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### **American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention: Reducing the Risk of Cancer with Healthy Food Choices and Physical Activity**

Tim Byers, Marion Nestle, Anne McTiernan, Colleen Doyle, Alexis Currie-Williams, Ted Gansler and Michael Thun  
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# American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention: Reducing the Risk of Cancer with Healthy Food Choices and Physical Activity

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**ABSTRACT** The American Cancer Society (ACS) has set aggressive challenge goals for the nation to decrease cancer incidence and mortality—and to improve the quality of life of cancer survivors—by the year 2015.

To address these critical goals, the ACS publishes the *Nutrition and Physical Activity Guidelines* to serve as a foundation for its communication, policy, and community strategies and ultimately, to affect dietary and physical activity patterns among Americans.

These guidelines, published every five years, are developed by a national panel of experts in cancer research, prevention, epidemiology, public health, and policy, and as such, they represent the most current scientific evidence related to dietary and activity patterns and cancer risk.

The American Cancer Society guidelines include recommendations for individual choices regarding diet and physical activity patterns, but those choices occur within a community context that either facilitates or interferes with healthy behaviors. Therefore, this committee presents one key recommendation for community action to accompany the four recommendations for individual choices for nutrition and physical activity to reduce cancer risk. This recommendation for community action underscores just how important community measures are to the support of healthy behaviors by means of increasing access to healthful food choices and opportunities to be physically active.

The ACS guidelines are consistent with guidelines from the American Heart Association for the prevention of coronary heart disease as well as for general health promotion, as defined by the Department of Health and Human Services' 2000 Dietary Guidelines for Americans.<sup>1,2</sup> (*CA Cancer J Clin* 2002;52:92-119.)

\*See pages 104 and 105.

## INTRODUCTION

**The Importance of Diet and Physical Activity in Cancer Prevention**

For the great majority of Americans who do not smoke cigarettes, dietary choices and physical activity are the most important modifiable determinants of cancer risk.<sup>3</sup> Evidence suggests that one third of the more than 500,000 cancer deaths that occur in the United States each year can be attributed to diet and physical activity habits, with another third due to cigarette smoking. Although genetic inheritance influences the risk of cancer, and cancer arises from genetic mutations in cells, most of the variation in cancer risk across populations and among individuals is due to factors that are *not* inherited. Behavioral factors such as smoking cigarettes, consuming foods along certain patterns of diet, and staying active across the lifespan can substantially affect one's risk of developing cancer.<sup>4,5,6</sup> Because healthful individual behaviors are most effectively enabled by social and environmental support within communities, these 2001 guidelines include, for the first time, an explicit recommendation for community action.

## OVERVIEW OF THE GUIDELINES

The American Cancer Society publishes nutrition and physical activity guidelines to advise health care professionals and the general public about dietary and other lifestyle practices that reduce cancer risk.<sup>7</sup> These guidelines, updated in 2001 by the American Cancer Society Nutrition and Physical Activity Guidelines Advisory Committee, are based on existing scientific evidence that relates diet and physical activity to cancer risk in human population studies as well as in laboratory experiments.

These guidelines reflect the current state of the scientific evidence. For many issues, the evidence is not definitive either because studies are not yet available, or current findings are inconsistent. Although the randomized, controlled trial is often considered the gold standard for scientific conclusions, such evidence is not presently available—and may never become available—for many dietary factors associated with cancer risk. Inferences about the many complex interrelationships among diet, physical activity, and cancer risk are based, for the most part, on observational studies coupled with advancing understanding of the biology of cancer. The relative strength of current scientific evidence linking major components of diet to common cancer sites is summarized later in Table 5. In considering the totality of evidence from a variety of sources, these guidelines take into consideration both the benefits to cancer risk reduction and overall health benefits. Although no diet can guarantee full protection against any disease, these guidelines offer the best information currently available about how diet and physical activity can reduce the risk of cancer. The ACS guidelines are consistent with guidelines from the American Heart Association for the prevention of coronary heart disease as well as for general health promotion, as defined by the Department of Health and Human Services' 2000 Dietary Guidelines for Americans.<sup>1,2</sup>

The American Cancer Society guidelines include recommendations for individual choices regarding diet and physical activity patterns, but those choices occur within a community context that either facilitates or interferes with healthy behaviors. Therefore, this committee presents one key recommendation for community action to accompany the four recommendations for individual choices for nutrition and physical activity to reduce cancer risk (Table 1). This recommendation for community action underscores the importance of community

TABLE 1

American Cancer Society (ACS) Guidelines on Nutrition and Physical Activity for Cancer Prevention	
<b>ACS Recommendations for Individual Choices</b>	
1. Eat a variety of healthful foods, with an emphasis on plant sources.	<ul style="list-style-type: none"> <li>• Eat five or more servings of a variety of vegetables and fruits each day.</li> <li>• Choose whole grains in preference to processed (refined) grains and sugars.</li> <li>• Limit consumption of red meats, especially those high in fat and processed.</li> <li>• Choose foods that help maintain a healthful weight.</li> </ul>
2. Adopt a physically active lifestyle.	<ul style="list-style-type: none"> <li>• Adults: engage in at least moderate activity for 30 minutes or more on five or more days of the week; 45 minutes or more of moderate-to-vigorous activity on five or more days per week may further enhance reductions in the risk of breast and colon cancer.</li> <li>• Children and adolescents: engage in at least 60 minutes per day of moderate-to-vigorous physical activity at least five days per week.</li> </ul>
3. Maintain a healthful weight throughout life.	<ul style="list-style-type: none"> <li>• Balance caloric intake with physical activity.</li> <li>• Lose weight if currently overweight or obese.</li> </ul>
4. If you drink alcoholic beverages, limit consumption.	
<b>ACS Recommendation for Community Action</b>	
Public, private, and community organizations should work to create social and physical environments that support the adoption and maintenance of healthful nutrition and physical activity behaviors.	
<ul style="list-style-type: none"> <li>• Increase access to healthful foods in schools, worksites, and communities.</li> <li>• Provide safe, enjoyable, and accessible environments for physical activity in schools, and for transportation and recreation in communities.</li> </ul>	

measures to support healthy behaviors by increasing access to healthful food choices and opportunities to be physically active.

AMERICAN CANCER SOCIETY GUIDELINES FOR NUTRITION AND PHYSICAL ACTIVITY

**Recommendation for Community Action**

Social, economic, and cultural factors strongly influence individual choices about diet and physical activity. While most Americans would like to adopt a healthful lifestyle, many encounter substantial barriers

that make it difficult to follow diet and activity guidelines. Indeed, current trends toward increasing consumption of high-calorie convenience foods and restaurant meals, and declining levels of physical activity are contributing to an alarming epidemic of obesity among Americans of all ages and across all population segments.<sup>2</sup> Longer workdays and more households with multiple wage earners reduce the amount of time available for preparation of meals, with a resulting shift toward increased consumption of food outside the home—often processed foods, fast foods, and snack foods. Reduced leisure time, increased reliance on automobiles for

transportation, and increased availability of electronic entertainment and communications media all contribute to a less active and increasingly sedentary lifestyle. These trends are of particular concern, especially with regard to the adverse effects they have on the long-term health of children, who are establishing lifetime patterns of diet and physical activity, as well as on the poor, who live in communities with less access to safe and healthful lifestyle options.

Facilitating improved diet and increased physical activity patterns will require multiple strategies, ranging from the implementation of community and work-site health promotion programs to policies that affect community planning, transportation, school-based physical education, and food services. Particular efforts will be needed to ensure that all population groups have access to healthful food choices and opportunities for physical activity. Both public and private organizations at the local, state, and national levels will have to develop new policies and will need to raise or reallocate resources to facilitate needed changes. Health care professionals, who can be especially persuasive on matters of lifestyle change, can provide leadership in promoting policy changes in their communities.

The decline in cigarette use by adults provides a useful analogy for the power of social context in changing health behaviors. Adult-per-capita cigarette consumption began a sustained decline after the 1964 Surgeon General's Report, which publicized the health hazards of smoking.<sup>6</sup> From that time on, other community-wide social and political factors have become increasingly important in reducing smoking. These include public policy changes regulating cigarette advertising, restricting minors' access to tobacco products, increasing taxation of tobacco products, and addressing concerns about rights of nonsmokers, and exposure to second-hand smoke. Establishing healthful patterns of diet and physical activity will require similar purposeful changes in

individual lifestyle choices and in public policy. Public, private, and community organizations should strive to create social and physical environments that support the adoption and maintenance of healthful dietary and physical activity behavior patterns.

