps because they contain fiber, magnesium, folate, and vitamins B₆ and E. The fiber in whole grains helps lower cholesterol and may increase the body's anticoagulant activity, which helps prevent the formation of blood clots that can cause heart attacks and strokes. But fiber can't do it all. Studies

show that even when fiber intake is high, overweight and obese women have an increased risk of heart disease if they are eating a high-glycemic diet. Once again, the high-unsaturated fat diet from the OmniHeart trial (see page 28) is a good choice, or the Mediterranean diet. Both have lots of vegetables, olive oil, fish, fruits, and nuts but less meat and dairy.

B vitamins

There is some evidence that B vitamins, including folic acid, B₆, and B₁₂, may help lower blood levels of a substance called homocysteine. Why is this important? A good deal of research has implicated high homocysteine levels in heart disease and stroke. One analysis of several studies found folic acid cut homocysteine levels by about a fourth, according to a 2002 study published in *The Journal of the American Medical Association (JAMA)*. When folic acid was combined with vitamin B₁₂, homocysteine levels sank another 7%. In this study, B₆ had no additional effect. The Nurses' Health Study, however, found that folic acid and B₆ offered more protection as a duo than when used alone. The risk of heart attack or death from heart disease was nearly halved among women who consumed the most folic acid and B₆ from diet and supplements compared with those who consumed the least. Smaller but still significant effects occurred with folic

acid or vitamin B₆ alone.

But disappointing news emerged in 2004, when *JAMA* published a study of 3,680 people who had suffered mild strokes. The researchers concluded that a high-dose formulation of the B vitamins (25 mg of B₆, 400 mcg of B₁₂, and 2.5 mg of folic acid) lowered homocysteine levels as expected, but had no effect on cardiovascular health. This was not the only clinical trial showing no effect of these supplements.

These results aren't the last word. Often, larger studies are needed. Also, relatively few people in these studies had high levels of homocysteine to begin with. A meta-analysis published in the Dec. 13, 2006, issue of *JAMA* found no significant benefit or harm from folic acid supplements (.5 to 15 grams a day) on the risk of cardiovascular disease, stroke, or all-cause mortality among persons with a history of vascular disease or renal disease. Several ongoing larger trials may provide more definitive answers.

Vitamin E

Early evidence from the large observational studies showing that vitamin E might reduce risk of heart disease has not held up under the closer scrutiny of randomized clinical trials. Although one of the randomized studies found lower rates of heart attack and death from heart disease among people given vitamin E supple-

ments, three other studies failed to confirm this link, and a combined analysis found suggestions of increased cardiovascular disease. But because these studies involved high-risk populations or had other limitations, the possibility that vitamin E may provide some protection to some people has not been completely ruled out. In any case, it's important to get the RDA of 15 mg in your diet. But most experts no longer recommend taking vitamin E supplements for heart protection.

Halting hypertension

About half of adults in the United States, and 80% of those over 50, have blood pressure high enough to put them at risk for heart disease. A healthy blood pressure is 120/80 millimeters of mercury (mm/Hg) or lower. The higher your blood pressure, the greater your risk for heart disease and stroke. Hypertension, or high blood pressure, is defined as 140/90 mm Hg or higher.

Diet has a big impact on blood pressure. The DASH diet was the first diet plan shown to reduce high blood pressure. No one has teased out exactly which components of this healthy diet influence blood pressure, but the evidence for its effectiveness is striking. The DASH diet is rich in fruits, vegetables, and low-fat dairy products, and low in red meat and other sources of saturated fats, sweets, and sugary drinks. Further refinements came in 2005 with the Om-

niHeart trial (see “Healthy diets from the OmniHeart trial,” below) that improved on the DASH diet and showed that reducing carbohydrates and increasing healthy fats or proteins can lower blood pressure even more.

These diet plans reduce blood pressure enough that many people with mild hypertension can try using them instead of blood pressure drugs. For people already taking blood pressure drugs, the diet could enable them to reduce the dose or the number of drugs they take.

One reason these diets work is that they are rich in potassium, a mineral known to lower blood pressure. Potassium is found in many fruits and vegetables including bananas, melons, and avocados. Reducing salt intake enhances the effect. Research shows that the sodium in salt can raise blood pressure in many people and suggests that reducing salt intake may help offset the natural rise in blood pressure that occurs with age.

Modest alcohol consumption may be beneficial, but heavier drinking increases blood pressure and interferes with blood pressure medication. It also adds “empty” calories that can contribute to weight gain and also deny your body the benefits of nutrient-packed calories instead.

Regular exercise not only helps prevent high blood pressure, but it's also a proven treatment for existing hypertension. Moderate-intensity training (such as walk-

ing) seems to be at least as good for blood pressure as high-intensity exercises like running.

Being overweight can raise your blood pressure and your risk for diabetes, arthritis, sleep apnea, and some cancers. Weight loss alone may reduce blood pressure in people who are more than 10% over a normal weight.

Healthy diets from the OmniHeart trial

The OmniHeart diet plans were created as the next step beyond the well-known DASH diet, a low-fat and high-carbohydrate diet proven to help lower blood pressure and cholesterol. When the DASH diet was originally designed, major health organizations instructed people to lower their dietary fat as much as possible. As you know by reading this far, newer research shows that diets rich in unsaturated fat (from plant oils, nuts, and whole grains) and high in proteins can be heart-healthy because they improve cholesterol and blood pressure levels.

Your Diet: Hypertension

GOOD CHOICES

- Fruits and vegetables
- Fish
- Nuts
- Low-fat dairy products
- Potassium-rich foods

RISKY CHOICES

- Salt and salty foods
- Red meats
- Saturated and trans fats
- Sugary foods and drinks

The key to a healthy diet, based on the latest research, is to eat healthy fats. A high-protein diet is healthy so long as you base it on healthy high-protein foods such as poultry, fish, beans, and vegetable protein products. In so doing,

you limit saturated fats (found in meats, cheeses, and whole-fat dairy products), and of course eliminate trans fats (hydrogenated oils found in commercial baked goods, many candies, and many margarines). Also, the research shows that lim-

iting carbohydrates, especially those from refined starches and sugar, can also be heart-healthy.

This information comes from the OmniHeart trial published in *JAMA* in 2005. In the study, researchers from Harvard and Johns

Table 6 OmniHeart diets compared

The high-carb (DASH-like) diet	The high-unsaturated fat diet	The high-protein diet
This diet lowers blood pressure and LDL cholesterol.	This diet lowers blood pressure, LDL cholesterol, and triglycerides and raises healthy HDL cholesterol.	This diet (high in protein without saturated and trans fats) lowers blood pressure, LDLs, and triglycerides.
PERCENTAGE OF DAILY CALORIES		
Fat: 27% Protein: 15% Carbohydrate: 58%	Fat: 37% Protein: 15% Carbohydrate: 48%	Fat: 27% Protein: 25% Carbohydrate: 48%
EXAMPLE OF A ONE-DAY FOOD PLAN, 2,100 CALORIES		
Breakfast: grapefruit juice multigrain cereal skim milk banana	Breakfast: orange juice cereal with raisins skim milk white-bread toast with olive-oil margarine and jelly	Breakfast: tomato juice scrambled egg substitute with low-fat shredded cheese hot cereal with bulgur wheat, soy, olive-oil margarine, raisins, and sugar skim milk
Lunch: chicken sandwich with whole-wheat bread, chicken breast, mayonnaise salad with lettuce and olive oil trail mix with almonds and dried apricots	Lunch: chicken sandwich with white bread, chicken breast, barbecue sauce, and olive-oil margarine olive-oil potato chips spinach salad with tomato and olive oil–balsamic dressing tomato juice	Lunch: vegetarian burger with hamburger roll, vegetarian patty, barbecue sauce, lettuce, and tomato broccoli salad unsalted potato chips chocolate pudding
Dinner: penne pasta with spinach, tomatoes, olive oil, beef meatballs, and parmesan cheese tossed salad with Romaine lettuce, cherry tomatoes, Italian dressing with safflower oil grapes Peppermint Pattie candy	Dinner: black bean taco with black beans and vegetables three-grain pilaf with olive oil tortilla chips carrots, cooked pecan cookie skim milk	Dinner: black bean taco with wheat protein and vegetables three-grain pilaf with olive oil tortilla chips chicken breast fresh orange skim milk
Snacks: small fresh apple yogurt	Snacks: mandarin oranges almonds	Snacks: cottage cheese (fat-free) mandarin oranges almonds

Hopkins universities compared healthy versions of three popular diets: high in carbohydrate, high in protein, or high in unsaturated fat (see Table 6). All of the diets included lots of fruits, vegetables, and whole grains. Meats were limited to lean cuts and skinless poultry. Dairy products were nonfat or low-fat.

The results were striking. All three diets lowered blood pressure, improved cholesterol profiles, and lowered risk of heart disease, but the high-protein and the high-unsaturated fat diets were most effective. After six weeks on each diet, the high-protein diet and the high-unsaturated fat diet both delivered even greater health benefits than the high-carbohydrate DASH-like diet did by improving blood pressure and cholesterol levels even more. The high-unsaturated-fat diet stood out as the only one that increased beneficial HDL cholesterol instead of lowering it. The high-protein plan did the best of the three in lowering triglycerides—another good step in lowering risk of heart disease.

Defeating diabetes

Diabetes is three times as common today as it was in 1960. That's particularly bad news not only because diabetes is a life-threatening disease in its own right, but also because it increases the risk for cardiovascular disease, kidney disease, memory loss, and other kinds of mental deterioration. Diabetes is

a condition in which the body can no longer produce enough of the hormone insulin to lower blood sugar to normal levels. In non-insulin-dependent diabetes, also known as type 2 diabetes, the cells in muscles, liver, and fat gradually become less responsive to insulin, so the body cannot properly use the insulin that it does produce. This decline in responsiveness, called insulin resistance, is caused in large measure by a poor diet, excess weight, and lack of exercise. The good news is that, according to research, type 2 diabetes can be prevented with healthier eating habits and regular exercise.

