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# Nutrition and Physical Activity During and After Cancer Treatment: An American Cancer Society Guide for Informed Choices

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**ABSTRACT** Cancer survivors are often highly motivated to seek information about food choices, physical activity, dietary supplement use, and complementary nutritional therapies to improve their treatment outcomes, quality of life, and survival. To address these concerns, the American Cancer Society (ACS) convened a group of experts in nutrition, physical activity, and cancer to evaluate the scientific evidence and best clinical practices related to optimal nutrition and physical activity after the diagnosis of cancer. This report summarizes their findings and is intended to present health care providers with the best possible information on which to help cancer survivors and their families make informed choices related to nutrition and physical activity. The report discusses nutrition and physical activity issues during the phases of cancer treatment and recovery, living after recovery from treatment, and living with advanced cancer; selected nutritional and physical activity issues such as body weight, food choices, and complementary and alternative nutritional options; and selected issues related to breast, colorectal, lung, prostate, head and neck, and upper gastrointestinal cancers. In addition, handouts containing commonly asked questions and answers and a resource list are provided for survivors and families. Tables that grade the scientific evidence for benefit versus harm related to nutrition and physical activity for breast, colorectal, lung, and prostate cancers are also included for this growing body of knowledge to provide guidance for informed decision making and to identify areas for future research. (*CA Cancer J Clin* 2003;53:268–291.) © American Cancer Society, 2003.

## INTRODUCTION

Approximately 9.5 million persons in the United States are cancer survivors.<sup>1</sup> Anyone who has been diagnosed with cancer, from the time of diagnosis through the rest of life, is considered a cancer survivor. From diagnosis through the balance of life, many cancer survivors are highly motivated to seek information about food choices, physical activity, dietary supplement use, and complementary nutritional therapies to improve their response to treatment, quality of life, and survival.

Nutritional needs change for most persons during the phases of cancer treatment, recovery from treatment, and thereafter. The need for informed lifestyle choices for cancer survivors becomes particularly important as they look forward to successful completion of therapy and begin to search for the best strategies to improve long-term outcomes. Sixty-two percent of Americans with cancer now live more than 5 years after their disease is diagnosed. Although many cancer survivors live with active or advanced disease, a large and growing number live extended, cancer-free lives. For these long-term cancer survivors, an appropriate weight, a healthful diet, and a physically active lifestyle aimed at preventing second primary cancers and other chronic diseases become a priority. For some, managing nutritional needs while living with advanced cancer is a particular challenge.

After receiving a diagnosis of cancer, survivors soon find there are few clear answers to even the simplest questions, such as *Should I change what I eat? Should I exercise? Should I lose weight? Should I take dietary supplements? How about herbal remedies?* Cancer survivors receive a wide range of advice from many sources about foods to eat, how to exercise, and what types of supplements or herbal remedies might improve the outcome of standard cancer therapy that is often conflicting. To synthesize evidence-based guidance, the American Cancer Society (ACS) convened a group of experts in nutrition, physical activity, and cancer to evaluate the scientific evidence and best clinical practices related to nutrition and physical activity after the diagnosis of cancer. This report summarizes their findings. It is intended to present health care providers with the best possible information on which to help cancer survivors and their families make informed choices related to nutrition and physical activity after receiving a cancer diagnosis.

#### OVERVIEW OF THE REPORT

This is the second report on nutrition for cancer survivors issued by the ACS.<sup>2</sup> It builds on the first report published in 2001 by includ-

ing more information on physical activity and by adding new evidence from research published in the past 3 years. In addition to a review of the current scientific evidence and best clinical practices, the Expert Committee has also provided summary tables grading both the quality and certainty of the scientific evidence for selected factors affecting common cancers. The report is organized into three sections.