#### Recommendations for Individual Choices

There is strong scientific evidence that healthful dietary patterns, in combination with regular physical activity, can reduce cancer risk.<sup>4,5</sup> Approximately 35 percent of cancer deaths in the United States may be avoidable through dietary modification.<sup>8,9,10,11</sup> The scientific study of nutrition and cancer is highly complex, and many important questions remain unanswered. It is not presently clear how single nutrients, combinations of nutrients, overnutrition and energy imbalance, or the amount and distribution of body fat at particular stages of life affect one's risk of specific cancers. However, epidemiological studies have shown that populations whose diets are high in vegetables and fruits and low in animal fat, meat, and/or calories have a reduced risk of some of the most common types of cancer. Until more is known about the specific components of diet that influence cancer risk, the best advice is to emphasize whole foods and certain broad dietary patterns, as described within these guidelines.

#### 1. Eat a variety of healthful foods, with an emphasis on plant sources.

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

- Include vegetables and fruits at every meal and for snacks.
- Eat a variety of vegetables and fruits.
- Limit French fries, snack chips, and other fried vegetable products.
- Choose 100% juice if you drink fruit or vegetable juices.

Choose whole grains in preference to processed (refined) grains and sugars.

- Choose whole grain rice, bread, pasta, and cereals.
- Limit consumption of refined carbohydrates, including pastries, sweetened cereals, soft drinks, and sugars.

Limit consumption of red meats, especially those high in fat and processed.

- Choose fish, poultry, or beans as an alternative to beef, pork, and lamb.
- When you eat meat, select lean cuts and have smaller portions.
- Prepare meat by baking, broiling, or poaching rather than by frying or charbroiling.

Choose foods that help you maintain a healthful weight.

- When you eat away from home, choose foods that are low in fat, calories, and sugar, and avoid large portion sizes.
- Eat smaller portions of high-calorie foods. Be aware that “low-fat” or “nonfat” does not mean “low-calorie,” and that low-fat cakes, cookies, and similar foods are often high in calories.
- Substitute vegetables, fruits, and other low-calorie foods for calorie-dense foods such as French fries, cheeseburgers, pizza, ice cream, doughnuts, and other sweets.

#### *Beneficial Effects of Vegetables and Fruits*

Greater consumption of vegetables, fruits, or both together has been associated in the majority of epidemiological studies with a lower risk of lung, oral, esophageal, stomach, and colon cancer. Evidence is less strong for cancers considered hormonal, such as breast and prostate. Diet can be an important factor even in cancers caused, in large part, by other factors. For instance, many studies have found a

lower risk of lung cancer among those who eat more vegetables and/or fruits in their diet.<sup>12,13,14,15</sup> Although the major factor that causes lung cancer is tobacco smoking, diet also modifies risk, both in smokers and in lifelong nonsmokers.

Evidence that vegetable and fruit consumption reduces cancer risk has led to attempts to isolate specific nutrients and to administer these in pharmacological doses to high-risk populations. Most of these attempts have been unsuccessful in preventing cancer or its precursor lesions, and in some cases, have had adverse effects. Notable examples are the three randomized trials of beta-carotene for the prevention of lung cancer, initiated because of many observational epidemiological studies indicating lower risk of lung cancer in persons eating foods high in beta-carotene. Two of the clinical trials showed that smokers taking high-dose beta-carotene supplements developed lung cancer at higher rates than those taking a placebo,<sup>14,15</sup> while a third study showed no effect.<sup>16</sup> These findings support the idea that beta-carotene may be only a proxy for other single nutrients or combinations of nutrients found in whole foods, and that taking a single nutrient in large amounts may be harmful.

It is presently unclear which components of vegetables and fruits are most protective against cancer.<sup>17</sup> Vegetables and fruits are complex foods, each containing more than 100 potentially beneficial vitamins, minerals, fiber, and other substances that may help to prevent cancer. Vegetables and fruits also contain specific phytochemicals, such as carotenoids, flavonoids, terpenes, sterols, indoles, and phenols that show benefit against certain cancers in experimental studies. There is ongoing research, for example, on the potential benefits of green and dark yellow vegetables, plants related to the cabbage family, soy products, legumes, allium (onion and garlic), and tomato products. Until more is known

about specific food components, the best advice is to eat five or more servings of a variety of vegetables and fruits in their various forms: fresh, frozen, canned, dried, and juiced.

Despite recommendations from numerous health agencies to eat at least five servings of vegetables and fruits each day, intake of these foods remains low among adults and children.<sup>18,19</sup> Concern about low-intake levels has led to a nationwide initiative—the *National 5 A Day for Better Health* program—to help insure that vegetables and fruits are available and accessible to all population groups, and to increase vegetable and fruit consumption to five or more servings per day.<sup>20</sup>

#### Whole Grains

Grains such as wheat, rice, oats, and barley, and the foods made from them, constitute the basis of a healthful diet. Whole grains are an important source of many vitamins and minerals that have been associated with lower risk of colon cancer, such as folate, vitamin E, and selenium.<sup>21</sup> Whole grains are higher in fiber, certain vitamins, and minerals than processed (refined) flour products. Although the association between fiber and cancer risk is inconclusive,<sup>22,23</sup> consumption of high-fiber foods is still recommended. Since the benefits grain foods impart may derive from their other nutrients as well as from fiber, it is best to obtain fiber from whole grains—and vegetables and fruits—rather than from fiber supplements. As shown in Table 2, standard portion sizes are quite small.

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<sup>24</sup> and can be a useful low-fat, high-protein, alternative to meat.

TABLE 2

What Counts as a Serving?
<p>Fruits</p> <ul style="list-style-type: none"> <li>• 1 medium apple, banana, or orange</li> <li>• 1/2 cup of chopped, cooked, or canned fruit</li> <li>• 3/4 cup of 100% fruit juice</li> </ul>
<p>Vegetables</p> <ul style="list-style-type: none"> <li>• 1 cup of raw, leafy vegetables</li> <li>• 1/2 cup of other cooked or raw vegetables, chopped</li> <li>• 3/4 cup of 100% vegetable juice</li> </ul>
<p>Grains</p> <ul style="list-style-type: none"> <li>• 1 slice of bread</li> <li>• 1 ounce of ready-to-eat cereal</li> <li>• 1/2 cup of cooked cereal, rice, or pasta</li> </ul>
<p>Beans and nuts</p> <ul style="list-style-type: none"> <li>• 1/2 cup of cooked dry beans</li> <li>• 2 tablespoons of peanut butter</li> <li>• 1/3 cup nuts</li> </ul>
<p>Dairy foods and eggs</p> <ul style="list-style-type: none"> <li>• 1 cup of milk or yogurt</li> <li>• 1 1/2 ounces of natural cheese</li> <li>• 2 ounces of processed cheese</li> <li>• 1 egg</li> </ul>
<p>Meats</p> <ul style="list-style-type: none"> <li>• 2-3 ounces of cooked, lean meat, poultry, or fish</li> </ul>

Source: US Department of Agriculture and US Department of Health and Human Services. Nutrition and Your Health: Dietary Guidelines for Americans, 4th ed. Home and Garden Bull 232. Washington, DC: Government Printing Office, 1995.

#### Dietary Fat and Consumption of Red Meat

High-fat diets have been associated with an increase in the risk of cancers of the colon and rectum, prostate, and endometrium. The association between high-fat diets and breast cancer is much weaker. Research continues to examine whether the association between high-fat diets and various cancers in some epidemiological studies is due to the total amount of fat, the particular type of fat

(saturated, monounsaturated, or polyunsaturated), the calories contributed by fat, or some other factor associated with high-fat foods. Fats such as the saturated fat in red meats, omega-3 fatty acids in fish oils, or monounsaturated fats in olive oil, for example, likely differ in their effects on cancer risk. The relationship between specific types of fat and certain cancers is an important area of current research.<sup>25</sup>

Because a gram of fat contains more than twice the calories of a gram of protein or carbohydrates (9 versus 4 kcal/gram), studies cannot easily distinguish the effects of fat itself from the effects of the calories it contains. In addition, dietary fat consumption is also correlated with greater consumption of meat and calories; lower consumption of vegetables, fruits, and grains; and higher body weight, so that it may be difficult to disentangle the separate contribution of fats to cancer risk.

Foods from animal sources remain major contributors of total fat, saturated fat, and cholesterol in the American diet.<sup>26</sup> Although meats are good sources of high-quality protein and can supply many important vitamins and minerals, consumption of meat—especially red meats (beef, pork, lamb)—has been associated with cancers in many studies, most notably those of the colon and prostate.<sup>27</sup> How much of this association is due to specific constituents within meat (such as saturated fats) or to correlated dietary factors is presently unclear.<sup>28,29,30</sup> For example, mutagenic compounds, such as heterocyclic amines, are produced when protein is cooked at a high temperature, and may contribute to the association between meat and colon cancer.