The single biggest risk factor for type 2 diabetes is obesity. It's no coincidence that the rates of both diabetes and obesity have soared since the 1970s; most experts believe it is the increase in obesity that has triggered the increase in diabetes. More than half of adults in the United States are overweight or obese, according to the CDC. Three-quarters of all people with type 2 diabetes are or have been overweight. Overeating in general can cause type 2 diabetes, but certain types of foods in particular can also affect your risk.

Carbohydrates

The leading dietary villains in diabetes appear to be carbohydrates with a high glycemic index (see Table 1, page 9). Several studies show that people whose diets have the highest glycemic load—from

eating a large proportion of such foods as sugars and refined starches—also have the greatest risk of diabetes, suggesting that eating lots of foods with a high glycemic index probably contributes to the development of diabetes.

Foods with a high glycemic index can promote diabetes in two ways. To begin with, they have a roller-coaster effect on blood sugar. That is, they leave you feeling hungry after just a few hours, which can make you overeat and ultimately make you overweight. In addition, a steady diet of foods with a high glycemic index may cause diabetes by setting up a cycle of repeated surges of blood sugar and excess insulin production. The more foods you eat that have a high glycemic index, the more likely you are to overload your blood with sugar, spurring your pancreas to pump out large amounts of insulin. This cycle may ultimately wear down the cells that make insulin, causing insulin output to drop and resulting in high blood sugar, a hallmark of diabetes.

Foods that protect

No high-quality data on the efficacy of diet alone exist for treatment of type 2 diabetes, concluded a 2007 Cochrane systematic review of 18 of the best studies to date. A similar review for prevention is under way. Adding exercise did show improvement of metabolic control at six-month and 12-month follow-ups.

Despite the lack of definitive data, three types of foods seem to guard against the development of diabetes: high-fiber cereals, polyunsaturated fats, and, unsurprisingly, foods with a low glycemic index. A small amount of alcohol appears to be beneficial, too. In the Nurses' Health Study, the risk of diabetes was low among women with a very specific dietary profile: they ate a lot of these beneficial foods and very few saturated fats, trans fats, and foods with a high glycemic index. Women with these eating habits who had normal weight, exercised for at least half an hour a day, didn't smoke, and had at least half a drink of alcohol each day had a risk of diabetes that was a mere one-tenth that of women who didn't do these things. In other words, 90% of cases of diabetes could be prevented with a healthy diet and lifestyle, including exercise.

Today's experts recommend a diet that protects against heart disease and obesity as the best choice for persons with diabetes. That means limiting foods with saturated and trans fats such as meats and high-fat dairy products and commercial baked goods like cookies, chips, and cakes. Reduce consumption of refined starches and sugars and eat more whole grains, fiber, fruits and vegetables, and nuts.

Battling breast cancer

Despite years of research on the topic, the connection between food

Your Diet: **Diabetes**

GOOD CHOICES

- Whole grains
- Fiber
- Fruits and vegetables
- Polyunsaturated fats

RISKY CHOICES

- Excess calories
- Sugar
- Refined starches
- Saturated and trans fats

and breast cancer remains unclear. Most experts now believe that other factors, mostly having to do with hormone levels, affect the risk of breast cancer more than what you eat. Hormonal factors such as less time spent breast-feeding, later age at first pregnancy, use of postmenopausal hormones, weight gain after menopause, and sedentary living all seem to raise the risk of developing breast cancer. Taller people seem to have more risk, but adult height is considered an indicator of other factors that promote growth in childhood.

One of the most-studied questions in the diet-breast cancer connection is the role of dietary fat. Scientists became interested in this question when international studies showed that women in countries where fat consumption was low had low rates of breast cancer. Not only that, but when women migrated to the United States, where fat consumption is high, breast cancer rates rose both for the women who migrated and for their daughters.

In 1989, the National Academy of Sciences recommended cutting fat from the diet as one of the best ways to prevent breast

cancer, as well as colorectal cancer and prostate cancer. The National Cancer Institute recommended that people lower their fat intake to 30% of calories a day. Later studies did not confirm the idea that a high-fat diet contributes

to breast cancer, and the connection between diet and breast cancer appeared weak. In particular, the large Nurses' Health Study has not found a link between fat consumption and breast cancer. Then, in 2006, authors of the randomized Women's Health Initiative dietary modification study suggested that a slight trend toward lower breast cancer rates in women on a low-fat diet might become more solid if the women were followed longer. However, women on low-fat diets lost about 5 pounds, so the lower breast cancer rates may have been the result of losing weight rather than eating less fat. The same year, another randomized trial in women treated for breast cancer, the Women's Intervention Nutrition Study, credited modest weight loss (6 pounds), not lower dietary fat, with a small reduced risk of recurrence.

Another common source of calories, alcohol, seems to raise the risk of breast cancer by about 10% for each additional drink per day (see page 31). Regarding fruits and vegetables, studies have revealed little protective effect. In an analysis of several studies of large groups of women, those who ate

the most fruits and vegetables had about the same risk of developing breast cancer as those who ate the least. More recently, a diet high in vegetables, fruit, and fiber and low in fat did not prevent further breast cancer or death in early-stage breast cancer survivors over a seven-year follow-up period, reported a 2007 study in *JAMA*.

Alcohol and folic acid

Several large studies showed that having two drinks a day increased a woman's risk of developing breast cancer by 20% to 25%. A larger analysis of seven major population studies found that drinking one glass of any kind of alcohol per day increased a women's risk of breast cancer by about 9%. In weighing the evidence, the 2007 global report from the World Cancer Research Fund and the American Institute for Cancer Research cited alcoholic drinks as a cause of breast cancer (see "Preventing cancer: Global report recommendations," page 32). A possible explanation for the alcohol-breast cancer connection is that moderate alcohol consumption boosts the body's levels of estrogen, which can promote breast cancer.

Interestingly, having a diet rich in folic acid may cancel out this risk. The Nurses' Health Study and other studies have shown that women who consume more than one drink a day but also get 600 mcg or more of folic acid do not have a higher risk of breast cancer than women

who drink less. You can lower your risk of breast cancer by holding your alcohol intake to one drink a day or less and getting 600 mcg of folic acid a day. You can get folic acid from a multivitamin, as well as from foods such as fortified breakfast cereals, liver, and lentils and other legumes. In an exception to our recommendation to eat only whole-grain, most processed cold cereals are fortified with 100 mcg of folic acid, and most multivitamins provide 400 mcg.

Calories and body fat

One thing that experts do agree on is that the amount of food you eat—regardless of what that food is—strongly affects your breast cancer risk, especially if it is not balanced by exercise. Studies of animals as well as humans consistently show that eating too many calories increases the risk of breast cancer. Reducing calories seems to lower breast cancer risk. Animal research suggests that calorie restriction might slow down cell division, a hallmark of cancer, and inhibit tumor growth. In laboratory animals, cutting daily calories by 30% reduced mammary cancer rates by as much as 80%.

In particular, women who gain weight after menopause appear to have a higher breast cancer risk. Researchers think that this occurs because fat cells contain the enzyme aromatase, which converts other hormones into estrogen, a known promoter of breast can-

cer. In one large study, postmenopausal women who gained the most weight were more than twice as likely to develop breast cancer compared with women who gained no weight or lost weight.

General fatness and belly fat also are probable causes of postmenopausal breast cancer, but not premenopausal breast cancer. Similarly, exercise seems to be more important in postmenopausal women in lowering the risk of breast cancer than in younger women, with lowered risk proportional to the hours of activity every week.

How does this translate to practical, daily eating patterns? All women should make it a goal to consume no more than the number of calories they need each day to maintain their current weight if their body mass index (BMI) is normal, or to lose weight if it is too high.

Soy

Another food that's drawn attention in relationship to breast cancer is soy. In international studies, women who live in countries where soy is a big part of the diet, such as Japan, have less

Your Diet: **Breast cancer**

GOOD CHOICES

- Folic acid (folate)
- Regular exercise

RISKY CHOICES

- Alcohol
- Weight gain; or being overweight or obese
- Excess calories
- High soy intake (uncertain)

breast cancer than women elsewhere. Laboratory studies show that substances in soy can inhibit the growth of breast cancer cells. But further studies that compared women who ate a lot of soy with those who didn't found no difference in breast cancer rates. When researchers looked more closely at the diets in Asia, it turned out that women who ate a lot of soy as adolescent girls had a lower lifetime risk of breast cancer, but eating soy later in life had no effect.

Even worse, some studies raised alarm that soy, under some

circumstances, could actually promote the growth of breast cancer. Some experts propose that while eating soy early in life may protect against breast cancer, increasing soy consumption in middle age or beyond may promote it (see "Soy: A wonder food?" on page 11). Until more is known, a sensible approach is to consider soy a meat substitute, but not to take soy supplements.

Controlling colorectal cancer

Although many foods have been studied for their ability to raise or lower risk of colorectal cancer, at

present, only red meat and alcohol appear to increase risk, and folic acid, vitamin D, and high-fiber foods may help reduce risk.

