The Importance of Nutrition in Cancer Prevention

The American Cancer Society publishes nutrition guidelines to advise the public about dietary practices that reduce cancer risk. These guidelines are developed by expert advisory committees and are based on existing scientific evidence that relates diet and nutrition to cancer risk in human population studies as well as in laboratory experiments.

This evidence suggests that about one third of the 500,000 cancer deaths that occur in the United States each year is due to dietary factors. Another third is due to cigarette smoking. Therefore, for the large majority of Americans who do not smoke cigarettes, dietary choices and physical activity become the most important modifiable determinants of cancer risk. The evidence also indicates that although genetics is a factor in the development of cancer, cancer cannot be explained by heredity alone. Behavioral factors such as cigarette smoking, dietary choices, and physical activity modify the risk of cancer at all stages of its development. The introduction of healthful diet and exercise practices at any time from childhood to old age can promote health and reduce cancer risk.

On the basis of its review of the scientific evidence, the American Cancer Society 1996 Advisory Committee on Diet, Nutrition, and Cancer Prevention reaffirms previous conclusions of the Society that dietary practices and physical activity—along with smoking cessation, avoidance of occupational carcinogens, and early detection—are important factors in the prevention of cancer and cancer death.

Many dietary factors can affect cancer risk: types of foods, food preparation methods, portion sizes, food variety, and overall caloric balance. Cancer risk can be reduced by an overall dietary pattern that includes a high proportion of plant foods (fruits, vegetables, grains, and beans); limited amounts of meat, dairy, and other high-fat foods; and a balance of caloric intake and physical activity.

Many Americans do not follow such healthful practices. Indeed, trends indicate an increase in caloric intake, greater use of high-fat convenience foods, and a
decline in physical activity among Americans. We believe that such unhealthful trends are due in part to shifts toward consumption of food outside the home, to more sedentary lifestyle patterns, and to the advertising and promotion of high-calorie foods. The committee is especially concerned about the effects of such trends on the long-term health of children, who are establishing lifetime patterns of food intake and physical activity.

In this report, the committee presents four broad guidelines to reduce cancer risk among people aged two years and older (Table 1). In addition, we offer advice on a wide variety of questions about nutrition and cancer that concern the public at large. These recommendations represent the committee’s best efforts to provide advice based on scientific studies related specifically to the primary prevention of cancer. This advice does not apply to cancer treatment or to reducing the risk of cancer recurrence. The committee’s recommendations are consistent in principle with the 1992 Food Guide Pyramid, the 1995 Dietary Guidelines for Americans, and dietary recommendations of other agencies for general health promotion and for the prevention of coronary heart disease, diabetes, and other diet-related chronic conditions. Although the committee recognizes that no diet can guarantee full protection against any disease, we believe that our recommendations offer the best nutrition information currently available to help Americans reduce their risk of cancer.

**Recommendations**

1. **Choose most of the foods you eat from plant sources.**

   **Eat five or more servings of fruits and vegetables each day.**

   • Include fruits or vegetables in every meal.
   • Choose fruits and vegetables for snacks.

   **Eat other foods from plant sources, such as breads, cereals, grain products, rice, pasta, or beans several times each day.**

   • Include grain products in every meal.
   • Choose whole grains in preference to processed (refined) grains.
   • Choose beans as an alternative to meat.

   The scientific basis for these recommendations is very strong for cancers at many sites, particularly for cancers of the gastrointestinal and respiratory tracts. The evidence is particularly strong that increased consumption of fruits and vegetables reduces the risk of colon cancer. Evidence is less strong for cancers considered hormonal, such as breast and prostate cancer. Of the many scientific studies on this subject, the great majority show that eating fruits and vegetables (especially green and dark yellow vegetables and those in the cabbage family, soy products, and legumes) protects against colon cancer.

   Greater consumption of vegetables, fruits, or both together has also been associated with a lower risk of lung cancer. The major risk factor for lung cancer is tobacco, but diet also affects risk. Studies have shown that people who smoke cigarettes tend to eat less healthful diets than nonsmokers, but fruits and vegetables reduce cancer risk whether or not people smoke.

   Because many studies indicate that foods high in beta carotene protect against lung cancer, scientists have suggested that
Recent clinical trials of beta carotene supplements, however, have shown that smokers taking the supplement developed lung cancer at higher rates than those taking a placebo. These findings support the idea that beta carotene may be a proxy for other protective nutrients or substances, singly or in combination, within foods. They also suggest that taking a single nutrient in large amounts may produce adverse effects.