Much evidence indicates that saturated fat may be particularly important in increasing risk of 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-based 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 meat, rather than frying, reduces its overall fat content. Meat should be cooked thoroughly to destroy harmful bacteria and parasites, but should not be charred.

#### *Choosing Foods that Help Maintain a Healthful Body Weight*

Most people cannot maintain a healthful body weight without limiting caloric intake while maintaining regular physical activity. Current trends indicate that the largest percentage of calories in the American diet comes from foods high in fat, sugar, and refined carbohydrates. Consuming a varied diet that emphasizes plant-based foods may help to displace these calorie-dense foods. Limiting portion sizes, especially of these types of foods, is another important strategy to reduce total caloric intake.

Replacing dietary fat with foods that are high in calories from sugar and other refined carbohydrates does not protect against obesity. The decrease in fat intake and increase in consumption of refined carbohydrates that occurred in the United States between 1977 and 1995 coincided with an 8% increase in the prevalence of obesity.<sup>31,32</sup> Excessive intake of sugar and other highly-refined carbohydrates may contribute to insulin insensitivity, alterations in the amount and distribution of body fat, and increased concentrations of growth factors that may promote the growth of cancers.

## 2. Adopt a physically active lifestyle.

- Adults: engage in at least moderate activity for 30 minutes or more on five or more days of the week; 45 minutes or more of moderate-to-vigorous activity on five or more days per week may further enhance reductions in the risk of breast and colon cancer.
- Children and adolescents: engage in at least 60 minutes per day of moderate-to-vigorous physical activity for at least five days per week.

### *Benefits of Physical Activity*

Scientific evidence indicates that physical activity may reduce the risk of several types of cancer, including cancers of the breast and colon, and can provide other important health benefits.<sup>33,34</sup> Physical activity acts in a variety of ways to impact cancer risk. Regular physical activity helps maintain a healthful body weight by balancing caloric intake with energy expenditure.<sup>35</sup> Other mechanisms by which physical activity may help to prevent certain cancers may involve both direct and indirect effects. For colon cancer, physical activity accelerates the movement of food through the intestine, thereby reducing the length of time that the bowel lining is exposed to mutagens.<sup>36</sup> For breast cancer, vigorous physical activity may decrease the exposure of breast tissue to circulating estrogen.<sup>36</sup> Physical activity may also affect cancers of the colon, breast, and other sites by improving energy metabolism and reducing circulating concentrations of insulin and related growth factors. Physical activity helps to prevent adult-onset diabetes, which has been associated with increased risk of cancers of the colon, pancreas, and possibly other sites.<sup>37,38,39,40</sup> The benefits of physical activity go far beyond reducing the risk of cancer,

TABLE 3

Examples of Moderate and Vigorous Intensity Physical Activities		
	Moderate Intensity Activities	Vigorous Intensity Activities
<b>Exercise and Leisure</b>	Walking, dancing, leisurely bicycling, ice skating, roller skating, horseback riding, canoeing, yoga	Jogging or running, fast bicycling, circuit weight training, aerobic dance, martial arts, jumping rope, swimming
<b>Sports</b>	Volleyball, golfing, softball, baseball, badminton, doubles tennis, downhill skiing	Soccer, field or ice hockey, lacrosse, singles tennis, racquetball, basketball, cross-country skiing
<b>Home Activities</b>	Mowing the lawn, general lawn and garden maintenance	Digging, carrying and hauling, masonry, carpentry
<b>Occupational Activities</b>	Walking and lifting as part of the job (custodial work, farming, auto or machine repair)	Heavy manual labor (forestry, construction work, fire fighting)

however, and include reducing the risk of other chronic diseases, such as heart disease, diabetes, osteoporosis, and hypertension.

### *Recommended Amount of Activity*

There are many unanswered questions about the optimal intensity, duration, and frequency of physical activity needed to reduce cancer risk. However, current evidence suggests that there is substantial risk reduction for colon cancer from simply not being sedentary. And by participating in moderate-to-vigorous physical activity at least 45 minutes on five or more days of the week, individuals may achieve optimal activity levels needed to reduce the risk of developing both breast and colon cancers, as well as several other types of cancer, including kidney, endometrial, and esophageal cancer.<sup>30,41,42,43,44</sup> Moderate-to-vigorous physical activity is needed to metabolize stored body fat and to modify physiological functions that affect insulin, estrogen, androgen, prostaglandins, and immune function.<sup>5,45,46</sup> This recommendation to include physical activity in one's lifestyle to reduce cancer risk is supported by a recent

TABLE 4

Suggested Ways to Reduce Sedentary Behavior
Use stairs rather than an elevator.
If you can, walk or bike to your destination.
Exercise at lunch with your co-workers, family, or friends.
Take a 10-minute exercise break at work to stretch or take a quick walk.
Walk to visit co-workers instead of sending an e-mail message.
Go dancing with your spouse or friends.
Plan active vacations rather than only driving trips.
Wear a pedometer every day and watch your daily steps increase.
Join a sports team.
Use a stationary bicycle while watching TV.
Plan your exercise routine to gradually increase the days per week and minutes per session.

extensive review by the World Health Organization.<sup>47</sup>

For people who are largely inactive or just beginning a physical activity program, a gradual increase to 30 minutes per day of moderate-to-vigorous physical activity on at least five days per week will provide substantial cardiovascular benefits and aid in weight control.<sup>48,49</sup> Those who are already active at least 30 minutes on most days of the week should strive toward accumulating 45 minutes of moderate-to-vigorous activity on most days of the week. Selected examples of moderate and vigorous activities are provided in Table 3.

Moderate activities are those that require effort equivalent to a brisk walk. Vigorous activities generally engage large muscle groups and cause an increase in heart rate, breathing depth and frequency, and sweating. These activities can be performed in a variety of settings: occupational, recreational, in the home or garden, and with friends or family.<sup>50,51</sup> While there is limited evidence regarding whether

physical activity is most protective if done in a single session or incrementally throughout the day, it is reasonable to assume that benefit can be accumulated in separate sessions of 20 to 30 minutes each.

Adopting a physically active lifestyle involves making deliberate decisions and changing lifestyle behaviors in order to select active rather than sedentary behavior. To enhance the ability of individuals to adopt a more active lifestyle, communities as well as individuals need to implement changes. Ideas to reduce sedentary behavior are suggested in Table 4.

People who are less active than recommended by these guidelines should gradually increase the intensity, duration, and frequency of physical activity. Most children and young adults can safely engage in moderate physical activity without consulting their physicians. However, men over 40, women over 50, and people with chronic illnesses and/or established cardiovascular risk factors should consult their physicians before beginning a vigorous physical activity program. Stretching and warm-up periods should be part of each exercise session to reduce risk of musculoskeletal injuries. More detailed information on exercise safety can be found in the Surgeon General's Report on Physical Activity and Health.<sup>52</sup>

Because one of the best predictors of adult physical activity is activity levels during childhood and adolescence, and because of the critical role physical activity plays in weight maintenance, children and adolescents should be encouraged to be physically active at moderate-to-vigorous intensities for at least 60 minutes per day on five or more days per week.<sup>53,53a</sup> Such activities should include sports and fitness activities at school and at home. To help achieve activity goals, daily physical education programs and activity breaks should be provided for children at school, and

television viewing and computer game time should be minimized at home.

The health benefits of physical activity in preventing cancer and other chronic diseases are thought to accumulate over the course of a lifetime<sup>5</sup> and are facilitated by the development of healthy activity patterns in childhood. However, increasing the level of physical activity at any age can provide important health benefits. Although it is uncertain at the present time whether increasing physical activity among the elderly will reduce cancer risk, many other health benefits can be achieved by an appropriate exercise regimen, even among the elderly.<sup>54</sup>

### 3. Maintain a healthful weight throughout life.

- Balance caloric intake with physical activity.
- Lose weight if currently overweight or obese.