Fiber. As with breast cancer, the list of foods that scientists thought could influence your risk of colorectal cancer has continued to change. In particular, the evidence in favor of a high-fiber diet has gone up and down. For two decades, experts believed that fruits, vegetables, and especially high-fiber foods such as bran and whole-grain breads could help prevent colon cancer. Then sev-

Preventing cancer: Global report recommendations

In November 2007, the World Cancer Research Fund and the American Institute for Cancer Research released the second global report on *Food, Nutrition, Physical Activity, and the Prevention of Cancer*. For five years, a 21-scientist expert panel evaluated the best evidence conducted by dozens of scientists in 30 countries and then debated the meaning of the evidence to arrive at public health recommendations. Many recommendations in the report also apply to dietary causes of cardiovascular disease. The notable exception is alcohol: for preventing cancers, the best level of consumption is zero; for cardiovascular disease, it may be one to two drinks a day. The authors also emphasize the importance of avoiding exposure to tobacco smoke.

Recommendations include the following:

- 1. Body fatness.** Be as lean as possible within the normal range of body weight. Avoid weight gain and increases in waist circumference throughout adulthood.
- 2. Physical activity.** Be physically active as part of everyday life. Walk or do equivalent exercise for at least 30 minutes every day. Try to work up to 60 minutes a day.
- 3. Foods and drinks that promote weight gain.** Limit consumption of energy-dense foods, and avoid sugary drinks. Consume fast foods sparingly.
- 4. Plant foods.** Eat mostly foods of plant origin. Eat at least five portions of a variety of non-starchy vegetables and fruits

every day. Eat relatively unprocessed grains or beans with every meal. Limit refined starchy foods.

5. Animal foods. Limit intake of red meat to less than 18 ounces a week, and avoid processed meat.

6. Alcoholic drinks. If you consume alcoholic drinks, limit consumption to no more than two drinks a day for men and one drink a day for women.

7. Salt. Limit consumption of salt. Limit consumption of processed foods with added salt to ensure an intake of less than 2.4 g of sodium a day.

8. Dietary supplements. Aim to meet nutritional needs through diet alone. Dietary supplements are not recommended for cancer prevention.

Special recommendation 1: Breast-feeding. Aim to breast-feed infants exclusively up to 6 months and continue with complementary feeding thereafter.

Special recommendation 2: Cancer survivors. All cancer survivors should receive nutritional care from a trained professional. If able and not otherwise advised, aim to follow the recommendations for diet, healthy weight, and physical activity.

Source: Adapted from *Food, Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective*, World Cancer Research Fund and the American Institute for Cancer Research, www.dietandcancerreport.org, November 2007.

Your Diet: **Colorectal cancer**

GOOD CHOICES

- Folic acid (folate)
- Vitamin D
- Exercise

RISKY CHOICES

- Red meat
- Processed meats
- Alcohol
- Excess calories

eral large studies, including the Nurses' Health Study and others from Finland, Sweden, and the United States, found fiber had no protective effect against this form of cancer. Since then, other studies have shown a potentially protective effect. A pooled analysis of 8,100 cases among 730,000 people showed a slightly decreased risk—but too small to be statistically significant—for people eating the most fiber, according to a study led by Harvard researchers and published in *JAMA* in 2005. The 2007 global report said an analysis of a group of studies showed 10% lower risk per 10 grams a day of fiber consumed, primarily from dietary sources. The report concluded that fiber is probably protective, but that it could not be singled out from the foods containing it, primarily plants that have been minimally processed.

Folic acid. Many studies have shown that more folic acid, and more vegetables and fruit, reduce the risk of colorectal polyps and cancer. For example, in Harvard's Health Professionals Follow-up Study and the Nurses' Health Study, men and women who took folic acid supplements had a lower incidence of colon cancer than those who didn't take them. These results have been corroborated by animal experiments with plausible biological mechanisms. Yet, the first large chemoprevention trial investigating the effects of folic acid supplementation showed no de-

crease and possibly some increase in colorectal adenomas and other cancers among men and women with a recent history of precancerous conditions. Folic acid may not be the protective agent in fruits and vegetables, or it may prevent precancerous lesions by guarding against DNA damage but have no effect in slowing their progression, suggested an accompanying editorial in *JAMA* in 2007.

Folic acid can be found in fortified breads and cereals (the more processed kind) and many fruits and vegetables, as well as in legumes such as lentils. Both the Harvard studies found that the benefits from folic acid came specifically with supplement use. The Nurses' Health Study found that women who took multivitamins for at least 15 years were 75% less likely to develop colorectal cancer than women who never took them.

Vitamin D. This vitamin may protect against colon and rectal cancers. Harvard researchers found that higher blood levels of vitamin D were directly related to a lower risk of colon cancer, supporting other studies associating vitamin D with cancer protection.

Dietary fat. Findings have also rewritten the chapter on fat and colon cancer. Researchers originally associated a high-fat diet with higher risk of colorectal cancer because people who live in areas where high-fat diets are typical have a higher incidence of colorectal cancer than do people who live

in areas with more moderate fat intake. But in more than a dozen studies involving thousands of volunteers, fat intake has borne no relation to people's risk of getting colorectal cancer. Neither total fat intake nor the type of fat (saturated, polyunsaturated, monounsaturated) has any influence.

Red meat. Several large studies show that people who eat a lot of red meat or processed meat or who drink more than a modest amount of alcohol have higher rates of colon cancer than people who consume lower amounts. Specifically, people who eat red meat every day have a risk for colorectal cancer about two and a half times that of people who eat red meat less than once a month. The USDA classifies pork and beef as red meats. Cementing already convincing evidence, a major American Cancer Society study published in *JAMA* in 2005 showed that people who ate the most red meat were 30% more likely to develop colon cancer than those who ate little or no red meat, and those who ate the most processed meat were 50% more likely to develop colon cancer.

Why does red meat increase the risk of colorectal cancer? One theory centers on cancer-causing

agents, or carcinogens, generated by cooking and processing. Cooking meat at high temperatures (by broiling, grilling, or searing) generates carcinogens. These agents come in contact with the bowel wall during digestion, where they could potentially cause cancerous changes in the cells. Processing meats may also generate carcinogens.

How much meat does it take to cause colon cancer? The men who had the highest rate of this cancer ate an average of 3 ounces of red meat a day over a prolonged period; the women ate about 2 ounces a day. That's not a lot of meat for people who love their steaks. By this standard, steak houses serve a full week's worth of meat in one meal.

Alcohol. Regular drinking of any type of alcohol appears to increase risk for colorectal cancer. Scientists think this happens because alcohol hampers the body's ability to use folic acid, and this nutrient plays a leading role in preventing colorectal cancer (see "Folic acid," page 33). There are two messages here. One is that if you're going to drink, do so in moderation—no more than one drink a day for women and two for men. The other message is to get plenty of folic acid.

Overeating. While you're paying attention to the foods that you should and shouldn't eat to prevent colon cancer, don't overlook the big picture: the total

amount of food you eat. So far, the strongest known dietary link to colon cancer is overeating—consuming more calories than you need and storing it as excess body fat. Overweight people are more likely to develop colon cancer than people whose weight is normal. Belly fat adds additional risk. One study cited in the global report found a 5% increased risk of colon cancer per inch of waist circumference.

Physical activity. No matter what your weight, you can reduce your risk of colon cancer further by exercising more. Physical activity may do more than burn excess calories. It also increases metabolic efficiency and speeds food through the gut.

Preventing prostate cancer

The science of food and cancer prevention is a moving target that, so far, hasn't produced clear-cut advice for prostate cancer prevention. Still, some interesting trends are emerging. A Western diet seems somehow to raise the risk for prostate cancer, but the details of exactly which components of the Western diet are responsible are only beginning to become clear.

Calcium

A number of studies have linked an increased risk for prostate cancer with high calcium consumption. One of these is the Health Professionals Follow-up Study, which showed that men who

consumed more than 2,000 mg of calcium a day had more than four times the risk of developing prostate cancer compared with those who consumed only 500 mg a day. (One cup of low-fat yogurt contains about 380 mg

Your Diet: Prostate cancer

GOOD CHOICES

- Selenium
- Cooked tomatoes (uncertain)

RISKY CHOICES

- Red meat
- Calcium

of calcium; one cup of skim milk has 300 mg.) A Swedish study also confirmed a higher rate of prostate cancer for men who consumed more calcium. Researchers have separated calcium from the other components of dairy products, such as dairy fat. The Cancer Prevention Study II Nutrition Cohort also showed that calcium, whether or not it came from dairy products, raised the risk for prostate cancer.

Red meat

Previously, research seemed to point to a connection between red meat and prostate cancer, but more recent data do not bear this out. The National Health and Nutrition Examination Survey (NHANES) followed 3,779 men for 10 years and found no connection between prostate cancer and a diet high in meat and carbohydrates. Neither total fat nor saturated fat showed any connection to an increased risk for the disease.

Foods, vitamins, and other nutrients

Thus far, selenium, found in certain plant foods, is showing the most promise for protecting against prostate cancer. The amount of selenium in the soil, which varies by region, determines the amount found in the plant. But your selenium intake isn't wholly dependent on the amount in the fruit and vegetables in your diet; animals that eat plants grown in selenium-rich regions also have higher levels. In the United States, the highest soil concentrations are found in the high plains of northern Nebraska and the Dakotas.

A study of 1,312 men at the Arizona Cancer Center showed that those who took 200 mcg of selenium per day were 63% less likely to get cancer of any kind and, in particular, reduced their risk for lung, colorectal, and prostate cancers. And a 2005 meta-analysis of 16 individual trials linked a moderate consumption of selenium to a 26% reduction in the risk of developing prostate cancer. Other large trials are under way, including the Selenium and Vitamin E Cancer Trial (SELECT), which involves some 32,000 participants.

The evidence that a diet rich in fruits and vegetables could reduce risk for prostate cancer is becoming more tenuous. Much hope was focused on tomatoes and their component lycopene as a protective agent, but recent studies have failed to confirm this connection.

A 2007 review by the FDA published in *The Journal of the National Cancer Institute* found no evidence to support an association between lycopene and a reduced risk of prostate cancer. What's more, the study found only "very limited" evidence of a link between tomato consumption and reduced risk of prostate cancer.