Despite the strength of the evidence associating consumption of fruits and vegetables with decreased cancer risk, intake of these foods is low among many adults and children. Concern about low intake levels has led to a country-wide initiative—the National 5 A Day for Better Health Program—to increase fruit and vegetable intake to five or more servings of fruits and vegetables daily. This recommendation applies to foods in their fresh, frozen, canned, dried, or juice forms, but does not apply to specific nutrients or other substances that might be extracted from them.

Vegetables and fruits are complex foods containing more than 100 beneficial vitamins, minerals, fiber, and other substances. Scientists do not yet know which of the nutrients or other substances in fruits and vegetables may be protective against cancer. The principal possibilities include specific vitamins and minerals, fiber, and phytochemicals—carotenoids, flavonoids, terpenes, sterols, indoles, and phenols—that are present in foods of plant origin. How fruits and vegetables exert their protective effects constitutes an active area of scientific inquiry. Until more is known about specific food components, the best advice is to eat 5 or more servings of fruits and vegetables each day.

**Table 1**

**American Cancer Society Guidelines on Diet, Nutrition, and Cancer Prevention**

1. Choose most of the foods you eat from plant sources
   - Eat five or more servings of fruits and vegetables each day
   - Eat other foods from plant sources, such as breads, cereals, grain products, rice, pasta, or beans several times each day

2. Limit your intake of high-fat foods, particularly from animal sources
   - Choose foods low in fat
   - Limit consumption of meats, especially high-fat meats

3. Be physically active: Achieve and maintain a healthy weight
   - Be at least moderately active for 30 minutes or more on most days of the week
   - Stay within your healthy weight range

4. Limit consumption of alcoholic beverages, if you drink at all
Grains such as wheat, rice, oats, barley, and the foods made from them constitute the base of healthful diets as illustrated in the Food Guide Pyramid. Healthful diets contain six to 11 standard servings of foods from this group each day. As shown in Table 2, standard portion sizes are defined as quite small, and this number of servings is not difficult to achieve. Grains are an important source of many vitamins and minerals such as folate, calcium, and selenium, all of which have been associated with a lower risk of colon cancer. Whole grains are higher in fiber and certain vitamins and minerals than refined flour products. Because the benefits of grain foods may derive from their other nutrients as well as from fiber, it is best to obtain fiber from fruits, vegetables, and whole grains rather than

| **Fruits**          |   |
|---------------------|---|
| 1 medium apple, banana, orange |   |
| 1/2 cup of chopped, cooked, or canned fruit |   |
| 3/4 cup of fruit juice |   |

| **Vegetables**      |   |
|---------------------|---|
| 1 cup of raw leafy vegetables |   |
| 1/2 cup of other cooked or chopped raw vegetables |   |
| 3/4 cup vegetable juice |   |

| **Grains**          |   |
|---------------------|---|
| 1 slice bread |   |
| 1 ounce ready-to-eat cereal |   |
| 1/2 cup of cooked cereal, rice, pasta |   |

| **Beans and Nuts**  |   |
|---------------------|---|
| 1/2 cup cooked dry beans |   |
| 2 tablespoons peanut butter |   |
| 1/3 cup nuts |   |

| **Dairy foods and eggs** |   |
|--------------------------|---|
| 1 cup milk or yogurt |   |
| 1 1/2 ounces of natural cheese |   |
| 2 ounces processed cheese |   |
| 1 egg |   |

| **Meats**            |   |
|----------------------|---|
| 2-3 ounces of cooked lean meat, poultry, fish |   |

*Information from US Department of Agriculture and US Department of Health and Human Services.*
from fiber supplements.

Beans are excellent sources of many vitamins and minerals, protein, and fiber. Beans are legumes, the technical term for the family of plants that includes dried beans, pinto beans, lentils, and soybeans, among many others. Beans are especially rich in nutrients that may protect against cancer\textsuperscript{23} and can be a useful low-fat but high-protein alternative to meat.

2. Limit your intake of high-fat foods, particularly from animal sources.

\textit{Choose foods low in fat.}

- Replace fat-rich foods with fruits, vegetables, grains, and beans.
- Eat smaller portions of high-fat foods.
- Choose baked and broiled foods instead of fried foods.
- Select non-fat and low-fat milk and dairy products.
- When you eat packaged, snack, convenience, and restaurant foods, choose those low in fat.

\textit{Limit consumption of meats, especially high-fat meats.}

- When you eat meat, select lean cuts.
- Eat smaller portions of meats.
- Choose beans, seafood, and poultry as an alternative to beef, pork, and lamb.
- Select baked and broiled meats, seafood, and poultry, rather than fried.