#### *Balancing Energy Intake and Expenditure*

Overweight and obesity are associated with increased risk for cancers at several sites: breast (among postmenopausal women), colon, endometrium, adenocarcinoma of the esophagus, gallbladder, pancreas, and kidney. These findings are supported both by animal studies and by epidemiological studies.<sup>30,40,41,55,56,57,58,59,60</sup>

The Body Mass Index (BMI) is an expression of weight-for-height calculated as body weight in kilograms divided by height in meters, squared.<sup>61</sup> Exact cut-offs for BMI levels at elevated risk are difficult to define, since epidemiological studies have used different cutpoints in calculating cancer risks associated with body weight. However, experts consider a BMI within the range of 18.5 to 25.0 kg/m<sup>2</sup> to be healthful, a BMI between 25.0 and 29.9 to be overweight, and a BMI of 30.0 and over to be obese (Figure 1). Individuals should

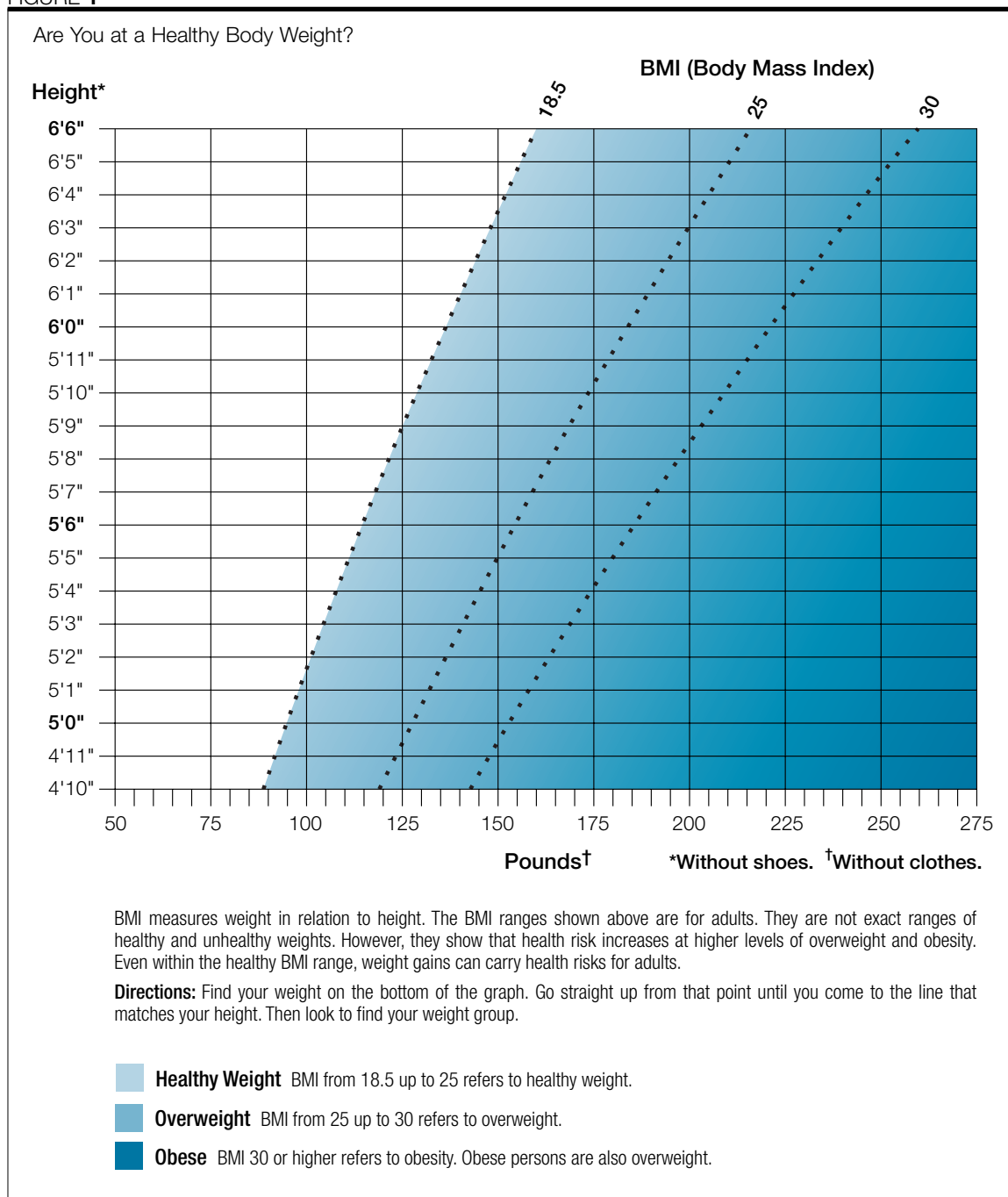
strive to maintain a BMI between 18.5 and 25.0 kg/m<sup>2</sup>.

The best way to achieve a healthful body weight is to balance energy intake (food intake) with energy expenditure (physical activity). Excess body fat can be reduced by restricting caloric intake and increasing physical activity. Caloric intake can be reduced by decreasing the size of food portions and limiting the intake of calorie-dense foods high in fat and refined sugars (e.g., fried foods, cookies, cakes, candy, ice cream, and soft drinks). Such foods should be replaced with foods like vegetables and fruits, whole grains, and beans. People should be aware that meals served in restaurants typically exceed the portion sizes needed to meet recommended daily caloric intake. Physical activity as well as diet is essential for maintenance of a healthful weight (see *Recommendations for Individual Choices*, recommendation number two, page 99).

As yet, no studies have convincingly demonstrated that losing weight reduces the risk of cancer, although there are biologically plausible mechanisms to suggest that weight loss might be beneficial. Overweight or obese individuals who intentionally lose weight have reduced levels of circulating glucose, insulin, and bioavailable estrogens and androgens. The health effects of intentional weight loss are difficult to evaluate, because people who manage to lose weight may do so because of unrecognized illness. Weight loss that results from an underlying illness or from smoking does not benefit one's health. Even though our knowledge about the relationship between weight loss and cancer risk is incomplete, individuals who are overweight and obese should be encouraged and supported in their efforts to reduce weight. Obesity is a major risk factor not only for cancer, but also for diabetes, stroke, and coronary heart disease.

Because overweight in youth tends to

FIGURE 1



Source: Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2000, page 3. 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.

continue throughout life, the increasing prevalence of overweight and obesity in pre-adolescents and adolescents may increase the incidence of cancer in the future. For these reasons, efforts to establish healthful weight, physical activity habits, and patterns of weight gain should begin in childhood.

#### 4. If you drink alcoholic beverages, limit consumption.

People who drink alcohol should limit their intake to no more than two drinks per day for men and one drink a day for women.<sup>2</sup> The recommended limit is lower for women because of their smaller body size and slower metabolism of alcohol. A drink of alcohol is defined as 12 ounces of beer, five ounces of wine, or 1.5 ounces of 80-proof distilled spirits. Alcohol consumption is an established cause of cancers of the mouth, pharynx, larynx, esophagus, liver, and breast.<sup>62,63</sup> Alcohol consumption may also be related to increased risk of colon cancer. For each of these cancers, risk increases substantially with intake of more than two drinks per day. Alcohol consumption combined with tobacco increases the risk of cancers of the mouth, larynx, and esophagus far more than the independent effect of either drinking or smoking. Furthermore, regular consumption of even a few drinks per week has been associated with an increased risk of breast cancer in women. The mechanism by which alcohol is related to breast cancer is not known with certainty, but may be due to alcohol-induced increases in circulating estrogens or other hormones in the blood, reduction of folic acid levels, or to a direct effect of alcohol or its metabolites on breast tissue.<sup>64</sup> Reducing alcohol consumption may be an important way for many women to reduce their risk of breast cancer. Some studies suggest that consuming the recommended amount of the vitamin folic acid can minimize the increased risk of breast cancer from

alcohol, but this relationship has not been firmly established.<sup>4</sup>

Complicating the recommendation for alcohol and cancer risk reduction is the evidence that even moderate intake of alcoholic beverages appears to decrease the risk of coronary heart disease in both men and women.<sup>65,66</sup> Even though alcohol can reduce the risk of coronary heart disease in women, those women who are at high risk of breast cancer might reasonably consider abstaining from alcohol. 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. There is no compelling reason for adults who currently do not consume alcoholic beverages to start consuming alcohol to reduce their risk for heart disease, as cardiovascular risk can be reduced by not smoking, consuming a low-saturated fat diet, avoiding obesity, staying physically active on a regular basis, and controlling blood pressure.

Some groups of people should not drink alcoholic beverages at all. These include children and adolescents; individuals of any age who cannot restrict their drinking to moderate levels; women who are or may become pregnant; individuals who plan to drive or operate machinery or who take part in other activities that require attention, skill, or coordination; and individuals taking prescriptions or over-the-counter medications that can interact with alcohol.