Multivitamins have also not proved to confer benefit. A study published in 2007 found that not only did vitamins—in this case, multivitamins—not help, but they actually caused harm. The report, published in *The Journal of the National Cancer Institute*, found that compared with men who did not take multivitamins, men who took them more than seven times a week were 32% more likely to develop advanced prostate cancer and 98% more likely to die from the disease. (The study showed no link between multivitamin use and the risk of localized prostate cancer.) Although the study suggests a need for caution, there's no need to throw away your vitamin bottles just yet. Upon closer examination, the study showed that men who took seven multivitamins a week, in keeping with the recommended daily amounts, did not have a

higher risk of prostate cancer than men who took one to six multivitamins a week, or none at all. It was the men who exceeded seven multivitamins a week (and the study did not show whether those men were taking eight, 15, or even more each week) who were at increased risk.

All in all, the evidence that any food or nutrient plays a role in preventing cancer of the prostate remains sketchy. Further study is clearly needed before scientists can reach any firm conclusions.

Beating bone loss

Calcium is the one nutrient that comes to mind when most people think of preventing osteoporosis, a loss of bone mass that often increases with age and can lead to fractures. Calcium is an important nutrient for building bone and for slowing the pace of bone loss that comes with age. But it's not the single magic bullet for preventing osteoporosis, and some scientists suggest that too much calcium or dairy products may be unhealthy. Keep in mind that there are other nutrients and foods that help keep your bones strong—most importantly vitamin D, but also vitamin K, fluoride, and possibly fish.

How much calcium? The DRI for calcium is 1,000 mg a day for adults up to age 50 and 1,200 mg a day for people over 50, when bone loss accelerates. With age, the intestines absorb less calcium from

Your Diet: Osteoporosis

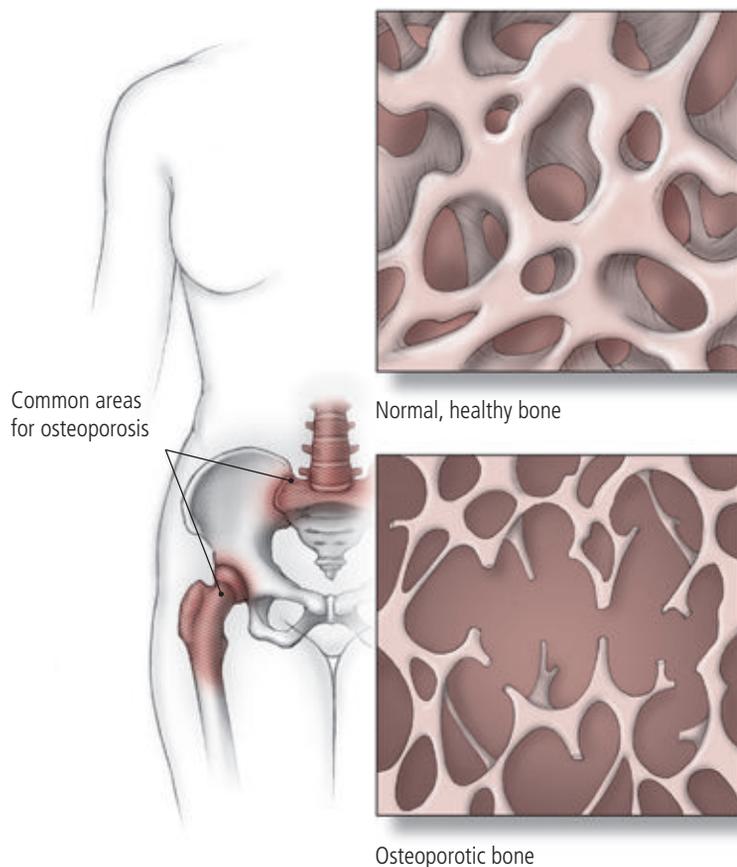
GOOD CHOICES

- Vitamin D
- Vitamin K
- Calcium
- Fluoride

RISKY CHOICES

- Heavy consumption of red meat
- Excess vitamin A

Figure 4 Osteoporotic bone



As the illustration above reveals, osteoporotic bone is more porous and less dense than healthy bone. The result is bone that is fragile and more vulnerable to breaks. But strength training can slow bone loss and even help build bone.

the diet, and the kidneys seem to be less efficient at conserving calcium. As a result, your body uses more of the calcium stored in your bones for a variety of important metabolic functions.

Scientific studies have yielded different results regarding how much calcium you really need for preventing age-related bone loss. For example, a report in the *American Journal of Clinical Nutrition* in 2003 found that calcium intake during youth pays dividends many

decades later. In this study of 3,215 women, those women over age 50 who, as children, drank very little milk (less than one serving a week) were twice as likely to fracture a hip as women who had consumed more than one serving a day. But calcium intake during adulthood may not have the same benefit. Seven studies done in the United States and Europe that have followed thousands of people for many years have found no correlation between a high intake of

calcium in adulthood and fewer bone fractures. For example, in the Nurses' Health Study and the Health Professionals Follow-up Study, people who drank two or more glasses of milk a day were no less likely to break a hip or forearm as people who drank one glass or less a week.

Men should be aware that some preliminary findings suggest that high calcium intake may increase the risk of prostate cancer (see "Preventing prostate cancer," page 34). For women, studies have suggested a possible link between calcium from milk and increased risk of ovarian cancer. However, it's not clear whether the culprit is calcium or other components in milk.

Vitamin D. Other foods and nutrients can help guard against osteoporosis. In building bone, calcium has an indispensable assistant: vitamin D. This vitamin helps the body absorb calcium, and some researchers think that increasing vitamin D can help prevent osteoporosis. But many people don't get enough vitamin D. A study of people admitted to Massachusetts General Hospital in Boston found that more than half had a deficiency. This problem is most common among people who live in northern regions of the country, because they don't spend much time in the sun. Exposure to sunlight prompts the skin to manufacture vitamin D. If you don't make enough vitamin D yourself, you can also get it from

milk and other dairy products, fortified breakfast cereals, eggs, and vitamin supplements.

Vitamin K. The Nurses' Health Study found that women who got more than 109 mcg of vitamin K a day were 30% less likely to break a hip than women who got less. To get enough vitamin K, eat one or more servings daily of dark green lettuce, broccoli, spinach, Brussels sprouts, or kale. Vitamin K helps regulate calcium and build bone.

Soy. Some studies show that isoflavones in soy can slow bone loss and therefore might help prevent osteoporosis. Whether soy actually helps build bone is an open question—some studies show that it does and others that it doesn't.

Fluoride. Fluoride has been tested in many experiments over the last few decades, with contradictory results. While some studies have shown that fluoride builds bone, several trials in the 1980s indicated that taking fluoride supplements did not reduce spinal fractures. But more recent research has shown that a newer slow-release version increases bone density and reduces spinal fractures. Fluoride therapy is used in several countries to treat osteoporosis, and the FDA is considering its use here. A recent meta-analysis concluded that fluoride treatment increases spine and hip bone mineral density, depending on treatment duration, but had no overall effect on hip or spine fracture risk. Whether the fluoride normally added to public drinking

water reduces bone fractures remains a controversial question. A word of caution: don't take fluoride supplements on your own. Taking too much fluoride can actually be bad for your bones by making them brittle. The amounts of fluoride added to drinking water are safe.

Too much fluoride can actually be bad for your bones by making them brittle. The amounts of fluoride added to drinking water are safe.

Foods that reduce bone density

Some foods and nutrients, when eaten to excess, can increase your risk of osteoporosis. One is meat. When the body digests protein, it releases acids into the bloodstream. Calcium then leaches out of the bones to neutralize these acids. The more protein you eat, the more calcium is pulled out of your bones. Animal protein has a greater effect on calcium than vegetable protein. The Nurses' Health Study found that women who ate red meat more than five times a week were more likely to break a wrist than women who ate red meat once a week, but the amount of vegetable protein that the women consumed bore no relation to their risk of bone fractures. Replacing meat with soy and other forms of vegetable protein may lower your risk.

Vitamin A may also harm bone density. Scientists have known for years that megadoses of vitamin A can deplete bone by interfering with the ability of vitamin D to maintain sufficient calcium levels.

Then in 2002, Harvard researchers involved with the Nurses' Health Study reported that vitamin A may promote bone loss even at levels considered safe. In the study, postmenopausal women who ingested 3,000 mcg or more per day of vitamin A from food, supplements, or

both over an 18-year period were more than twice as likely to fracture a hip as women who had less than 1,500 mcg daily.

The DRI for vitamin A is 700 mcg for women, with levels up to 3,000 mcg considered safe. The Nurses' Health Study suggests that postmenopausal women are best off with a vitamin A intake in the lower half of this range. To make sure your intake is at the right level, read the labels of the foods you often eat to see how much vitamin A they contain, paying special attention to fortified breakfast cereals. If you take a multivitamin, see how much vitamin A it has. If your multivitamin contains more than the DRI, consider switching to a brand with a lower amount. However, beta carotene, often used in multivitamins as a source of vitamin A, does not pose this risk.

Banishing birth defects

Decades ago, researchers found that women with poor diets were

most likely to give birth to babies with neural tube defects. Subsequent studies traced the problem specifically to a lack of folic acid, a B vitamin. In 1992, the RDA for folic acid was increased to 400 mcg, and the newer DRIs call for that amount as well.

Your Diet: **Birth defects**

GOOD CHOICES

- Folic acid (folate)
- Dark green leafy vegetables
- Fortified breads and cereals

RISKY CHOICES

- Alcohol
- Many drugs and medications

Because it's hard to get that much folic acid naturally from food, the FDA requires that certain foods—breads, flours, pastas, rice, and other grains—be fortified with folic acid. Taking a multivitamin containing the standard 400 mcg is extremely important for all women of childbearing age and is potentially useful for everyone because of its protective effects against several forms of cancer and possibly heart disease. Research suggests that the daily dose for women of childbearing age should be even higher, as much as 600 mcg.