High-fat diets have been associated with an increase in the risk of cancers of the colon and rectum, prostate, and endometrium.\textsuperscript{16,24,25} For example, in addition to fat, mutagenic compounds such as heterocyclic amines, which are produced when protein is cooked, may help explain the association between meat and colon cancer. Saturated, monounsaturated, and polyunsaturated fats all yield the same number of calories, but may affect cancer risk in different ways. Even the effects of specific fats, such as those from vegetable or fish oils, may differ in their effects on cancer risk. This relationship of types of fat to cancer risk is under active investigation.

Much evidence indicates that saturated fat may be particularly important in increasing the risk for cancer as well as for heart disease. The best way to reduce...
saturated fat intake is to make wise choices in the selection and preparation of animal foods. Choose lean meats and lower-fat dairy products, and substitute vegetable oils for butter or lard. Food labels can be a useful guide to choosing packaged foods lower in saturated fat. Choose smaller portions and use meat as a side dish rather than as the focus of a meal. Emphasize beans, grains, and vegetables in meals to help shift dietary patterns to include more foods from plant rather than animal sources. Preparation methods are also important; baking and broiling foods, rather than frying them, reduces the overall amount of fat in food. These recommendations for cancer prevention are consistent with dietary advice to reduce cardiovascular disease risk.7-10,29

3. Be physically active: achieve and maintain a healthy weight.

Be at least moderately active for 30 minutes or more on most days of the week. Stay within your healthy weight range (Figure).

Physical activity can help protect against some cancers, either by balancing caloric intake with energy expenditure or by other mechanisms. An imbalance of caloric intake and output can lead to overweight, obesity, and increased risk for cancers at several sites: colon and rectum,16 prostate,24 endometrium,25 breast (among postmenopausal women),26 and kidney.30

These findings are supported by animal studies, and by epidemiologic studies demonstrating an association between physical activity and a reduced risk of developing some cancers.31 Activity simply may prevent obesity, or it may act in other ways to reduce cancer risk. For breast and prostate cancer, physical activity may act through effects on hormone levels.32,33 For colon cancer, physical activity stimulates movement through the bowel, thereby reducing the length of time that the bowel lining is exposed to mutagens.

Both physical activity and controlled caloric intake are necessary to achieve or to maintain a healthy body weight.34 The figure displays healthy weight ranges for adult men and women of all ages. Maintaining a body weight within recommended ranges helps to reduce the risk for chronic diseases such as coronary heart disease and diabetes as well as cancer. Moderate physical activity may increase caloric needs and permit people to consume more healthful foods—especially fruits, vegetables, grains, and beans—while maintaining a recommended body weight.

The Centers for Disease Control and Prevention and the American College of Sports Medicine,35 a National Institutes of Health Consensus Conference,36 and the US Surgeon General37 recommend 30 minutes of moderate physical activity each day as a means to promote health. The 30 minutes does not need to be continuous to be beneficial, and can be accomplished by walking briskly (3-4 miles per hour) for about two miles, or by a variety of other enjoyable activities including calisthenics, jogging, swimming, gardening, yard work, housework, and dancing at a level of intensity equivalent to brisk walking. Studies suggest that when overweight people intentionally lose weight, they reduce their cancer risk.38 To lose weight, restrict caloric intake and increase physical activity. The easiest way to restrict calories is to limit serving sizes, particularly of high-fat foods (Table 2). It is important to recognize, however, that many fat-free cakes, cookies, snack foods, and frozen and other desserts remain high in calories.

4. Limit consumption of alcoholic beverages, if you drink at all.

Alcoholic beverages, along with cigarette smoking and use of snuff and chewing tobacco, cause cancers of the oral cavity, esophagus, and larynx. Cancer risk increases with the amount of alcohol con-
sumed and may start to rise with intake of as few as two drinks per day. A drink is defined as 12 ounces of regular beer, 5 ounces of wine, and 1.5 ounces of 80-proof distilled spirits.

Oral and esophageal cancers are much more common in countries where alcohol consumption is high. The combined use of tobacco and alcohol leads to greatly increased risk of oral and esophageal cancers. The effect of tobacco and alcohol combined is greater than the sum of their individual effects.