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#### DIET AND PHYSICAL ACTIVITY FACTORS THAT AFFECT RISKS FOR THE MOST COMMON CANCERS

While the diet and activity factors presented within the guidelines are intended to reduce overall cancer risk, certain dietary and physical activity habits affect specific cancer sites. This section summarizes the relation of diet and

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physical activity factors to particular common cancers in the United States.

**Bladder Cancer**

The major risk factors for bladder cancer are tobacco smoking and exposure to certain industrial chemicals. Limited evidence suggests that drinking more fluids may lower the risk of bladder cancer, as may eating more vegetables.<sup>67</sup>

**Brain Cancer**

There are no known nutritional risk factors for brain cancer.

**Breast Cancer**

Breast cancer is the most common cancer diagnosed among American women and is second only to lung cancer as a cause of cancer deaths in women. The risk of breast cancer is increased by several reproductive and other factors that presently cannot be easily modified: menarche before age 12, nulliparity or first birth at age greater than 30, late age at menopause, and a family history of breast cancer. Risk, however, can be reduced by changes in behavior, including limiting the use of hormone replacement therapy, avoiding obesity, staying physically active, and breast feeding.

Some studies also suggest that diets high in vegetables and fruits decrease the risk for breast cancer, although this evidence is much weaker

than for other cancer sites. Alcohol increases risk modestly, however, and increasing evidence suggests that longer duration and greater intensity of physical activity are associated with reduced risk of breast cancer. At the present time, the best nutritional advice to reduce the risk of breast cancer is to engage in vigorous physical activity at least four hours a week, avoid or limit intake of alcoholic beverages to no more than one drink per day, and minimize lifetime weight gain through the combination of caloric restriction and regular physical activity.<sup>5,34,55,60,64</sup>

**Colorectal Cancer**

Colorectal cancer is the second leading cause of cancer death among American men and women combined. Risk of colorectal cancer is increased in those with a family history of colorectal cancer. In addition to diet and physical activity, several other modifiable risk factors influence the etiology of this cancer. Risk is increased by tobacco use and possibly excessive alcohol consumption. Risk may be decreased by use of aspirin or other non-steroidal anti-inflammatory drugs and, possibly, by hormone replacement therapy. Currently, however, neither aspirin-like drugs nor postmenopausal hormones are recommended to prevent colorectal cancer because of their potential side effects. Studies demonstrate a lower risk of colon cancer among those who are moderately active on a regular basis, and increasing evidence suggests that more vigorous activity may have an even greater benefit in reducing the risk of colon cancer.<sup>33,42</sup> Physical inactivity is more consistently associated with increased risk of cancer of the colon than cancer of the rectum. Diets high in vegetables and fruits have been associated with decreased risk, and diets high in red meat have been associated with increased risk of colon cancer.<sup>25,27,28</sup> There is some evidence that folic

acid supplements may reduce the risk of colon cancer. The best nutritional advice to reduce the risk of colon cancer is to increase the intensity and duration of physical activity; eat more vegetables and fruits; limit intake of red meat; avoid obesity; and avoid excess alcohol consumption.<sup>33,40,42,43</sup> In addition, it is very important to follow the ACS guidelines for regular colorectal screening, as identifying and removing polyps in the colon can prevent colorectal cancer (see *Smith R, Cokkinides V, von Eschenbach A, et al. American Cancer Society Guidelines for the Early Detection of Cancer. CA Cancer J Clin 2002;52:8-22*).

#### Endometrial Cancer

Studies of endometrial cancer consistently find that obesity and use of hormone replacement therapy after menopause increase cancer risk. The association with overweight is thought to result from the increase in estrogen levels that occurs among postmenopausal women who are overweight. Consumption of vegetables and fruits may decrease risk of endometrial cancer. At the present time, the best advice to reduce the risk of endometrial cancer is to maintain a healthful weight through diet and regular physical activity, and eat at least five servings of vegetables and fruits each day.<sup>30</sup>

#### Kidney Cancer

Kidney cancer risk is increased among those who are overweight. The reason for this is unknown. The best nutritional advice to lower risk for kidney cancer is to avoid becoming overweight.<sup>58</sup>

#### Leukemias and Lymphomas

There are no known nutritional risk factors for leukemias or lymphomas.

#### Lung Cancer

Lung cancer is the leading cause of cancer death among Americans. More than 85 percent of lung cancers occur because of tobacco smoking. Many studies have demonstrated that the risk of lung cancer is lower among smokers and nonsmokers who consume at least five servings of vegetables and fruits a day. Although healthful eating may reduce the risk of lung cancer, the risks posed by tobacco remain substantial. Nutritional supplementation with high doses of beta-carotene and/or vitamin A has increased (not decreased) lung cancer risk among smokers (see *Beta-carotene*, page 107). At the present time, the best advice to reduce the risk of lung cancer is to avoid tobacco use or exposure, and to eat at least five servings of vegetables and fruits every day.<sup>6,13,14,15</sup>

#### Oral and Esophageal Cancers

Tobacco (including cigarettes, chewing tobacco, and snuff) and alcohol, alone, but especially when used together, increase the risk for cancers of the mouth and esophagus. Obesity increases the risk for adenocarcinoma occurring in the lower esophagus and at the junction of the esophagus and stomach, likely due to the increased acid reflux from abdominal obesity. Eating recommended

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amounts of vegetables and fruits probably reduces the risk of oral and esophageal cancers. At the present time, the best advice to reduce the risk of oral and esophageal cancers is to avoid all forms of tobacco, restrict alcohol consumption, avoid obesity, and eat at least five servings of vegetables and fruits each day.<sup>68,69,70</sup>

#### Ovarian Cancer

There are no firmly established nutritional risk factors for ovarian cancer, though vegetable and fruit consumption may lower risk.

#### Pancreatic Cancer

Pancreatic cancer is the fifth leading cause of cancer death in the United States, accounting for nearly 30,000 deaths annually. Substantial evidence indicates that tobacco smoking, adult-onset diabetes, and impaired glucose tolerance increase the risk for pancreatic cancer.<sup>39</sup> Some studies have also shown that obesity and physical inactivity (both factors strongly linked to abnormal glucose metabolism) are associated with elevated pancreatic cancer risk, and that fruit and vegetable intake is associated with reduced risk.<sup>59</sup> At the present time, the best advice to reduce the risk of pancreatic cancer is to avoid tobacco use, maintain a healthful weight, remain physically active, and eat five or more servings of vegetables and fruits each day.

#### Prostate Cancer

Prostate cancer is the most common cancer among American men. While prostate cancer is clearly related to male sex hormones, just how nutritional factors might increase risk remains uncertain. Several studies have found high consumption of red meat and dairy products to be associated with increased risk of prostate

cancer.<sup>29,71</sup> There is also evidence that a high calcium intake, primarily through supplements, is associated with increased risk for more aggressive types of prostate cancer.<sup>72</sup> Other studies suggest that diets high in certain vegetables (including tomatoes, beans, and other legumes) are associated with decreased risk. Current evidence for these associations is limited, however. The possibility that specific nutrients in foods, notably vitamin E, selenium, and lycopene, may protect against prostate cancer is under active investigation. At the present time, the best advice to reduce the risk of prostate cancer is to limit intake of animal-based products, especially red meats and high-fat dairy products; and eat five or more servings of vegetables and fruits each day.

#### Stomach Cancer

The incidence of stomach cancer continues to decrease worldwide, especially in the United States. Year-round consumption of fresh foods made possible by refrigeration, and other improvements in food preservation methods have likely helped to reduce the rate of stomach cancer, as has concomitant reduction in the prevalence of chronic stomach infections by the bacterium *Helicobacter pylori*. At the present time, the best advice to reduce the risk of stomach cancer is to eat at least five servings of vegetables and fruits daily.<sup>73</sup>

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#### COMMON QUESTIONS ABOUT DIET AND CANCER

Because people are interested in the relationship specific foods or nutrients have to specific cancers, research on dietary factors and cancer risk is often widely publicized. Health professionals who counsel patients should emphasize that no one study provides the last word on any subject, and that individual news reports may overemphasize what appear to be

contradictory or conflicting results. In brief news stories, reporters cannot always put new research findings in their proper context. The best advice about diet and physical activity is that it is rarely, if ever, advisable to change diet or activity levels based on a single study or news report, especially if the data are reported as “preliminary findings.” The following questions and answers address common concerns about diet and physical activity in relation to cancer.