The first section addresses nutrition and physical activity issues across the stages of cancer survivorship including treatment and recovery, living after recovery from treatment, and living with advanced cancer. Selected nutritional and physical activity issues including body weight, food choices, physical activity, and complementary and alternative nutritional options are discussed in the second section. The third section provides information about selected issues for the major cancer sites (breast, colorectal, lung, prostate, head and neck, and upper gastrointestinal).

This report is intended for health care providers caring for cancer survivors, but it can also be used directly by survivors and their families. The underlying premise is that even when the scientific evidence is incomplete, reasonable conclusions can be made on several issues that can guide choices about body weight, foods, physical activity, and complementary and alternative nutritional options.

It is important for both health care providers and cancer survivors to consider the nutritional and physical activity issues discussed in this report within the context of the individual survivor's overall medical and health situation. This report is not intended to imply that nutrition and physical activity are more important than other factors. Although we present nutritional suggestions for persons with nausea or fatigue, we recognize that other medical interventions may be more important in controlling

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these symptoms. In writing these suggestions, we have assumed that survivors are receiving appropriate medical and supportive care and are seeking information on self-care strategies to provide further relief of symptoms and to enhance health and improve the quality of their lives.

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NUTRITION AND PHYSICAL ACTIVITY ACROSS THE SPECTRUM OF CANCER SURVIVORSHIP

The spectrum of cancer survival includes treatment and recovery, living after recovery, and, for some, living with advanced cancer. Each of these phases has different needs and challenges with respect to nutrition and physical activity. The primary site of the cancer and therapeutic methods influence these needs.

**Cancer Treatment and Recovery**

Surgery, radiation therapy, and chemotherapy can change nutritional needs and alter the survivor's intake and the body's digestion, absorption, and use of food.<sup>3</sup> The need for food intake may be increased during cancer treatment. Changes such as unintentional loss of body weight, loss of muscle mass, unintentional weight gain, and eating and digestive difficulties are usually temporary but can sometimes persist. Common cancer symptoms and toxic effects of cancer treatments that influence nutrition and physical activity include fatigue, anorexia, weight change, nausea, vomiting, pain, and changes in taste or smell and bowel habits. If these occur, usual food choices and eating patterns may need to be temporarily adjusted. For example, radiation therapy and digestive problems after gastrointestinal surgery may require some modification of the amount, choice, and preparation of foods to manage digestive symptoms.

During active cancer treatment, maintaining energy balance or preventing weight loss is the most important nutritional goal for survivors at risk for unintentional weight loss, such as those who are already undernourished or those who receive directed treatment to the alimentary tract. Assessment and planning for survivors

should begin while treatment is being planned and should focus on current nutritional status and anticipated nutritional problems related to treatment.<sup>4</sup> If survivors experience early satiety or reduced appetite, smaller, more frequent meals can help to increase food intake. For those who cannot meet their nutritional needs through a regular diet alone, nutritious snacks or drinks may be indicated. Commercially prepared or homemade nutrient-dense drinks may improve the intake of calories and nutrients. These drinks can be beneficial when regular feedings cannot sustain needs. If these supportive measures fail to meet nutritional needs, then other means of nutritional support (eg, enteral nutrition) may be temporarily indicated.

The use of dietary vitamin and mineral supplements during cancer treatment is controversial. It may be counterproductive, for example, for survivors to take folic acid supplements or to eat fortified food products that contain high levels of folic acid when receiving methotrexate, a chemotherapy drug that acts by interfering with folic acid metabolism.<sup>3</sup> Many vitamin supplements contain higher levels of antioxidants (such as vitamins C and E) than those recommended in the Dietary Reference Intakes for optimal health.<sup>5-8</sup> Many cancer researchers have recommended against taking any antioxidant supplements during treatment because antioxidants could repair cellular oxidative damage to cancer cells caused by treatments such as radiotherapy and chemotherapy.<sup>9,10</sup> In contrast, others have noted that the possible harm from antioxidants is only hypothetical and that there may be a net benefit to help protect normal cells from the collateral damage associated with these therapies.<sup>11</sup> Endogenous antioxidants, such as melatonin, might work to enhance chemotherapy, but such findings have not been consistently reproduced.<sup>12,13</sup> Whether antioxidants are beneficial or harmful is a critical question without a clear scientific answer at this time. Given this uncertainty, until evidence is available suggesting more benefit than harm, it would be prudent for cancer survivors receiving chemotherapy or radiotherapy to avoid exceeding the tolerable upper limits of the Dietary Reference Intakes for antioxidant vitamins such as vitamins C and E during the treatment phase.<sup>5-8</sup>