Studies also have noted an association between alcohol consumption and an increased risk of breast cancer. The mechanism for this effect is unknown, but the association may be due to carcinogenic actions of alcohol or its metabolites, to alcohol-induced changes in levels of hormones such as estrogens, or to some other process. Alcohol may have additional effects on cancer risk. Alcoholic beverages supply calories but few nutrients; people who drink heavily may be substituting alcohol for nutrient-rich, cancer-protective foods. Regardless of the mechanism, studies suggest that the risk of

Healthy weight ranges for adult men and women of all ages. The higher weights apply mainly to men, who have more muscle and bone. To use this chart, find your height in feet and inches (without shoes) along the left side of the graph. Trace the line corresponding to your height across the figure until it intersects with the vertical line corresponding to your weight in pounds (without clothes). The point of intersection lies within a band that indicates whether your weight is healthy or is moderately or severely overweight.
breast cancer may increase with an intake of just a few drinks per week.26

Moderate intake of alcoholic beverages has been shown to decrease the risk of coronary heart disease, at least in middle-aged adults. These cardiovascular benefits may outweigh the risk of cancer in men older than 50 years and in women older than 60 years.42 Public health officials advise people who already drink alcoholic beverages to limit their intake to two drinks a day for men and one drink per day for women.7 Women generally tolerate alcohol less well than men as a result of smaller body size and greater ability to absorb alcohol. Women with an unusually high risk for breast cancer might reasonably consider abstaining from alcohol. Children and adolescents, pregnant women, and people taking certain medications also should abstain from alcohol consumption.

Diet and Activity Factors that Affect Risks for the Most Common Cancers

Breast Cancer

Breast cancer is the leading site for cancer cases among American women and is second only to lung cancer in cancer deaths. Breast cancer is influenced by factors that affect circulating hormone levels throughout life: age at first menstruation, number of pregnancies, breast feeding, obesity, and physical activity. Many studies suggest that consuming alcoholic beverages may increase the risk of breast cancers, even when consumed in moderation. Some studies suggest that diets high in fruits and vegetables decrease the risk of breast cancer, although this evidence is much weaker than that for other cancer sites. At the present time, the best advice to reduce the risk of breast cancer is to limit intake of alcoholic beverages, eat a diet rich in fruits and vegetables, be physically active, and avoid obesity.26

Colorectal Cancer

Colorectal cancers are the second leading cause of cancer death among Americans. Diets high in foods from plant sources (vegetables, fruits, whole grains, beans) have been associated with a decreased risk, whereas diets high in fat and red meat have been associated with an increased risk of colorectal cancer. Obesity and physical inactivity also appear to increase risk. Currently, the best approach to reducing the risk of colorectal cancer is to consume fewer high-fat foods, limit intake of red meats, eat more vegetables, fruits, and whole grains, be physically active, and avoid obesity.16

Endometrial Cancer

Studies of endometrial cancer consistently find that being overweight increases risk. The association may be due to the increase in estrogen levels that occurs among postmenopausal women who are overweight. To reduce the risk of endometrial cancer, maintain a healthy weight through regular physical activity and healthy food choices.25

Lung Cancer

Lung cancer is the leading cause of cancer death among Americans. More than 80 percent of lung cancer cases occur as a result of tobacco smoking. Many studies have demonstrated that the risk of lung cancer among both smokers and non-smokers is lower among people who consume recommended amounts of fruits and vegetables. To reduce the risk of lung cancer, do not smoke tobacco, and eat at least five servings of vegetables and fruits every day.17

Oral and Esophageal Cancers

Tobacco—including cigarettes, chewing tobacco, and snuff—and alcohol, singly and together, increase the risk of cancers of the mouth and esophagus. Eating rec-
ommended amounts of fruits and vegetables decreases that risk. To protect against these cancers, do not use tobacco in any form, do not drink more than one or two alcoholic beverages each day, and eat at least five servings of fruits and vegetables each day.39-41

PROSTATE CANCER
Prostate cancer is the leading cancer among American men. Scientists know that prostate cancer is related to male hormones, but are uncertain as to the exact mechanism involved. Intake of animal fat, red meats, and dairy products has been found to be associated with an increase in the risk of prostate cancer, suggesting a role for saturated fat.24 To reduce the risk of prostate cancer, limit intake of foods from animal sources, especially saturated fats and red meats.

STOMACH CANCER
The incidence of stomach cancer is decreasing worldwide, especially in the United States. Year-round consumption of fresh foods, refrigeration, and other improvements in food-preservation methods have helped reduce risk. Infection with the bacterial species *Helicobacter pylori* may increase risk. To reduce the risk of stomach cancer, eat at least five servings of fruits and vegetables each day.43

Common Questions About Diet and Cancer
Because people are interested in the relationship of specific foods or nutrients to specific cancers, research in this area is often widely publicized. No one study is the last word on any subject, and it is easy to become confused by what may appear to be contradictory and conflicting advice. Each study should be considered in the light of existing knowledge, but in brief news stories, reporters cannot always put new research findings in context. The best advice is to use common sense; it is rarely, if ever, advisable to change your diet based on a single study or news report, especially if the data are reported as “preliminary.”