Eradicating eye disease

Age-related macular degeneration (AMD), the leading cause of blindness in seniors, is caused by deterioration of the center of the retina at the back of the eye, called

the macula. Risky exposures include tobacco smoke, alcohol, air pollution, bright sunlight, excess weight, and even infection.

Can your diet also affect these eye conditions? Studies of people with AMD show a beneficial effect of dark green leafy vegetables and fruits. The effect seems to come from two pigments, lutein and zeaxanthin. Recent studies have found that people with certain common gene variations were most likely to develop the disease in combination with risky behaviors such as smoking or excess weight than those without the high-risk gene.

Omega-3 fats found in fatty fish (salmon, herring, bluefin tuna) and flaxseed also show a protective effect for the eyes. There is some evidence as well that a diet high in saturated fat may increase your risk of developing AMD, but a study of about 11,500 people published in 2001 found no such association. A different study, however, did find that obesity was a risk factor for AMD in men. Although the jury is still out, reducing saturated

Your Diet: **Eye disease**

GOOD CHOICES

- Dark green leafy vegetables
- Vitamin C in foods
- Vitamin E in foods
- Beta carotene in foods
- Zinc
- Copper
- Omega-3 fats (fish, flaxseed)

RISKY CHOICES

- Saturated and trans fats

and trans fat in your diet is healthful in several ways and might also help prevent AMD. The National Eye Institute has launched a randomized clinical trial of lutein and fish oil supplements to see just how effective they are in preventing progression of the disease.

Middle-aged and older people may benefit from diets rich in fresh fruits and dark green leafy vegetables such as spinach or collard greens. The large, multicenter Age-Related Eye Disease Study (AREDS) reported in 2001 that for people at high risk of developing advanced stages of wet AMD, high-dose combinations of the antioxidant vitamins C and E, beta carotene, and zinc lowered risk by about 25%. The supplements provided no apparent benefit for participants who had either no AMD or early AMD. But ask your doctor about taking such supplements if you have intermediate dry AMD in one or both eyes, or advanced dry or wet AMD.

Discouraging diverticular disease

You probably know that fiber helps prevent constipation, but it has other benefits for the digestive tract, too. Fiber from cereals, fruits, and vegetables helps prevent diverticular disease, an umbrella term for two diseases of the colon: diverticulosis and diverticulitis.

Diverticulosis, a condition in which balloon-like pouches (diverticula) develop in the wall of

the colon, is one of the most common afflictions of the colon, affecting about 10% of Americans and up to half of those over age 60. Although diverticulosis usually causes few or no symptoms, it can develop into diverticulitis, a painful inflammation or infection caused when a seed or a piece of stool becomes trapped in one of the diverticula. Symptoms of diverticulitis are sudden intense abdominal pain and sometimes fever, nausea, constipation, or diarrhea. Diverticulitis can cause the bowel to rupture, spilling its contents into the abdominal cavity, which can be fatal.

Epidemiologists think that a low-fiber diet sets the stage for diverticula formation in the colon, but why 10% to 25% of people with diverticular disease go on to develop acute diverticulitis remains unknown. Harvard's Health Professionals Follow-up Study found that men who ate more fiber had about a 40% lower risk of developing this problem. How does this work? Plenty of fiber (and liquid) in the diet produces large soft stools that are easy to pass. Without sufficient fiber, you have hard stools and relatively infrequent bowel movements. This can put pressure against the colon that may promote

Your Diet: **Diverticular disease**

GOOD CHOICES

- High-fiber foods
- Plenty of fluids

RISKY CHOICES

- Low-fiber diet

the formation of diverticula. A diet with plenty of fiber can keep stools soft and bulky and prevent undue pressure. If you increase your fiber intake, make sure to get plenty of fluids, to help the fiber pass through your system.

An emerging idea among researchers is that lack of fiber alters the intestinal bacterial flora, a change that may allow a low-grade chronic inflammation in the intestinal lining. More study is needed to confirm this hypothesis.

Arresting Alzheimer's disease

Can your diet play a role in preventing Alzheimer's disease? Are there certain foods or nutrients that are protective? So far, several studies suggest that a Mediterranean diet high in plant foods and

Your Diet: **Alzheimer's disease**

GOOD CHOICES

The Mediterranean diet:

- whole grains, vegetables, legumes, fruits, fish, and unsaturated fats (such as olive oil)
- moderate amounts of wine

RISKY CHOICES

- saturated fats, trans fats

oils reduces the risk of developing Alzheimer's disease in European and North American populations. In addition, a study published in 2007 in *Neurology* shows eating a Mediterranean diet may even help people with the disease live longer. People who consumed mostly cereals, vegetables, legumes, fruits, fish, relatively high amounts of unsaturated fats (such as olive oil), and a moderate amount of alcohol lived about four years longer than others whose diets were higher in saturated fats, dairy products, and meat and poultry.

But, over all, the existing evidence does not support the recommendation of specific supplements, foods, or diets for the prevention of Alzheimer's, a recent review in *Current Neurology and Neuroscience Reports* concluded. Some epidemiologic studies suggest that higher dietary intake of antioxidants, vitamins B₆, B₁₂, folate, unsaturated fats, and fish are related to a lower risk of Alzheimer's, but reports are inconsistent. Randomized clinical trials of supplements of vitamins E, B₁₂, B₆, and folate have shown no cognitive benefit. Modest to moderate alcohol intake, particularly wine, may be related to a lower risk of Alzheimer's. ♥

How safe is your food?

Aside from being nutritious, healthy foods must also be safe—untainted by bacteria, free from dangerous levels of pesticides and other impurities. In recent years, concerns about food safety have grown stronger and more far-reaching. Headlines warn of contamination in beef, lettuce, and other fruits and vegetables. Fears of toxic pesticides and potential hazards from genetically engineered foods are widespread.

Modern farming and food processing methods have done a great job of making more food available more cheaply. But these methods have created safety issues. Efforts to maximize yield have led to greater use of pesticides on crops and hormones in animals. The crowded animal pens of factory farms and the large-scale assembly-line nature of slaughterhouses and food processing plants have increased the spread of dangerous bacteria in food. Farmers' routine addition of antibiotics to animal feed has given rise to bacteria that are resistant to treatment with medications.

In truth, our food supply is reasonably safe, but it could be safer. The government is working with farmers and slaughterhouses to take greater precautions against the spread of germs. Organic and sustainable agriculture (see page 42) and other strategies are one way to reduce the need for synthetic fertilizers and toxic pesticides but drive up the cost. Meanwhile, there are steps you can take in selecting, handling, and storing food to minimize safety problems.

The biggest threat: Contamination

The food safety threat that eclipses all others is bacterial contamination—a problem that mainly affects meat, fish, and dairy products, and also some fresh produce. Microbes that not long ago were either unheard of or considered a minor threat now cause 76 million cases of food poisoning and 5,000 deaths in the United States each year. The main reason that food contamination is on the rise is that large-scale pro-

cessing and packaging affects larger batches of food. So when contamination does occur—shipped to more supermarkets, restaurants, and school cafeterias—it also affects larger amounts of food than ever before.

The widespread use of antibiotics in animal feed is another factor because it promotes the emergence of disease-resistant pathogens that are resistant to antibiotics. These resistant germs breed inside the animals and are then passed to humans in meat, eggs, and other foods.

The foods that are most prone to contamination are meat, poultry, eggs or foods made with raw eggs, raw shellfish, cold cooked seafood such as smoked salmon, soft cheeses, and bean sprouts. You can help guard against food poisoning by washing meat and

Large-scale processing and packaging means that when contamination does occur, it affects larger batches of food.

produce before handling it, cooking foods thoroughly, and refrigerating them (see “Handling food safely,” at right). But these measures are not foolproof, because contamination can spread during delivery to other foods that aren't normally affected. Fruits, vegetables, and milk have become tainted after being shipped in the same trucks as tainted eggs or meat.

To help prevent contaminated foods from even reaching delivery trucks, the USDA, since 1995, has been phasing in a more comprehensive, scientific system of inspecting meat, poultry, and processed egg products. This surveillance system targets the most prevalent sources of food-borne illness: *Escherichia coli* (*E. coli*) in ground meat, and *Salmonella* in ground meat and poultry. Slaughterhouses must regularly test meats for the presence of *E. coli*, and government inspectors must test for *Salmonella*.

The FDA has pledged to create a stronger national food protective program in response to outbreaks of

food-borne illness in 2006 and 2007. These involved fresh spinach contaminated with a harmful strain of *E. coli*, a multi-state outbreak of *Salmonella* infection caused by contamination of a brand of peanut butter, and contaminated pet food that killed people's cats and dogs. Despite these intentions, the FDA's Subcommittee on Science and Technology questioned whether the FDA has the capacity to ensure the safety of the nation's food or the ability to provide its basic food system inspection, enforcement, and rulemaking functions. It also questioned the agency's ability to respond to outbreaks in a timely manner and to develop and keep pace with the new regulatory science needed to prevent future problems.

With these challenges in mind, consumers can play their part by becoming aware of the nature of food safety problems and taking steps to ensure their own safety when handling and cooking foods. Common sources of contamination include the following:

- ***E. coli***. A toxic variation of this bacterium, found mainly in ground beef, causes an estimated 25,000 cases of food poisoning in the United States each year and kills about 100 people. It is the most common cause of sudden kidney failure in children and can also cause kidney damage in adults. Contamination occurs during meat processing, when *E. coli* from the animals' intestines becomes mixed in with the meat. *E. coli* contamination has prompted massive recalls of millions of pounds of ground meat. The damage is done by a toxin known as shiga, which is commonly found in the O157:H7 subtype.