An increasing number of studies have examined the therapeutic value of exercise during primary cancer treatment.<sup>14</sup> Most of these have examined women with early-stage breast cancer receiving chemotherapy and persons with various cancers immediately after bone marrow transplantation. Despite methodologic limitations and small sample sizes, good evidence suggests that exercise is not only safe and feasible but also can enhance physical and functional well-being and improve overall quality of life.<sup>14</sup> No studies have examined the interaction of exercise with the efficacy of cancer treatments. Consequently, it is not known whether exercise during cancer treatment may enhance, impede, or have no effect on treatment efficacy. Research into this question is urgently needed. Nevertheless, a strong biologic rationale for concerns about any adverse effects of exercise during treatment does not exist.

If the disease or treatment necessitates periods of bed rest, then reduced fitness, reduced endurance, and decreased muscle strength can be expected. Physical therapy during bed rest is advisable to maintain strength and range of motion and to help to counteract the fatigue and depression that are often experienced under those circumstances.

The decision regarding how to maintain or when to initiate physical activity should be individualized to the survivor's condition and personal preferences. In some circumstances, a training program to improve cardiopulmonary fitness before cancer surgery might help in recovery, although adequate research has not been done in this area. Persons receiving chemotherapy and radiation therapy should change their program or begin exercise at a lower intensity and progress at a slower pace compared with persons who are not receiving cancer treatment. For those who were exercising before diagnosis, the principal goal should be to maintain activity as much as possible. For those who were sedentary before diagnosis, low-intensity activities such as stretching and short, slow walks should be adopted and slowly advanced. For older persons and those with significant impairments such as arthritis or peripheral neuropathy, careful attention should be given to balance to reduce the risk for falls

and injuries. The presence of a caregiver or exercise professional during exercise sessions can be helpful. Some clinicians advise some survivors to wait to determine their response to chemotherapy before beginning an exercise program. Other survivors may find that they have little fatigue early in treatment, and thus their interest in exercise is greater.<sup>15</sup> After treatment, in the phase of increasing body strength toward recovery or improvement of prediagnostic fitness level, a program of regular physical activity is important.

#### Living After Recovery From Treatment

After initial diagnosis and treatment, most cancer survivors are free of disease or stable. During this phase, setting and achieving life-long goals for an appropriate weight, a healthful diet, and a physically active lifestyle are important to promote quality of life and longevity. The ACS has established nutrition and physical activity guidelines for the prevention of cancer.<sup>16</sup> Although it may seem reasonable to assume that following these guidelines would also favorably affect cancer recurrence or survival rates, few data are available to support this assumption. In some instances, there is evidence for such a link, as with obesity and breast cancer recurrence, but in many instances the evidence linking food choices and physical activity to cancer recurrence and survival is absent or unclear. Although the scientific evidence for advice on nutrition and physical activity after cancer is much less certain than for cancer prevention, it is likely that following the ACS guidelines on diet, nutrition, and cancer prevention (Table 1) may be helpful for reducing the risk for the occurrence of second cancers.<sup>16</sup> It is important to realize that because persons who have been diagnosed with cancer may be at increased risk for other cancers and for cardiovascular disease, diabetes, and osteoporosis, the guidelines established to prevent these diseases are especially important for cancer survivors.<sup>17-20</sup>