ANTIOXIDANTS
What are antioxidants and what do they have to do with cancer? Certain nutrients in fruits and vegetables appear to protect the body against the oxygen-induced damage to tissues that occurs constantly as a result of normal metabolism. Because such damage is associated with increased cancer risk, antioxidant nutrients are thought to protect against cancer.12 Antioxidant nutrients include vitamin C, vitamin E, selenium, and carotenoids. Studies suggest that people who eat more fruits and vegetables containing these antioxidants have a lower risk for cancer.13 Clinical studies of antioxidant supplements, however, have not demonstrated a reduction in cancer risk (see Beta Carotene, Supplements).

ARTIFICIAL SWEETENERS
Do artificial sweeteners cause cancer? Several years ago, experiments on rats suggested that saccharin might cause cancer. Since then, however, studies of primates and humans have shown no increased risk of cancer from either saccharin or aspartame.

BETA CAROTENE
Does beta carotene reduce cancer risk? Because beta carotene, an antioxidant, is found in fruits and vegetables, and because eating fruits and vegetables is clearly associated with a reduced risk of cancer, it seemed possible that taking high doses of beta carotene supplements might reduce cancer risk. In three major experiments, people were given high doses of synthetic beta carotene in an attempt to prevent lung and other
cancers. Two of these studies found beta carotene supplements to be associated with a higher risk of lung cancer in cigarette smokers\textsuperscript{18,19} and a third found neither benefit nor harm from beta carotene supplements.\textsuperscript{44} Thus, research has not reproduced the beneficial effects of fruits and vegetables by giving high-dose supplements of beta carotene. For cigarette smokers, such supplements may be harmful.\textsuperscript{18}

**Bioengineered Foods**

**What are bioengineered foods, and are they safe?** Foods made through techniques of bioengineering or biotechnology have been altered by the addition of genes from plants or other organisms to increase resistance to pests, to retard spoilage, or to improve transportability, flavor, nutrient composition, or other desired qualities. Few such foods have as yet been marketed. At present, there is no reason to believe that these foods will either increase or decrease cancer risk.

**Calcium**

**Is calcium related to cancer?** Some research has suggested that foods high in calcium might help reduce the risk of colorectal cancer, but this relationship is not proven. Whether or not calcium intake affects cancer risk, eating foods containing this mineral is important to reduce the risk of osteoporosis. Low-fat and non-fat dairy products are excellent sources of calcium, as are some leafy vegetables and beans.

**Carotenoids**

**What are carotenoids, and do they reduce cancer risk?** Carotenoids are a group of pigments in fruits and vegetables that include alpha carotene, beta carotene, lycopene, lutein, and many other compounds. Consumption of foods containing carotenoids is associated with a reduced cancer risk (see Beta Carotene).

**Cholesterol**

**Does cholesterol in the diet increase cancer risk?** Cholesterol in the diet comes only from foods from animal sources—meat, dairy, eggs, and fats. At present, little evidence is available to determine whether dietary cholesterol itself or the foods containing this substance might be responsible for the increase in cancer risk associated with eating foods from animal sources. Low blood cholesterol has been found to be more common in people with cancer, but is an effect of cancer, not its cause. There is no evidence that lowering blood cholesterol causes an increase in cancer risk.

**Coffee**

**Does drinking coffee cause cancer?** Several years ago, a highly publicized study suggested that coffee might increase risk for cancer of the pancreas. Because caffeine may heighten symptoms of fibrocystic breast lumps in some women, media stories also have focused on concerns about coffee and breast cancer. Many studies in recent years, however, have found no relationship at all between coffee and the risk of pancreatic, breast, or any other type of cancer.

**Cooking Methods**

**Does cooking affect cancer risk?** Adequate cooking is necessary to kill harmful microorganisms in meat. However, some research suggests that frying or charcoal-broiling meats at very high temperatures creates chemicals that might increase cancer risk. Preserving meats by methods involving smoke also increases their content of potentially carcinogenic chemicals. Although these chemicals cause cancer in animal experiments, it is uncertain whether they actually cause cancer in people. Techniques such as braising, steaming, poaching, stewing, and microwaving meats do not produce these chemicals.
CRUCIFEROUS VEGETABLES
What are cruciferous vegetables and are they important in cancer? Cruciferous vegetables belong to the cabbage family, which includes broccoli, cauliflower, and brussels sprouts. These vegetables contain certain chemicals thought to reduce the risk of colorectal cancer. The best evidence suggests that a wide variety of vegetables, including cruciferous and other vegetables, reduces cancer risk (see Phytochemicals).