#### Alcohol

*Does alcohol increase cancer risk?* Alcohol increases the risk of cancers of the mouth, pharynx, larynx, esophagus, liver, and breast. People who drink alcohol should limit their intake to no more than two drinks per day for men and one drink per day for women. A drink is defined as 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of 80-proof distilled spirits. The combination of alcohol and tobacco increases the risk of cancer far more than the independent effects of either drinking or smoking. Regular consumption of even a few drinks per week is associated with an increased risk of breast cancer in women. Women at high risk of breast cancer may consider abstaining from alcohol (see *Recommendations for Individual Choices*, recommendation number four, page 103).<sup>2,62,63,64</sup>

#### Antioxidants

*What are antioxidants and what do they have to do with cancer?* Certain nutrients in vegetables and fruits appear to protect the body against the damage to tissues that occurs constantly as a result of normal metabolism. Because such damage is associated with increased cancer risk, the so-called “antioxidant nutrients” are thought to protect against cancer.<sup>8</sup> Antioxidants include vitamin C, vitamin E, selenium, carotenoids, and

many other phytochemicals. Studies suggest that people who eat more vegetables and fruits, which are rich sources of antioxidants, have a lower risk for some types of cancer. Clinical studies of antioxidant supplements are currently underway, but studies have not yet demonstrated a reduction in cancer risk from vitamin supplements (see also *Beta-carotene* below; *Lycopene*, page 110; *Selenium*, page 111; *Vitamin E*, page 114; *Supplements*, page 112). To reduce cancer risk, the best advice presently is to consume antioxidants through food sources rather than supplements.

#### Aspartame

*Does aspartame cause cancer?* Aspartame is a low-calorie artificial sweetener that is about 200 times sweeter than sugar. Current evidence does not demonstrate any link between aspartame ingestion and increased cancer risk. People with the genetic disorder phenylketonuria should avoid aspartame in their diets.

#### Beta-carotene

*Does beta-carotene reduce cancer risk?* Because beta-carotene, an antioxidant chemically related to Vitamin A, is found in vegetables and fruits, and because eating vegetables and fruits is associated with a reduced risk of cancer, it seemed plausible that taking high doses of beta-carotene supplements might reduce cancer risk. In three major clinical trials, people were given high doses of synthetic beta-carotene in an attempt to prevent lung cancer and other cancers. Two studies found beta-carotene supplements to be associated with a higher risk of lung cancer in cigarette smokers, and a third found neither benefit nor harm from beta-carotene supplements. Therefore, consuming vegetables and fruits that contain beta-carotene may be helpful, but high-dose

beta-carotene supplements may be harmful, especially for cigarette smokers.<sup>14,15,16</sup>

#### Bioengineered Foods

*What are bioengineered foods, and are they safe?* Bioengineered foods are made by adding genes from other plants or organisms to increase a plant's resistance to insect pests, retard spoilage, or improve transportability, flavor, nutrient composition, or other desired qualities. In theory, these added genes might create substances that could cause adverse reactions among sensitized or allergic individuals. However, there is currently no evidence that the substances found in bioengineered foods now on the market are harmful or that they would either increase or decrease cancer risk because of the added genes.

#### Calcium

*Is calcium related to cancer?* Several studies have suggested that foods high in calcium might help reduce the risk for colorectal cancer,<sup>74</sup> and calcium supplementation modestly reduces the formation of colorectal adenomas. There is also evidence, however, that a high calcium intake, primarily through supplements, is associated with increased risk for prostate cancer, especially for prostate cancers that are more aggressive.<sup>72</sup> In light of this, both men and women should strive to consume recommended levels of calcium intake, primarily through food sources. Recommended intake levels of calcium are 1000 mg/day for people aged 19 to 50 and 1200 mg/day for people over 50 years old. Dairy products are excellent sources of calcium, as are some leafy vegetables and greens. People who obtain much of their calcium from dairy products should select low or nonfat choices to reduce intake of saturated fat. Those wishing to take calcium supplements

should consult with their health care provider.

#### Cholesterol

*Does cholesterol in the diet increase cancer risk?* Cholesterol in the diet comes only from foods derived from animal sources—meat, dairy foods, eggs, and animal fats. At present, there is little evidence that cholesterol itself causes the increased risk of certain cancers associated with eating foods from animal sources. Lowering blood cholesterol lowers cardiovascular disease risk, but there is no evidence that lowering blood cholesterol has an effect on cancer risk.

#### Coffee

*Does drinking coffee cause cancer?* Caffeine may heighten symptoms of fibrocystic breast lumps (a type of benign breast disease) in some women, but there is no evidence that it increases the risk of breast cancer or other types of cancer. The association between coffee and pancreatic cancer, widely publicized in the past, has not been confirmed by other studies.

#### Fat

*Will eating less fat lower cancer risk?* Diets high in fat are also high in calories and contribute to obesity, which in turn is associated with increased risk of cancers at several sites. Although all types of fats have similar numbers of calories, there is some evidence that certain types, such as saturated fats, may have a greater effect on increasing cancer risk, and that fats containing omega-3 fatty acids may reduce cancer risk (see *Recommendations for Individual Choices*, recommendation number one, page 95).

#### Fiber

*What is dietary fiber and can it prevent cancer?* Dietary fiber includes a wide variety of plant

carbohydrates that are not digestible by humans. Specific categories of fiber are “soluble” (like oat bran) or “insoluble” (like wheat bran and cellulose). Soluble fiber helps to reduce blood cholesterol and therefore, helps lower the risk of coronary heart disease. Good sources of fiber are beans, vegetables, whole grains, and fruits. Associations between fiber and cancer risk are inconclusive, but consumption of these foods is still recommended because they contain other substances that can help prevent cancer and because of their other health benefits.

#### Fish Oils

*Does eating fish protect against cancer?* Fish is a rich source of omega-3 fatty acids. Studies in animals have found that these fatty acids suppress cancer formation, and there is limited suggestive evidence of a possible benefit in humans. Research has not yet demonstrated whether the possible benefits of fish consumption may be reproducible by taking omega-3 or fish oil supplements.

#### 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 (closely related to folate or folacin) is a B vitamin found in many vegetables, beans, fruits, whole grains, and fortified breakfast cereals. Since 1998, all grain products have been fortified with folic acid.<sup>75</sup> Folic acid deficiency may increase the risk of cancers of the colorectum and breast.

Current evidence suggests that to reduce cancer risk, folic acid is best obtained through consumption of vegetables, fruits, and enriched grain products.

#### 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 consumed 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, mostly because garlic has very small effects on blood cholesterol levels. Garlic is currently under study for its ability to reduce cancer risk. Insufficient evidence exists at this point to support a specific role for this vegetable in cancer prevention.

#### Genetics

*If our genes determine cancer risk, how can diet help prevent cancer?* Damage to the genes that control cell growth and maturation can either be inherited or acquired during one's lifetime. Certain types of mutations or genetic damage can increase the risk of cancer. Nutrients in the diet can protect DNA from being damaged. Physical activity, weight control, and diet might delay or prevent the development of cancer in people with an increased genetic risk for cancer. The many interactions between diet and genetic factors are an important and complex topic of widespread current research interest.

**Irradiated Foods**

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

**Lycopene**

*Will lycopene reduce cancer risk?* Lycopene is the red-orange carotenoid antioxidant found at high levels in tomatoes and tomato-based foods. Several studies have reported that consumption of tomato products reduces the risk of some cancers. It is uncertain, however, whether lycopene is the micronutrient responsible for this association. Absorption of lycopene is increased when lycopene-rich vegetables are cooked and are consumed together with fat, although only very small amounts of fat are needed for absorption. Even if lycopene in foods is associated with lower risk for cancer, it does not follow that high doses taken as supplements would be either more effective or safe.<sup>12</sup>

**Meat: Cooking and Preserving**

*Should I avoid processed meats?* Some epidemiological studies have linked high consumption of processed meats with increased risk of colorectal and stomach cancers. This association may or may not be due to nitrites, which are added to many luncheon meats, hams, and hot dogs to maintain color and to prevent contamination with bacteria. Nitrites can be converted within the stomach into carcinogenic nitrosamines, which may increase the risk of gastric cancer. Diets high in vegetables and fruits containing vitamin C and phytochemicals retard the conversion of nitrites into nitrosamines.

Consumption of meats preserved by methods involving smoke or salt increases exposure to potentially carcinogenic chemicals, and so should be minimized.<sup>76</sup>

*How does cooking meat affect cancer risk?* Adequate cooking is necessary to kill harmful microorganisms within meat. However, some research suggests that frying, broiling, or grilling meats at very high temperatures creates chemicals that might increase cancer risk. Although studies show these chemicals cause cancer in animals, it is uncertain whether they actually cause cancer in humans. Techniques such as braising, steaming, poaching, stewing, and microwaving meats minimize the production of these chemicals.