Convincing data exist that obesity is associated with breast cancer recurrence, and evidence on obesity and prognosis is also accumulating for other cancers.<sup>21</sup> Therefore, achieving and maintaining a healthy weight

TABLE 1

## American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention

- 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.
  - Choose whole grains in preference to processed (refined) grains and sugars.
  - Limit consumption of red meats, especially those high in fat and processed.
  - Choose foods that help to maintain a healthful weight.
- Adopt a physically active lifestyle.
  - Adults: Engage in at least moderate activity for 30 minutes or more on 5 or more days of the week; 45 minutes or more of moderate to vigorous activity on 5 or more days per week may further enhance reductions in the risk for breast and colon cancer.
  - Children and adolescents: Engage in at least 60 minutes per day of moderate to vigorous physical activity at least 5 days per week.
- Maintain a healthy weight throughout life.
  - Balance caloric intake with physical activity.
  - Lose weight if currently overweight or obese.
- Limit consumption of alcoholic beverages.

with appropriate diet and physical activity is important.<sup>22</sup> A healthful diet and physical activity are important to improve well-being, quality of life, and survival.

An increasing number of studies have examined exercise during recovery and long-term survival after cancer treatment.<sup>14</sup> Most research has been on women with breast cancer or those who have received bone marrow transplants. Exercise has been shown to improve cardiovascular fitness, muscle strength, body composition, fatigue, anxiety, depression, self-esteem, happiness, and several components of quality of life (physical, functional, and emotional) in cancer survivors.<sup>14</sup> Although no studies have examined the effects of exercise on cancer recurrence or overall survival after cancer treatment, several cohort studies are ongoing that will provide data on this issue during the next several years. In the meantime, it is increasingly clear that increased exercise is related to the primary prevention of some cancers and other chronic conditions, such as cardiovascular disease and diabetes.<sup>22</sup> It is likely that these relationships will also hold among cancer survivors. Physical activity is therefore possibly beneficial for cancer survivors in the prevention of second cancers and other chronic diseases.

#### Living With Advanced Cancer

Although some persons are cured or experience cancer as a controllable chronic disease, others live with advanced cancer. For these persons, nutrition and physical activity are important factors in establishing and maintaining a

sense of well-being and enhancing quality of life. Although advanced cancer may be accompanied by substantial weight loss, it is not inevitable that persons with cancer necessarily lose weight or experience malnutrition.<sup>3</sup> Many persons with advanced cancer may need to adapt food choices and eating patterns to meet nutritional needs and to manage symptoms and adverse effects such as pain, constipation, and loss of appetite. For persons with poor appetites, weight loss, or both, convincing evidence exists that some medications (eg, megestrol acetate) enhance appetite.<sup>23–26</sup> Furthermore, using nonsteroidal anti-inflammatory drugs or omega-3 fatty acid oral supplements may stabilize or improve nutritional status, body weight, and functional status.<sup>27,28</sup>

Physical activity may help to increase appetite and to relieve constipation. Additional nutritional support such as nutrient-dense drinks can be provided for those who cannot eat enough solid food to maintain energy intake. The use of tube feedings and total parenteral nutrition should be individualized with clear recognition of the associated risks for complications. Both the American Society for Parenteral and Enteral Nutrition and the American Dietetic Association recommend that total parenteral nutrition should be used selectively and with caution.<sup>29,30</sup>

In principle, some level of physical activity is desirable for persons with advanced cancer. Physical activity for these survivors, even those who are confined to bed, may help increase appetite, reduce constipation, and counteract

fatigue, but there is limited research on exercise in cancer survivors with advanced disease. Thus, the evidence of benefit from exercise for advanced cancer survivors is insufficient to make generalized recommendations. Recommendations for nutrition and physical activity for persons who are living with advanced cancer are best made based on individual needs and abilities.