- ***Salmonella***. This bacterium is found mostly in meat and eggs. But it spreads to other foods, such as ice cream and fruit, when they are shipped with contaminated meat or eggs. A study in *The New England Journal of Medicine* in 2001 showed how alarmingly prevalent it is: 20% of 200 samples of ground chicken, beef, turkey, and pork contained *Salmonella*. Of particular concern, 84% of the *Salmonella* samples were resistant to at least one antibiotic, and 53% to at least three antibiotics. This means that when animals carry *Salmonella*—and when people get *Salmonella* food poisoning—it's more difficult to cure than it was in years past.

- ***Campylobacter***. Usually transmitted by poultry, this bacterium is the most common cause of bacterial

gastroenteritis in the United States, causing approximately 2.5 million cases of diarrhea, fever, and abdominal cramps each year. Antibiotic-resistant strains are becoming more prevalent because of the widespread use of antibiotics in chicken feed. In 2007, the CDC reported increasing resistance to ciprofloxacin, a fluoroquinolone, the most common antimicrobial drug prescribed for *Campylobacter* infections in people. To help control this problem, the FDA has begun to reduce the use of fluoroquinolones in poultry. One, enrofloxacin, is now prohibited in poultry.

Handling food safely

You can prevent most cases of food poisoning in your household by preparing and storing your foods safely. These precautions will help kill germs that are present in the meat and eggs you buy and help you avoid introducing new bugs to your food at home.

- **Rinse foods**. Rinsing can wash off some germs from meat, poultry, and fish and pesticide residues from produce. Rinse all meat, poultry, and fish under running water before cooking. Rinse all fruits and vegetables under running water before cooking or serving them.

- **Wash your hands**. Frequent handwashing helps prevent you from passing germs from one food to another. Use soap and water to wash your hands each time you handle a raw food. Don't wipe your hands on a dishtowel without washing them first.

- **Use separate utensils**. Don't prepare meat and fish on the same surface that you use for other foods—otherwise, you risk contaminating those foods with bacteria from the meat and fish. Use one cutting board for meats and fish and a second one for produce. Be sure to wash the cutting boards with soap and water after each use. Use different knives to cut different foods to prevent cross-contamination.

- **Cooking**. Cook all meat, poultry, eggs, and freshwater fish. Don't rely on color alone to indicate whether meat is fully cooked. The USDA recommends that everyone use a meat thermometer. Different temperatures are required to kill off germs in different kinds of meat. It's also important to cook hot dogs and other precooked meats and fish, to destroy bacteria that may have contaminated them in the processing plants.

Table 7 How long to store foods

Discard foods after the given time period has elapsed.		
FOOD	REFRIGERATOR	FREEZER
Fresh meat and fish		
Ground beef	1–2 days	3–4 months
Steaks and roasts	3–5 days	6–12 months
Pork chops	3–5 days	4–6 months
Ground pork	1–2 days	3–4 months
Pork roasts	3–5 days	4–6 months
Lean fish (flounder, haddock, cod, etc.)	1–2 days	up to 6 months
Fatty fish (blue, perch, salmon, etc.)	1–2 days	2–3 months
Whole chicken	1–2 days	12 months
Chicken parts	1–2 days	9 months
Giblets	1–2 days	3–4 months
Cured meats		
Lunch meats (ham, turkey, etc.)	3–5 days	1–2 months
Sausage	1–2 days	1–2 months
Dairy products		
Milk	5 days	1 month
Cheese (Swiss, brick, processed)	3–4 weeks	—
Ice cream, ice milk	—	2–4 months
Uncooked eggs (in shell)	3 weeks	—
Hard-boiled eggs	1 week	—
Source: FDA.		

■ **Storing.** Don't leave any foods, before or after cooking, at room temperature for more than two hours (one hour if the air temperature is above 90° F). Put them in the refrigerator or freezer. The temperature inside your refrigerator should be 40° F or below; your freezer should be at 0° F or below. If you have large amounts of leftovers, divide them into small batches when you put them away in the refrigerator or freezer. That way, the temperature of each batch will reach a safe level faster. Keep in mind that freezing does not necessarily kill bacteria; wash meats and poultry thoroughly after thawing, and handle them the same as you would fresh meats (see Table 7).

What about pesticides?

Residues of pesticides used to kill insects, weeds, and fungi on farms are present in many of the fruits and vegetables on the market. In some tests, about half of fruits and vegetables had residues. The Environmental Protection Agency (EPA) rates many of these pesticides as known or probable carcinogens. Evidence also suggests that pesticides can cause other health problems, such as impaired immune function and low sperm count.

No one knows how serious a threat pesticides pose to the average consumer. Estimates are extrapolated from the incidence of illnesses among farm workers and from research on animals. But a report by the National Academy of Sciences in 1993 concluded that infants and children are more vulnerable than adults to pesticide hazards because they are smaller and because they eat much larger amounts of certain fruits, such as apples in apple juice. As a result of that study, Congress passed the Food Quality Protection Act in 1997, which requires all pesticide exposures to be proved safe for infants and children. The EPA is charged with making this determination by monitoring pesticide residue levels in foods and finding out which foods children eat the most. When the EPA lacks enough information to tell how much of a particular pesticide is safe for children, it must build in a safety margin by lowering the limit for children.

Is organic better?

You may wonder whether organic produce is a healthier choice. To be labeled “organic,” produce must meet the guidelines in a 2002 federal law. These guidelines state that no synthetic chemicals can be used to grow the produce or to treat it after harvesting. USDA agents certify which produce can be called organic and can impose penalties of up to \$10,000 for violations. Organic farming leaves fewer pesticide residues than conventional farming, which certainly makes it healthier for the environment and possibly healthier for you. Keep in mind, however, that even organic produce isn't completely free of synthetic pesticide residues because these chemicals can persist in the soil for decades.

As defined by the USDA, organic foods are those grown only without the use of most conventional pesticides, petroleum- or sewage-based fertilizers, genetic engineering, or radiation. Organic farmers can use manure-based fertilizers if they comply with very specific regulations. For meats, eggs, and dairy products to be called organic, the farmers cannot give the animals antibiotics or growth hormones. Livestock must eat organic feed that doesn't contain parts of other slaughtered animals, and the livestock must be allowed outdoors.

But how can you really tell if that's what you're getting when you pay more to buy organic? After all, organic foods don't generally look different from their non-organic counterparts. As of October 2002, the USDA started lending its seal of organic approval to foods that are at least 95% organic. If you see the seal, the USDA has approved the food as organic. Even the use of the word "organic" on the label must first be approved by the USDA. For example, multi-ingredient foods (such as cereal or soup) that are 70% to 95% organic can't display the seal, but they can use the word organic to describe up to three ingredients on the front of the packaging. Foods that are less than 70% organic can identify specific ingredients as organic in the ingredient list.

Although all foods that have the USDA seal are certified organic foods, the reverse is not true: all organic foods do not necessarily carry the USDA label, because applying for the labeling is voluntary. Foods that are truly organic might not have the seal or even use the word organic on the label.

But the labels don't answer another nagging question: how important is it to buy organic? According to its Web site, the USDA "makes no claims that organic food is safer or more nutritious than conventionally produced foods." Harvard nutrition experts say there is no solid evidence that organic foods in general are healthier for humans, but that organically raised meat may prevent the spread of diseases such as bovine spongiform encephalopathy, better known as mad cow disease (see page 45). Conventionally raised livestock can catch this disease by eating the meat or bones of infected animals. But because animals sold as organic meat do not eat slaughtered animals, they are unlikely to catch mad cow disease.

What about the health value of organic produce? A 2002 study showed that children who ate organic fruits and vegetables had significantly less pesticide in their urine than those who followed conventional diets. This means that when children ate conventionally grown foods, pesticides entered their blood and circulated through their bodies before being excreted. But neither this study nor any others to date prove that organic foods are healthier, because the level of pesticides found hasn't been definitely linked to any health risk.

Until more conclusive evidence emerges, the decision to buy organic comes down to personal choice: if you like the idea of eating foods made without chemicals or pesticides, buy organic. Otherwise, it's good to know that eating conventionally grown fruits and vegetables is also a healthy choice. Whether or not you buy organic, don't let concerns over pesticides deter you from eating plenty of fruits and vegetables. The bottom line is that the health benefits from eating fruits and vegetables outweigh the risks from ingesting the pesticides on them.

Here are some ways to reduce your exposure to pesticides.

- **Buy locally grown produce in season.** Produce grown on small, nearby farms is less likely to be treated with pesticide waxes used to inhibit fungus growth on produce that's shipped long distances. Locally grown fruits and vegetables are available only in season.

- **Wash fruits and vegetables, and peel them when possible.** One study found that washing produce with a mix of water and mild dishwashing detergent, peeling the skins, and (for lettuce and cabbage) removing the outer leaves eliminated pesticide residues in 21% of fruits and vegetables. Peeling alone eliminated all of the residues in bananas, carrots, and potatoes. Similarly, corn had no residues after it was shucked.

Additives and your health

Additives are substances added to manufactured foods. This umbrella covers a broad range of substances: vitamins and minerals that fortify a food, preservatives that help keep a food from spoiling, sugar and other food flavorings (natural and artificial), and dyes added to make a food look appetizing.

Additives to avoid

The following food preservatives, colorings, and sweeteners are known or strongly suspected to cause cancer. Avoid eating foods that contain these additives.