**Obesity**

*Does being overweight increase cancer risk?* Yes. Overweight and obesity are associated with increased risk for cancers of the breast (among postmenopausal women), colon, endometrium, gallbladder, adenocarcinoma of the esophagus, pancreas, renal cell (kidney) carcinoma, and possibly other sites as well (see *Recommendations for Individual Choices*, recommendation number three, page 101).<sup>55,56,57,58,59,60</sup>

**Olive Oil**

*Does olive oil affect cancer risk?* Consumption of olive oil is not associated with any increased risk of cancer, and is most likely neutral with respect to cancer risk.<sup>77</sup> Olive oil is a significant source of calories and should be used in moderation.

**Organic Foods**

*Are foods labeled “organic” more effective in lowering cancer risk?* The term “organic” is popularly used to designate plant foods grown

without pesticides and genetic modifications. At present, no research exists to demonstrate whether such foods are more effective in reducing cancer risk than are similar foods produced by other farming methods.

#### Pesticides and Herbicides

*Do pesticides in foods cause cancer?* Pesticides and herbicides can be toxic when used improperly in industrial, agricultural, or other occupational settings. Although vegetables and fruits sometimes contain low levels of these chemicals, overwhelming scientific evidence supports the overall health benefits and cancer-protective effects of eating vegetables and fruits. At present there is no evidence that residues of pesticides and herbicides at the low doses found in foods increase the risk of cancer.<sup>78</sup>

#### Physical Activity

*Will increasing physical activity lower cancer risk?* Yes. People who engage in moderate-to-vigorous levels of physical activity are at lower risk of developing colon and breast cancer than those who do not.<sup>5,33,34,35,36</sup> This risk reduction is independent of the impact of activity on weight. Data for a direct effect on the risk of developing other cancers are more limited. Nonetheless, overweight and obesity have been associated with many types of cancer, and physical activity is a key component of maintaining or achieving a healthful body weight. In addition, physical activity has a beneficial impact on cardiovascular disease and diabetes (see *Recommendations for Individual Choices*, recommendation number two, page 99).

#### 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 vegetables and fruits reduces cancer risk, researchers are searching for specific components that might account for the beneficial effects. There is no evidence that phytochemicals taken as supplements are as beneficial as the vegetables, fruits, beans, and grains from which they are extracted.

#### Saccharin

*Does saccharin cause cancer?* High doses of the artificial sweetener saccharin cause the formation of bladder stones that can lead to bladder cancer in rats. Saccharin consumption does not cause the formation of bladder stones in humans. If saccharin would increase cancer risk in humans, it would do so at doses many times greater than amounts typically consumed by people.<sup>4</sup> Large epidemiological studies have not reported increases in bladder cancers among people using saccharin, and saccharin has been removed from the list of established human carcinogens by the US National Toxicology Program.<sup>78</sup>

#### Salt

*Do high levels of salt in the diet increase cancer risk?* Studies in other countries link diets containing large amounts of foods preserved by salting and pickling with an increased risk of stomach, nasopharyngeal, and throat cancer. No evidence suggests that salt used in cooking or in flavoring foods affects 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 mechanisms. Animal studies suggest that selenium protects against cancer, and one experimental trial has shown selenium supplements might reduce the risk of cancers of the lung, colon, and prostate. However, repeated and well-controlled studies are needed to confirm whether selenium is helpful in preventing these cancers.<sup>79</sup> High-dose selenium supplements are not recommended, as there is only a narrow margin between safe and toxic dosages. The maximum dose in a supplement should not exceed 200 micrograms per day. Seafood, meats, and grain products are good sources of selenium.

#### Soy Products

*Can soybeans reduce cancer risk?* Soy-derived foods are an excellent source of protein and a good alternative to meat. Soy contains several phytochemicals, some of which have weak estrogenic activity and appear to protect against hormone-dependent cancers in animal studies.<sup>24,80</sup> Most of the human studies compare Asian and Western populations, whose differences in cancer risk, however, may be due to factors other than soy consumption. Consumption of soy milk and soy powder has been shown to decrease concentrations of circulating estrogens. However, the phytoestrogens in soy are themselves weakly estrogenic, and the effects of dietary soy or of specific doses of soy-containing foods on cancer risk are unknown. Presently no convincing data exist to support the theory that soy supplements are beneficial in reducing cancer risk. There is a theoretical possibility that high doses of soy might increase the risk of estrogen-responsive cancers, such as breast or endometrial cancer, in certain individuals. Breast cancer survivors should consume only moderate amounts of soy foods as part of a healthy plant-based diet, and should not intentionally ingest very high levels of soy

products in their diet or more concentrated sources of soy, such as soy-containing pills, powders, or supplements containing isolated or concentrated isoflavones (see Brown J, Byers T, Thompson K, et al. *Nutrition During and After Cancer Treatment: A Guide for Informed Choices by Cancer Survivors*. *CA Cancer J Clin* 2001; 51:153-187).

#### Sugar

*Does sugar increase cancer risk?* Sugar increases caloric intake without providing any of the nutrients that reduce cancer risk. By promoting obesity and elevating insulin levels, high sugar intake may increase cancer risk. White (refined) sugar is no different from brown (unrefined) sugar or honey with regard to these effects on body weight or insulin.

#### Supplements

*Can nutritional supplements lower cancer risk?* There is strong evidence that a diet rich in vegetables, fruits, and other plant-based foods may reduce the risk of cancer, but there is no evidence at this time that supplements can reduce cancer risk. The few intervention/clinical trials done in human populations designed to test whether supplements can reduce cancer risk have yielded disappointing results. Vitamin and mineral supplements have been shown to reduce the risk of stomach cancer in intervention studies of malnourished persons in China and South America,<sup>81</sup> but other studies using high doses of single nutrients have shown no benefit and have even shown harm (see *Beta-carotene*, page 107). Food is the best source of vitamins and minerals. Supplements, however, may be beneficial for some people, such as pregnant women, women of childbearing age, and people with restricted dietary intakes. If a supplement is taken, the best choice is a balanced multivitamin/mineral supplement containing no more than 100

percent of the “Daily Value” (formerly listed on supplement labels as ‘RDA’) of most nutrients, since high doses of some nutrients can have adverse effects.

*Can I get the nutritional equivalent of vegetables and fruits in a pill?* No. Many healthful compounds are found in vegetables and fruits, and it is likely that these compounds work synergistically to exert their beneficial effect. In many cases, it is not known which compounds or combination of compounds are most beneficial in reducing cancer risk. There are likely to be important, but as yet unidentified, components of whole food that are not included in supplements. Additionally, the small amount of dried powder in the pills that are represented as being equivalent to vegetables and fruits frequently contains only a small fraction of the levels contained in the whole foods.

#### Tea

*Can drinking tea reduce cancer risk?* Some researchers have proposed that tea might protect against cancer because of its antioxidant content (see *Antioxidants*, page 107). In animal studies, some teas (including green tea) have been shown to reduce cancer risk, but epidemiological studies have had mixed findings. Presently, tea has not been proven to reduce cancer risk in humans.<sup>82</sup>

#### Trans-fats

*Do trans-saturated fats increase cancer risk?* Trans-saturated fats are produced during the manufacture of hydrogenated oils such as margarine or shortening to make them solid at room temperature. Recent evidence demonstrates that trans-fats have adverse cardiovascular effects, such as raising blood cholesterol levels.<sup>83</sup> Their relationship to cancer risk, however, has not been determined.<sup>84</sup>

#### Vegetables and Fruits

*Will eating vegetables and fruits lower cancer risk?* Greater consumption of vegetables, fruits, or both together has been associated in the majority of epidemiological studies with a lower risk of lung, oral, esophageal, stomach, and colon cancer. Because it is not known which of the many compounds in vegetables and fruits are most protective, the best advice is to consume five or more servings of a variety of vegetables and fruits each day (see *Recommendations for Individual Choices*, recommendation number one, page 95).<sup>9,10</sup>

*What are cruciferous vegetables and are they important in cancer prevention?* Cruciferous vegetables belong to the cabbage family, and include broccoli, cauliflower, Brussels sprouts, and kale. These vegetables contain certain chemicals thought to reduce the risk for colorectal cancer. The best evidence suggests that a wide variety of vegetables, including cruciferous and other vegetables, reduces cancer risk (also see *Phytochemicals*, page 111).