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SELECTED ISSUES IN NUTRITION AND PHYSICAL ACTIVITY FOR CANCER SURVIVORS

### Body Weight

Persons across the spectrum of cancer survival should strive to achieve and maintain a healthy weight.<sup>17</sup> Some cancer survivors can be malnourished and underweight at diagnosis or as a result of aggressive treatment. For these persons, further loss of weight can impair their quality of life, interfere with completion of treatment, delay healing, and increase complications. In survivors with these difficulties, dietary intake and all factors affecting energy expenditure should be carefully assessed. For those at risk for unintentional weight loss, multifaceted interventions should focus on increasing food intake and reducing total energy expenditure to achieve a positive energy balance and thereby increase weight.<sup>26</sup> Physical activity may be useful to the underweight survivor when tailored to provide stress reduction and to increase strength, but high levels of physical activity make weight gain more difficult.<sup>14</sup>

Obesity is a risk factor for some of the most common cancers in the United States, such as postmenopausal breast cancer and colorectal cancer.<sup>21</sup> For this reason and because obesity is increasingly common in the US population,<sup>31</sup> many cancer survivors are overweight or obese at the time of diagnosis. Increasing evidence indicates that being overweight increases the risk for recurrence of many cancers,<sup>32-35</sup> and a recent study links obesity with an increased risk for dying of cancer.<sup>36</sup> In women with breast cancer, this problem is compounded because of weight gain associated with adjuvant thera-

py.<sup>37,38</sup> For cancer survivors who are overweight or obese, modest weight loss (ie, a maximum of 2 pounds per week<sup>39,40</sup>) can be encouraged during treatment, as long as the treating oncologists approve, weight loss is monitored closely, and weight loss does not interfere with treatment. Safe weight loss should be achieved through a healthful, well-balanced diet (see Balancing Fat, Protein, and Carbohydrate Intake) and physical activity tailored to the specific needs of the person being treated.

After cancer treatment, weight gain or loss should be managed with a combination of dietary and physical activity strategies. For some who need to gain weight, this means increasing caloric intake (food intake) to exceed energy expended, and for others who need to lose weight, this means increasing energy output (physical activity) to exceed caloric intake. Moderate physical activity during and after treatment will help survivors maintain lean muscle mass while reducing body fat. For those who need to lose weight, even if ideal weight reduction is not achieved, it is likely that any weight loss achieved by physical activity and healthful eating is beneficial.

### Nutrition and Food Choices

During all phases of cancer survival, even for those with no apparent nutritional problems, the principles outlined in the "American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention" should be regarded as the basis for a healthful diet.<sup>16</sup> These guidelines are similar to those recommended by several other organizations, agencies, and expert panels as a reasonable basis for the dietary prevention of other chronic diseases and cancer.<sup>17-20</sup>

### Balancing Fat, Protein, and Carbohydrate Intake

Fat, protein, and carbohydrate all contribute calories to the diet, and each of these dietary constituents is available from a wide variety of foods. Making informed choices about foods that provide these macronutrients can ensure variety and nutrient adequacy. A common mis-

conception is that all fats, proteins, or carbohydrates are similar in their health effects. It is now clear that the type of fat, protein, or carbohydrate and the food source can make a difference in long-term health. The choice of such foods is probably more important than the total amount of fat, carbohydrate, or protein in the diet. Many cancer survivors are at high risk for other chronic diseases, such as heart disease. Therefore, the recommended amounts of fats, proteins, and carbohydrates for cardiovascular health are appropriate for cancer survivors.<sup>16–20</sup>

Although much historical interest has been focused on linking dietary fat with cancer risk, especially breast cancer and colorectal cancer, the current evidence indicates it is unlikely that a high level of total fat in the diet is an important cause of cancer.<sup>41–43</sup> Total fat intake has not been linked to the risk for recurrence or survival in most studies reported to date.<sup>32–34,44,45</sup> However, two important randomized clinical trials are testing the effect of a low-fat dietary pattern on risk for recurrence and survival in women with breast cancer (the Women's Intervention and Nutrition Study [WINS] and the Women's Healthy Eating and Living Study [WHEL]).<sup>46,47</sup>