FIBER
What is dietary fiber and can it prevent cancer? Dietary fiber includes a wide variety of plant carbohydrates that are not digested by humans. Specific categories of fiber are “soluble” (like oat bran) and “insoluble” (like wheat bran). Insoluble fiber is thought to help reduce the risk of colorectal cancer, although the mechanism of this action is uncertain. Soluble fiber helps to reduce blood cholesterol and, therefore, to lower the risk of coronary heart disease. Good sources of fiber are beans, vegetables, whole grains, and fruits.

FISH OILS
Does eating fish protect against cancer? Like all fats, fish oils are high in calories. Fish fats are rich in omega-3 fatty acids. Studies in animals have found that omega-3 fatty acids suppress cancer formation, but there is no direct evidence for protective effects in humans at this time.

FLUORIDES
Do fluorides cause cancer? Extensive research has examined the effects of fluorides given as dental treatments or added to toothpaste, public water supplies, or foods. Fluorides do not increase cancer risk.

FOLIC ACID
What is folic acid and can it prevent cancer? Folic acid (sometimes called folate or folacin) is a B vitamin found in many vegetables, beans, fruits, whole grains, and fortified breakfast cereals. Folic acid may reduce the risk of some cancers. Supplements are sometimes recommended for women who are capable of becoming pregnant as a means to reduce the risk of spina bifida and other neural tube defects in their infants. Current evidence suggests that to reduce cancer risk, folic acid is best consumed along with the full array of nutrients found in fruits, vegetables, and other foods.

FOOD ADDITIVES
Do food additives cause cancer? Many substances are added to foods to preserve them and to enhance color, flavor, and texture. Additives are usually present in very small quantities in food, and no convincing evidence exists that any additive at these levels causes human cancers.

GARLIC
Can garlic prevent cancer? The health benefits of the allium compounds contained in garlic and other vegetables in the onion family have been publicized widely. Garlic is currently under study for its ability to reduce cancer risk, but insufficient evidence supports a specific role for this vegetable in cancer prevention.

GENETICS
If our genes determine cancer risk, how can diet help prevent cancer? Genes that increase or decrease cancer risk can be inherited or acquired by mutations throughout life. Nutrients and nutritional factors in the diet can protect DNA from being damaged and can delay or prevent the development of cancer even in people with an increased genetic risk for the disease.
IRRADIATED FOODS

Why are foods irradiated, and do irradiated foods cause cancer? Radiation is increasingly used to kill harmful organisms on foods so as to extend their “shelf life.” Radiation does not remain in the foods after treatment, and there is no evidence that consuming irradiated foods increases cancer risk.

NITRITES

Should I avoid nitrite-preserved meats? Most lunch meats, hams, and hot dogs are preserved with nitrates to maintain color and to prevent contamination with bacteria. Nitrates can be converted to carcinogenic nitrosamines in the stomach, which may increase the risk of gastric cancer.

Vitamin C and related compounds are often added to foods to inhibit this conversion. Diets high in fruits and vegetables that contain vitamin C and phytochemicals, such as phenols, retard the conversion of nitrates to nitrosamines. Nitrates in foods are not a significant cause of cancer among Americans.

OLESTRA

What is olestra and is it related to cancer? Some synthetic fat substitutes are not absorbed by the body. Although several fat substitutes are under development for use in the food supply, only one of this type—olestra (trademarked Olean)—has been approved for marketing. Olestra may reduce fat intake, but it also reduces the absorption of fat-soluble carotenones and other potentially cancer-protective phytochemicals in fruits and vegetables. Although reducing absorption of these substances might also reduce the health benefits of fruits and vegetables, the overall effect of this type of fat substitute on cancer risk is unknown at present.

OLIVE OIL

Does olive oil affect cancer risk? Olive oil, like all fats, is high in calories, but its fat is mostly monounsaturated. Consumption of olive oil is not associated with any increase in risk of cancer, and most likely is neutral with respect to cancer risk.

PESTICIDES AND HERBICIDES

Do pesticides and herbicides on fruits and vegetables cause cancer? Pesticides and herbicides can be toxic when used in high doses. Although fruits and vegetables sometimes contain low levels of these chemicals, overwhelming scientific evidence supports the overall health benefits and cancer-protective effects of eating fruits and vegetables. In contrast, current evidence is insufficient to link pesticides in foods with an increased risk of any cancer.