- acesulfame K
- acesulfame potassium
- butylated hydroxyanisole (BHA)
- blue #1
- blue #2
- green #3
- red #3
- yellow #6
- saccharine
- sodium nitrate
- sodium nitrite
- potassium bromate

Some additives are good for you, notably vitamins and minerals. But you may wonder about the safety of other additives, especially those with names that sound more at home in chemistry class than on your plate. Under federal law, most additives must be proved safe before a food manufacturer can put them into food. The exceptions are those that have been used for a long time with no apparent problems. These older additives range from sugar and salt to potassium nitrite, preservatives in hot dogs and luncheon meats.

Some additives are a cause for concern. Sodium nitrate and sodium nitrite in hot dogs, luncheon meats, and smoked fish create small amounts of cancer-causing chemicals called nitrosamines during cooking. Research on animals suggests that other additives may cause cancer. These include six artificial food colorings (blues #1 and #2, green #3, red #3, and yellow #6), two artificial sweeteners (saccharine and acesulfame K, or acesulfame potassium), and potassium bromate in white flour products.

Other additives may cause allergic or other adverse reactions. Monosodium glutamate (MSG), a flavor enhancer, can cause headache, nausea, and difficulty breathing in some people. Cochineal and carmine, which are artificial colorings made from pulverized insects, have caused a range of allergic reactions, from hives to anaphylactic shock.

Although other additives appear safe, the presence of a long list of food additives in the ingredients of any packaged food is a red flag—you're better off choosing a food with fewer additives to reduce the health risk.

Other food safety issues

As farming and food production methods change, new safety issues arise. For instance, modern factory farming methods are largely responsible for the spread of mad cow disease (at right). Some technological advances on the horizon or already in limited use have great potential to combat food-borne contamination and reduce our reliance on toxic pesticides. But some observers suggest that these innovations may pose new risks to our health and environment. Following are some of the most important emerging food safety issues.

Food irradiation

An overwhelming body of scientific evidence has shown food irradiation to be a safe and effective method of destroying bacteria and parasites in foods. Different food irradiation technologies exist, but they all use a beam of energy—usually either electrons or x-rays—that can penetrate the surface of a food and kill off germs in its path. The electron beam machine is similar to the machine hospitals use to sterilize medical equipment. The irradiating x-ray machine is a stronger version of the x-ray machine in dentists' offices. Irradiation can help eliminate *E. coli*, *Salmonella*, *Campylobacter*, and other common causes of food contamination.

Studies show that irradiated foods are safe. Food doesn't become radioactive or develop dangerous substances, and its nutritional value is not significantly changed. The safety of the technology has been endorsed by the World Health Organization and the CDC. The FDA has approved food irradiation for a variety of foods including meats, eggs, seeds, shellfish, and some fruits and vegetables. Foods that are exposed to radiation must be identified with an international symbol called a radura.

In the future, food irradiation could become as routine as milk pasteurization. Like pasteurized milk, irradiated foods still must be handled and stored safely; otherwise, they can become contaminated before they reach your table.

Genetic engineering

Genetically modified (GM) food is the result of a process of moving genes across natural boundaries from one plant or animal to another in order to confer cer-

tain traits. There are several ways of altering genes in plants and animals. Traditional breeding methods continue to be an effective and widespread means of enhancing the nutritional content of food.

Most GM products on the market have been engineered for agronomic traits, such as pest resistance or herbicide resistance, rather than for consumer health benefits.

Are genetically engineered foods safe? The National Academy of Sciences, in its 2004 report *Safety of Genetically Engineered Foods*, concluded that while genetic engineering of foods is not inherently dangerous, it may produce unintended changes in the composition of foods. The report recommends that genetically engineered foods be evaluated on a case-by-case basis and calls for ongoing monitoring of the population for adverse health effects.

That said, genetically engineered foods offer many advantages and are already widespread. If you worry about eating genetically engineered foods, you may be reassured to know that in most cases, you won't be eating the genes themselves, because by the time the food is processed—from corn to corn syrup, for example, or from soybean to soybean oil—none of the genes or proteins are left.

Some people are rightly concerned that an allergen might be transferred from one food to another during the genetic engineering process. This has already happened in the case of an allergen from Brazil nuts being inadvertently transferred into soybean plants. This is the reason the government requires manufacturers to test their genetically engineered foods for allergens.

Mad cow disease

Perhaps the scariest, most deadly food-borne illness is mad cow disease, or bovine spongiform encephalopathy. This is a fatal neurological illness that strikes adult cows. People who eat meat from infected cows can get a similar disease called variant Creutzfeldt-Jakob disease, which is also fatal.

The spread of mad cow disease to people is the direct result of unhealthy factory farming, specifically the practice of giving cattle feed made of ground-up meat and bone meal. Infected tissue in the feed can pass the infection to cows. The disease was first reported in the United Kingdom in 1986 and then spread rapidly in the years that followed, affecting as many as 1,000 cows per week. The specific cause of the disease is neither a bacterium nor a virus. Experts think it is a pathogenic prion, a protein that occurs naturally on the surface of brain cells. The disease doesn't spread easily—in Britain, less than 200 people have died from one million infected cattle that entered the food chain—but it is incurable.

Three cases of variant Creutzfeldt-Jakob disease had been reported in people in the United States. A similar chronic wasting disease has been found in deer, moose and elk in Colorado, Wyoming, and nearby states, but it does not seem to have spread to nearby grazing cattle or to people. To limit your risk, you can choose to avoid eating beef or, if you do eat beef, avoid those foods most likely to carry diseased central nervous system tissue, such as cow brains and processed beef products such as hamburger, hot dogs, and sausage. ♥

Shopping for food

Learning which foods are healthy is half the battle. The other half is knowing how to shop for them. The main rule of thumb is to choose a variety of foods to ensure that you get adequate amounts of nutrients and disease-fighting substances. But even savvy shoppers can get confused wading through all the choices at the market, decoding food labels, and cutting through the marketing claims on food packages. Here is a simple, no-nonsense guide to separating truths from half-truths, as well as determining which fruits, vegetables, meats, and fish are freshest and healthiest.

Reading a food label

If you aren't in the habit of reading food labels, try it. You will be surprised to see how much great information appears on this small government-mandated label. Federal law requires all packaged foods to bear a label stating the ingredients, the serving size, calories, total fat, saturated fat, trans fat, total carbohydrates, protein, cholesterol, sodium, and Daily Values (DV) of certain nutrients, such as vitamin A, vitamin C, calcium, and iron.

You can use this food label in many ways. For example, you can find out whether a loaf of bread is genuine whole wheat by checking whether the first item in the ingredients list is “whole-wheat flour.” Using the nutrients list, you can compare the amount of fiber among different brands of cereals, or you can see whether your bread is fortified with folic acid or your orange juice is fortified with calcium. If you see that there are 12 grams of fat and that 10 of them are saturated or trans fats, you'll know it's not a healthy choice for lowering your risk for heart disease, diabetes, or hypertension. The phrase “partially hydrogenated oil” in the list of ingredients is another way of saying trans fats.

Other elements of the food label can provide useful information as well. Here are some examples.

■ **Ingredients list.** The ingredients are listed by weight from the largest to the smallest amounts. The

healthiest products have the healthiest ingredients. Seeing sugar, corn syrup, salt, or some other unhealthy ingredient high on the list is a red flag. Sometimes food manufacturers use several different kinds of sugar—such as corn syrup, malt syrup, or fructose—listed separately, so that “sugar” does not appear first on the list; this is a tip-off for high sugar content.

■ **Product dates.** Perishable foods such as meats, poultry, fish, dairy products, and baked goods are marked with dates that say “use by,” “sell by,” or “best if used by.” The federal government doesn't require dating on foods except for infant formula and certain baby foods. But more than 20 states require date labeling of some foods, and many manufacturers use them regardless. The most useful date is the “sell by” date. This tells the store how long to keep the product on the shelf. Don't buy any food after this date. The other dates tell you how long a product will taste its best or be at peak quality, but they don't tell you when it will spoil.

■ **Low calorie, reduced calorie.** A “low-calorie” food may have no more than 40 calories per serving. A “reduced-calorie” food has no more than two-thirds the calories that are in the regular version of the product.

■ **Light, lean.** These terms appear on all sorts of packaged foods, from potato chips to soy sauce, to suggest that they're healthier than the original versions. But government regulations state that the term “light” has a quantifiable meaning only when used to refer to the fat, calories, or sodium in a food. It means that a food contains no more than three-quarters the fat, two-thirds the calories, or half the sodium of the original.

■ **Free.** A product with this label has none or negligible amounts of one of these components: fat, saturated fat, cholesterol, sodium, sugar, or calories.

Choosing meat and fish

Look for the leanest cuts of beef, poultry, and other meats, because they have the least saturated fat. For beef,

▶ Grading meat

Labels on beef and poultry indicate their grade, or quality. But they are also a key to fat content. The highest grades contain the most fat, because fat content makes the meat tender.

Prime	Beef or lamb cuts with the most marbling, or fat.
Choice	Beef or lamb cuts with less marbling than prime.
Select	Lean cuts of beef.
Grade A	The highest quality poultry, the grade usually sold in retail markets. It has no defects such as bruises and broken bones. Lower grades of poultry are used in processed meat products. If you see poultry in your supermarket that's not graded, it's not Grade A.

the leanest cuts are round, loin, and sirloin. Ground beef is higher in fat than these cuts; if you are cooking hamburger or meatballs, buy “extra-lean ground beef,” which has roughly 10% fat (compared with 20% or 25% in other ground meat). The leanest cut of chicken and turkey is the breast (white meat); of pork, the tenderloin. The leanest cuts of lamb are the leg, loin roast, and chops.

In addition, the healthiest meats come from “free-range” animals raised without antibiotics in the feed. Free-range cattle are less likely to develop infections (and need antibiotic treatment) than animals raised factory-style in tight pens.