*Is there a difference in the nutritional value of fresh, frozen, and canned vegetables and fruits?* Yes, but they can all be good choices. Fresh foods are usually considered to have the most nutritional value. However, frozen foods can be more nutritious than fresh foods because they are often picked ripe and quickly frozen. Canning is more likely to reduce the heat sensitive and water-soluble nutrients because of the high heat temperatures necessary in the canning process. Be aware that some fruits are packed in heavy syrup, and some canned vegetables are high in sodium. Choose vegetables and fruits in a variety of forms.

*Does cooking affect the nutritional value of vegetables?* Boiling vegetables, especially for long periods, can leach out their content of water-soluble vitamins. Microwaving and

steaming may be the best ways to preserve the nutritional content in vegetables.

*Should I be juicing my vegetables and fruits?* Juicing can add variety to the diet, and can be a good way to consume vegetables and fruits, especially for those who have difficulty chewing or swallowing. Juicing also improves the body's absorption of some of the nutrients in vegetables and fruits. However, juices may be less filling than whole vegetables and fruits and contain less fiber. Fruit juice, in particular, can contribute lots of calories to one's diet. Commercially juiced products should be 100% vegetable or fruit juices and should be pasteurized to eliminate harmful microorganisms.

#### Vegetarian Diets

*Do vegetarian diets reduce cancer risk?* Vegetarian diets include many health-promoting features; they tend to be low in saturated fat and high in fiber, vitamins, and phytochemicals (e.g., flavonoids, etc.). It is not possible to conclude at this time, however, that a vegetarian diet has any special benefits for the prevention of cancer. Vegetarian diets differ in composition, although all avoid consumption of red meat. A vegetarian diet can be quite healthful if it is carefully planned and provides adequate calories. Diets including lean meats in small to moderate amounts can be just as healthful. The greater the restriction of food groups in a particular diet, the more possibility there is of dietary deficiencies. Strict vegetarian diets that avoid all animal products, including milk and eggs, should be supplemented with vitamin B12, zinc, and iron (especially for children and premenopausal women).

#### Vitamin A

*Does vitamin A lower cancer risk?* Vitamin A (retinol) is obtained from foods in two ways: preformed from animal food sources, and derived from beta-carotene in plant-based

foods. Vitamin A is needed to maintain healthy tissues. Vitamin A supplements, whether in the form of beta-carotene or retinol, have not been shown to lower cancer risk, and high-dose supplements may, in fact, increase the risk for lung cancer.<sup>14,15</sup>

#### Vitamin C

*Does vitamin C lower cancer risk?* Vitamin C is found in many vegetables and fruits. Many studies have linked consumption of vitamin C-rich foods with a reduced risk for cancer. The few studies in which vitamin C has been given as a supplement, however, have not shown a reduced risk for cancer.<sup>85,86</sup>

#### Vitamin E

*Does vitamin E lower cancer risk?* One clinical trial showed that men who took vitamin E (50 mg/day) had a lower risk of prostate cancer compared with men who took a placebo,<sup>14</sup> but this observation has yet to be confirmed.

#### Water and Other Fluids

*How much water and other fluids should I drink?* Consumption of water and other liquids may reduce the risk of bladder cancer, as water dilutes the concentration of carcinogens and shortens the time in which they are in contact with the bladder lining. Drinking at least eight cups of liquid a day is usually recommended, and some studies indicate that even more may be beneficial.<sup>65</sup>

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#### AMERICAN CANCER SOCIETY GRADES FOR BENEFIT VERSUS HARM

To review the strength of the scientific evidence, a guidelines subcommittee used a method of summarizing the evidence similar to the methods used by other expert panels. For example, the US Preventive Services Task Force

judged the scientific evidence related to clinical preventive services using a system that considered both the source and strength of the evidence: from at least one controlled clinical trial, from good uncontrolled trials, from multiple good observation studies, expert opinion, and case reports. They then characterized those guidelines on a five-point grading scheme as to the strength of the guideline: “good for recommending, fair for recommending, insufficient to recommend for or against, fair for not recommending, good for not recommending.” The American Institute for Cancer Research (AICR) World Cancer Research Fund project summarized the nature

of the scientific evidence for nutritional factors in cancer prevention as being either “convincing, probable, possible, or insufficient.”

The American Cancer Society subcommittee employed a method similar to both groups. For each issue, the committee judged the likelihood of benefit to the general public as follows:

- A1. Convincing evidence for a benefit.
- A2. Probable benefit.
- A3. Possible benefit.
- B. Insufficient evidence to conclude benefit or risk.
- C. Evidence of lack of benefit.
- D. Evidence of harm.

TABLE 5

American Cancer Society Grades for Benefit Versus Harm (2001)*									
Nutritional Factor	Colorectal Cancer	Breast Cancer	Prostate Cancer	Lung Cancer	Esophageal, Oral Cancer	Stomach Cancer	Pancreatic Cancer	Bladder Cancer	Endometrial Cancer
Increasing vegetable and fruit intake	A2	A3	A3	A2	A2	A2	A3	A3	A3
Limiting intake of red meat	A2	B	A3	B	B	C	A3	C	B
Increasing physical activity	A1	A1	B	B	B	B	B	B	A2
Avoiding overweight	A1	A1	C	B	A2	C	A3	C	A1
Limiting alcohol intake	A3	A2	C	B	A1	C	A3	C	B
Consuming soy foods	B	B	B	B	B	B	B	B	B
Taking beta-carotene supplements	B	B	C	D	B	B	B	B	B
Taking vitamin E supplements	B	B	A3	C	B	B	B	B	B
Taking vitamin C supplements	B	B	B	B	B	B	B	B	B
Taking folic acid supplements	A3	A3	B	B	B	B	B	B	B
Taking selenium supplements	A3	B	A3	A3	B	B	B	B	B

\*Note: Group met in 2001 and recommendations were adopted by the American Cancer Society Board of Directors in November, 2001.

THE AMERICAN CANCER SOCIETY'S COMMIT-  
MENT TO NUTRITION AND PHYSICAL ACTIVITY  
FOR CANCER PREVENTION

The American Cancer Society is committed to improving the ability of Americans to eat a healthful diet and to be active because of the potential impact of diet and activity on cancer risk. The ACS has set aggressive challenge goals for the nation to decrease cancer incidence and mortality—and to improve the quality of life of cancer survivors—by the year 2015. As part of its strategic plan for achieving these goals, the ACS has established nationwide nutrition and physical activity objectives: to increase the awareness of the relationship of nutrition and physical activity to cancer risk and to motivate and enable all Americans to lead a healthful and active lifestyle.

To address these critical goals, the ACS publishes its *Nutrition and Physical Activity Guidelines* to serve as a foundation for its communication, policy, and community strategies and ultimately, to affect dietary and physical activity patterns among Americans. These guidelines, published every five years, are developed by a national panel of experts in cancer research, prevention, epidemiology, public health, and policy, and they represent the most current scientific evidence related to dietary and activity patterns and cancer risk. Recognizing that the ability to make healthful choices is often affected by factors within the environment in which people live, work, and play, the guidelines also attempt to identify key social and structural factors that influence access to resources for a healthful, active lifestyle. The ACS makes use of these guidelines to influence legislative and regulatory issues that support nutrition and physical activity; to influence environmental changes that increase public access to and availability of healthful foods and opportunities for physical activity; to advise the public about issues related to

nutrition, physical activity, and cancer; and to develop education programs and interventions designed to improve the dietary and activity habits of people of all ages.

The ACS also recognizes that many important questions about nutrition, physical activity, and cancer risk remain unanswered. The ACS will continue to support an ongoing program of research that addresses biological, clinical, epidemiological, behavioral, and policy studies on the role diet and physical activity play in cancer prevention. Greater efforts on the part of individuals in public and private agencies are also needed to translate these guidelines into effective action that reduces the burden of cancer among Americans.

The ACS 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 ACS are conducting epidemiological research in which they analyze and interpret data related to cancer mortality with regard to lifestyle among a population of more than one million people. In addition, scientists throughout the United States apply for research grants for their own investigations. The ACS reviews these applications rigorously, and awards funding to only the most meritorious proposals. Studies supported by the ACS on the role of diet and activity on cancer risk have been made possible by the efforts of nearly 100,000 volunteers and the financial contributions of millions of Americans.

To reverse current trends in diet and activity habits and the resultant increases in overweight and obesity among many segments of the population—including both youth and adults—increased attention and dedicated resources are needed. Positive action on the part of communities, public and private organizations, and individuals working together to raise the awareness of this issue and to

influence public policy and resource allocation will be needed. By acting on what is known now, and by continuing to pursue a comprehensive research agenda that includes policy and environmental change strategies, the ACS believes it can stimulate effective action to reduce the burden of cancer among Americans. CA

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