PHYTOCHEMICALS

What are phytochemicals, and do they reduce cancer risk? The term “phytochemicals” refers to a wide variety of compounds produced by plants. Some of these compounds protect plants against insects or have other biologically important functions. Some have either antioxidant or hormone-like actions both in plants and in people who eat them. Because consumption of fruits and vegetables reduces cancer risk, re-

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**Nutrients and nutritional factors in the diet can protect DNA from being damaged and can delay or prevent the development of cancer.**
searchers are searching for specific com-

ounds in these foods that might ac-

count for the beneficial effects. There is

no evidence that taking phytochemical

supplements is as beneficial as consum-

ing the fruits, vegetables, beans, and

grains from which they are extracted.

SALT

Do high levels of salt in the diet increase cancer risk? Some evidence links diets containing large amounts of foods pre-

erved by salting and pickling with an in-

creased risk of cancers of the stomach,

nose, and throat. Little evidence suggests

that moderate amounts of salt or salt-pre-

served foods in the diet affect cancer risk.

SELENIUM

What is selenium and can it reduce cancer risk? Selenium is a mineral needed by the body as part of antioxidant defense mech-

anisms. Animal studies suggest that sele-

nium protects against cancer, but human

studies are inconclusive. Selenium sup-

plements are not recommended, as there

is only a narrow margin between safe and

toxic doses. Grain products are good

sources of selenium.

SOYBEANS

Can soybeans reduce cancer risk? Soy-

beans are an excellent source of protein

and a good alternative to meat. Nonfer-

mented soybeans have high levels of phy-

toestrogens and other phytochemicals

that appear to have beneficial effects on

hormone-dependent cancers in animal

studies. These effects remain to be

proven in humans, however.

SUPPLEMENTS

Can nutritional supplements lower cancer risk? Strong evidence associates a diet rich in fruits, vegetables, and other plant foods with reduced risk of cancer,

but there is no evidence at this time that supplements can reduce cancer risk. The few studies in human populations that have attempted to determine whether supplements can reduce cancer risk have yielded disappointing results. Vitamin and mineral supplements have been shown to reduce the risk of stomach can-

cer in one intervention study in China, but other studies using high doses of single nutrients have shown no benefit and even unexpected evidence for harm (see Beta Carotene). Although supplements
do not substitute for healthful diets in re-

ducing cancer risk, it is possible that some people, such as pregnant women, women of childbearing age, and people with restricted dietary intakes, might benefit from taking moderate doses of vitamin and mineral supplements for other reasons.

TEA

Can drinking tea reduce cancer risk? Some researchers have proposed that tea, especially green tea, might protect against cancer because of its content of antioxi-

dants (see Antioxidants). In animal stud-

ies, some teas have been shown to reduce cancer risk, but beneficial effects of tea on cancer risk in people are not yet proven.

VITAMIN A

Does vitamin A lower cancer risks? Vita-

min A (retinol) is obtained from foods in two ways: as preformed from animal food sources and as derived from beta caro-
tene found in plant foods. Vitamin A is

needed to maintain healthy tissues. Vita-

min A supplements have not been shown
to lower cancer risk, however. If supple-

ments are taken, they should remain

within recommended levels, as high doses of preformed vitamin A can be harmful, especially to pregnant women. Because the body does not convert beta carotene to vitamin A when vitamin A levels are within normal ranges, eating fruits and
vegetables containing beta carotene cannot lead to vitamin A toxicity.

**Vitamin C**

**Does vitamin C lower cancer risk?** Vitamin C is found in many fruits and vegetables. Many studies have linked consumption of vitamin C-rich foods with a reduced risk of cancer. The few studies in which vitamin C has been given as a supplement, however, have not shown a reduced risk of cancer.49,50

**Vitamin E**

**Does vitamin E lower cancer risk?** Vitamin E may lower the risk for coronary heart disease. Vitamin E supplements, however, have not been shown to reduce cancer risks.18,50

**American Cancer Society Commitment to Nutrition and Cancer Prevention**

The American Cancer Society has a long-standing commitment to nutrition research. The Society recognizes that many important questions about diet, nutrition, and cancer risk remain unanswered. The Society, therefore, continues to support nutrition research in two ways: by conducting its own research and by funding outstanding research projects throughout the country. Staff scientists of the Society are conducting epidemiologic research in which they analyze and interpret data related to cancer deaths and lifestyle among a population of more than one million people. In addition, scientists from throughout the United States apply for research grants for their own investigations. The Society reviews these applications rigorously, and awards funding to only the most meritorious proposals. Studies supported by the Society on the effects of diet, nutrition, and exercise on cancer risk have been made possible by the efforts of nearly 100,000 volunteers and the financial contributions of millions of Americans.