High-quality fish can be fresh or frozen within hours of being harvested. When buying whole fish, the scales should be intact and colorful—color fades along with freshness. The eyes should be bright and the gills red and without slime. When buying fresh fillets, examine the flesh. It should be moist and elastic and should not be brown or dry at the edges. Frozen seafood should have solid flesh, no discoloration, and little or no odor.

Buying grains and beans

Look for “whole wheat” or another whole grain as the first ingredient in bread and rolls. In addition, consider whole-wheat pasta, which has a lower glycemic index than white pasta. Similarly, brown rice has a lower glycemic index than white rice. For variety, try some healthy alternatives to these grains, such as bulgur or quinoa.

Lentils, chickpeas, kidney beans, peanuts, and other legumes are important sources of vegetable protein. They come either dried or canned. Dried beans have a slight edge over canned beans because they are unprocessed, have no added salt, and are inexpensive. But they must be cooked, a process that can require overnight soaking. Canned beans are more convenient when you're pressed for time because they're already cooked. You can reduce their salt content by rinsing them in a strainer under cold water before preparing a meal with them.

Shopping for fruits and vegetables

Most Americans do not meet the minimum U.S. government advice of five servings a day of fruit and vegetables, let alone the preferred nine to 11 servings a day recommended by many health experts. One-third of our daily vegetables come from just two sources: iceberg lettuce and potatoes, according to the USDA, and most potatoes are eaten in the form of French fries. Americans do a little better with fruit, eating mostly apples, oranges, or bananas.

The healthiest fruits and vegetables are picked fresh. The longer they are stored, the more nutritional value (and taste) they lose. Frozen fruits and vegetables are almost as tasty and nutritious as fresh-picked ones, and they may be even better than fresh produce that was picked unripe and then stored for weeks. Select a variety of fruits and vegetables, concentrating on the most deeply colored ones because they contain substances that have healthful effects (see “Fruits and vegetables,” page 14). Have a spinach salad instead of iceberg lettuce, for example. Eat sweet potatoes or yams instead of white-fleshed potatoes.

In addition, choose fruits and vegetables that are in season (strawberries in the spring, zucchini in late summer). They are more likely than out-of-season produce to have been grown locally (or at least domestically) and not stored for long periods. It's also worth considering organic produce because it has lower levels of pesticide residues than other produce.

You can tell a lot about the condition of fruits and vegetables by looking at them and feeling them. Greens should not be wilted. Carrots should be crisp, not limp. Peaches, nectarines, and cantaloupes should be slightly

soft, but not mushy. Brown spots on fruits and vegetables are signs of spoiling. On the other hand, produce that is too perfect-looking is not always desirable. Shiny, flawless skin on apples, peppers, and cucumbers is a sign that they have been coated in a pesticide wax. Although the wax can be washed off with soap and water, you're better off avoiding it entirely.

One impediment for people trying to eat more vegetables is all the cleaning, peeling, and chopping necessary to get them onto the dinner table. Fortunately, convenience is the big driver of new items in the produce section. Look around, and you'll notice a lot more wrapped-and-ready options: prepackaged lettuce mixes; veggie mixes ready to steam, sauté, or throw into soup; fruit salads; and, of course, the best-selling, trend-setting baby carrots. These items often cost more but they may help you and your family get more fruits and vegetables in your diet.

Browsing the dairy case

Because regular milk, cheese, and other milk products contain saturated fat, look for nonfat or low-fat versions. Nonfat milk has just 1 gram of fat per cup, compared with 8 grams in whole milk. Low-fat (1%) milk has 2 grams of fat per cup. The yogurts with the least fat are those made with skim or low-fat milk instead of whole milk or cream. Be aware that most cheese has a lot of fat even if it's labeled "low-fat." Although a half-cup of low-fat cottage cheese has just 1 gram of fat, low-fat ricotta cheese has a whopping 10 grams of fat per half-cup.

When choosing frozen desserts, keep in mind that the gourmet or premium brands often have lots of unhealthy saturated fat. A half-cup of gourmet ice cream has 12 grams of fat because it's made with cream. Compare that to the low-fat products or frozen yogurt with 3 grams. Even better, try sherbet with only 2 grams, or sorbet with none. Remember that all these products are laden with added sugars; they're not health foods by any stretch of the imagination.

For safety's sake, always be sure to buy milk and milk products that are pasteurized. Pasteurization uses heat to kill off germs during processing. Don't be fooled into thinking that unpasteurized products are healthier or purer. Pasteurization has significantly reduced the inci-

dence of diseases transmitted by milk. Another way to guard against contamination is to buy milk and other dairy products (including eggs) before the "sell by" date.

Eating out

In general, the foods in restaurants are not as healthy as the foods you prepare at home. For one thing, they're more likely to be high in bad fats, high in glycemic load, or both. It's not obvious, but butter is in everything in many restaurants—chefs like the flavor and are trained to use it liberally even on those healthy-looking fresh vegetables.

Another down side of restaurant eating is portion size. Restaurant portions are often overly large, especially in fast-food restaurants. But if you're smart about what you order, you can get a healthy meal—including dessert—when eating out. Here are some guidelines.

- **Ask about fried foods.** Frying foods usually adds more fat to a food than broiling, baking, or sautéing, so the calorie count is likely to be high. But many restaurants are switching away from frying foods in trans fats and saturated fats and using healthier fats such as unhydrogenated vegetable oils. Ask your server what kind of oil is used for frying.

- **Avoid dishes prepared with gravy and heavy sauces.** Because gravy is often made with fatty pan drippings from meat, it is relatively high in saturated fat. Many sauces are made with cream, which is also high in saturated fat.

- **Ask the waiter how large the entrées are.** If they're bigger than the meals you usually eat, consider ordering an appetizer instead or sharing an entrée with someone else. And you don't have to eat everything on your plate. Take home your leftovers for tomorrow's lunch.

- **Eat a light healthy snack such as a piece of fruit or some carrots before going out.** That way, you won't be so ravenous when you arrive at the restaurant that you'll gorge on the bread served at the table (which will probably be white bread and, therefore, have a high glycemic load).

- **Share desserts.** If you want a sweet dessert, consider sharing it with others at your table. You'll get the full taste, but just a fraction of the calories, sugar, and bad fats. ♥

Glossary

body mass index (BMI): An estimate of the body's fat content, calculated from measurements of height and weight.

dietary fiber: The edible, nondigestible component of carbohydrates naturally found in plant food.

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

essential fats: Beneficial polyunsaturated fats, including both omega-3 and omega-6 fatty acids, that come exclusively from foods and supplements; they are not manufactured by the body.

glycemic index: A measure of how soon and how much a serving of a food causes blood sugar to rise. Foods with a high glycemic index are thought to increase the risk of insulin resistance and other health problems.

high-density lipoproteins (HDLs): Spherical particles that transport cholesterol from body cells to the liver and other sites for elimination; called "good" cholesterol because high levels are associated with a low risk for heart disease.

insulin resistance: An adverse condition in which the body does not respond normally to insulin, the hormone that ferries sugar from the blood into the cells. Insulin resistance can lead to type 2 diabetes and heart disease.

low-density lipoproteins (LDLs): Spherical particles that transport cholesterol in the blood; called "bad" cholesterol because high levels are associated with a high risk for heart disease.

macronutrients: The basic categories of nutrients that humans need for energy and metabolism: fat, carbohydrate, and protein.

micronutrients: The vitamins and minerals that humans need to maintain normal body functions and prevent certain illnesses.

monounsaturated fats: Beneficial fats that contain one double bond between adjacent carbon atoms.

omega-3 fatty acids: Beneficial fats also known as n-3 fatty acids. These are polyunsaturated fats in which the last double bond between carbon atoms is located three carbons from the end of the chain.

omega-6 fatty acids: Beneficial fats also known as n-6 fatty acids. These are polyunsaturated fats in which the last double bond between carbon atoms is located six carbons from the end of the chain.

phytochemicals: Substances made by plants that have biological effects in the human body. Some are phytoestrogens, chemicals that behave like (or sometimes block the action of) the hormone estrogen.

polyunsaturated fats: Beneficial fats that contain two or more double bonds between adjacent carbon atoms.

saturated fats: Unhealthy fats in which all the carbon atoms are bonded to the maximum number of hydrogen atoms so there are no double bonds between the carbons.

trans fatty acids (trans fats): Unhealthy fats that occur naturally in meat but come mainly from processed foods made with hydrogenated oils. Hydrogenated oils are polyunsaturated fats that have been chemically altered to be made more like saturated fats.

triglycerides: Fat that is transported through the bloodstream. High levels increase the risk of heart disease.

Resources

Organizations

American Dietetic Association
120 S. Riverside Plaza, Suite 2000
Chicago, IL 60606
800-877-1600
www.eatright.org

This large organization of food and nutrition professionals provides information and advice to the general public through its Web site, outreach efforts, and publications.

The Nutrition Source—Knowledge for Healthy Eating
Harvard School of Public Health
Department of Nutrition
www.hsph.harvard.edu/nutritionsource

This Web site gives free public access to the latest information on nutrition and health.

Books and publications

Eat, Drink, and Be Healthy: The Harvard Medical School Guide to Healthy Eating
Walter C. Willett, M.D., with P.J. Skerrett
(Simon & Schuster, 2005)

This book provides state-of-the-art information about the links between diet and health. An extensive selection of recipes helps readers put the latest nutrition findings into practice.

Eat, Play, and Be Healthy: The Harvard Medical School Guide to Healthy Eating for Kids
W. Allan Walker, M.D., with Courtney Humphries
(McGraw-Hill, 2005)

Written by a world-renowned nutrition expert and Harvard professor of pediatrics, this book shows you how to feed your children to ensure that their young bodies and minds enjoy full and healthy growth at every stage of development.



Other publications from Harvard Medical School

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