The American Cancer Society periodically reviews the scientific evidence relating dietary practices to cancer risk and revises dietary guidelines based on this information. The Society uses its dietary guidelines to advise the public about issues related to nutrition and cancer, to develop education programs and interventions to improve nutrition, and to influence legislative and regulatory issues that support cancer prevention. The Society first issued provisional nutrition guidelines in 198451 and then published new guidelines in 1991.1 Also in 1991, the Society endorsed the 1990 federal Dietary Guidelines for Americans,52 and designated nutrition as a high priority for the Society.

To update the 1991 guidelines, the Society commissioned a national panel of experts in cancer research, prevention, epidemiology, public health, and policy to provide advice about dietary guidelines for cancer prevention. Members of the 1996 advisory committee met in Atlanta from March 11-13, 1996, to review previous American Cancer Society guidelines in the context of recent research studies and in light of the recently revised US Dietary Guidelines.7 During that meeting, members of the committee achieved consensus on recommendations for new guidelines. This report reflects that consensus. The committee agreed that the Society should continue to support an ongoing program of research that addresses biological, clinical, epidemiologic, behavioral, and policy studies on the role of nutrition in cancer prevention. The committee also agreed that greater efforts of individuals in public and private agencies are needed to carry these recommendations into effective action to reduce the burden of cancer among Americans.
Appendix

Members of the American Cancer Society 1996 Advisory Committee on Diet, Nutrition, and Cancer Prevention:
Marion Nestle, PhD, MPH (Chair),* Professor and Chair, Department of Nutrition and Food Studies, New York University, New York, New York; Dileep G. Bal, MD, MS, MPH, Chief, Chronic Disease Control Branch, California Department of Health Services, Sacramento, California; Diane F. Birt, PhD, Professor, Eppley Institute for Research in Cancer, University of Nebraska Medical Center, Omaha, Nebraska; Gladys Block, PhD, Professor, Department of Nutrition, University of California, Berkeley, School of Public Health, Berkeley, California; Tim Byers, MD, MPH,* Professor, Department of Preventive Medicine and Biometrics, University of Colorado Health Science Center, Denver, Colorado; Susan Foerster, MPH, RD, Chief, Nutrition and Cancer Prevention Program, California Department of Health Services, Sacramento, California; Peter Greenwald, MD, DrPH, Director, Division of Cancer Prevention and Control, National Cancer Institute, Bethesda, Maryland; Ervin J. Hawrylewich, PhD, Director, Division of Research, Mercy Hospital and Medical Center, Chicago, Illinois; Brian E. Henderson, MD, Professor, Department of Preventive Medicine, Norris Comprehensive Cancer Center, University of Southern California, Los Angeles, California; David Hunter, ScD, Associate Professor of Epidemiology, Channing Laboratory, Harvard Medical School, Boston, Massachusetts; Lenore A. Kohlmeier, PhD, Professor, Departments of Epidemiology and Nutrition, University of North Carolina, Chapel Hill, North Carolina; David Kritchevsky, PhD, Caspar Wistar Scholar/Professor, The Wistar Institute of Anatomy and Biology, Philadelphia, Pennsylvania; Shiriki K. Kumanyika, PhD, MPH, RD, Professor and Head, Department of Human Nutrition and Dietetics, The University of Illinois at Chicago, Chicago, Illinois; Lawrence Kushi, ScD, Associate Professor, Division of Epidemiology School of Public Health, University of Minnesota, Minneapolis, Minnesota; Bonnie F. Liebman, MS, Director of Nutrition, Center for Science in the Public Interest, Washington, DC; Robert Russell, MD, Associate Director, USDA-Human Nutrition Research Center on Aging, Tufts University, Boston, Massachusetts; Henry Thompson, PhD, Director, Division of Laboratory Research, AMC Cancer Research Center, Denver, Colorado; David F. Williamson, PhD, MS, Acting Director, Diabetes Division, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia. American Cancer Society Staff Participants: Lynne Camoosa, Manager, Medical/Scientific Communications; Steve Dickinson, National Vice President, Public Relations; Nancy Hailpern, Manager, Grassroots Development; Clark Heath, MD,* Vice President, Epidemiology/Surveillance; Roberta Moss, MPH, Director, Program Development and Application; Mary C. O’Connell, Director, Prevention/Nutrition; Billie Parker, Staff Assistant; Amy Stone, Scientific and Medical Communications; Michael Thun, MD,* Director, Analytic Epidemiology, Allen Vegotsky, PhD, Scientific Program Director.

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