There are many types of dietary fat. Some fats, such as monounsaturated and omega-3 fatty acids, are associated with reduced risk for heart disease and possibly cancer, whereas others, such as saturated fats, are associated with increased risks.<sup>18–20</sup> Some studies have suggested that omega-3 fatty acids may have specific benefits for cancer survivors. These findings are not certain, and more research is needed.<sup>48</sup> Eating foods rich in omega-3 fatty acids (eg, fish and walnuts) is encouraged because this is associated with a lower risk for cardiovascular diseases and a lower overall mortality rate.<sup>17,19,20</sup>

Adequate protein intake is essential during all stages of cancer treatment, recovery, and long-term survival. The best choices to meet protein needs are foods low in saturated fat (eg, fish, lean poultry, eggs, low-fat meat, nonfat and low-fat dairy products, nuts, seeds, and legumes). An intake of 10% of calories from protein will generally meet the protein needs of adult cancer survivors; however, most elderly

need a higher proportion of calories from protein, given reduced energy intake. Importantly, however, persons with renal dysfunction may need to restrict their protein intake.

Healthful carbohydrate choices are foods that are rich in essential nutrients, phytochemicals, and fiber, such as whole grains, vegetables, legumes, and fruit. These foods should constitute the majority of carbohydrate-containing foods in the diet. Because nutrient-poor, low-fiber, carbohydrate-rich foods (highly refined foods such as white bread and rice or foods with added sugar) simply add calories to the diet or replace more healthful foods, and thereby reduce the overall diet quality, these foods should be only a small source of carbohydrate in the diet. Foods high in refined sugars or carbohydrates may also exacerbate insulin resistance. Although it is unknown whether insulin resistance is important in cancer survival, there is growing interest in determining whether these foods may increase the risk for certain cancers such as breast, colorectal, or pancreatic, and insulin resistance seems to play an important role in increasing obesity and the risk for diabetes and cardiovascular disease.<sup>19,20</sup>

Balancing fat, protein, and carbohydrate is challenging for the cancer survivor who eats a vegetarian diet. Vegetarian diets differ with respect to inclusion of dairy foods, fish, and/or eggs, but avoiding red meat is a universal feature. Although plant foods are sources of incomplete proteins that lack or are low in one or more essential amino acids, vegetarian diets that include fish and dairy foods typically contain the same quantity and quality of protein provided by nonvegetarian diets. A vegan diet excludes all animal foods and animal products. Adults eating vegan diets can meet protein needs if they consume nuts, seeds, legumes, and cereal-grain products in sufficient quantities.

Cancer survivors who eat a vegetarian diet need to use care to prevent nutrient inadequacy. In general, the risk for nutrient deficiencies and inadequate energy intake is greater with greater food restrictions. Regular use of a multiple vitamin/mineral supplement containing 100% of Daily Values may be indicated to prevent nutrient deficiencies, especially if the amount and types of foods being consumed by

the individual eating a vegetarian diet are very limited. Vegan diets should be supplemented with vitamin B<sub>12</sub>, iron, and zinc, or include foods that are fortified with these micronutrients.<sup>49</sup> During cancer treatment, eating a vegetarian diet may necessitate guidance from a dietitian to minimize adverse effects, such as diarrhea during radiation therapy.

Vegetarian diets include many health-promoting features, because they tend to be low in saturated fat and high in fiber, vitamins, and phytochemicals, and a vegetarian diet can be consistent with the ACS nutrition guidelines for the prevention of cancer. However, no direct evidence has determined whether consuming a vegetarian diet has any additional benefit for the prevention of cancer recurrence.

#### *Vegetables and Fruits*

Higher intake of vegetables and fruits may be associated with a lower incidence of colorectal and lung cancers as well as oral, esophageal, and stomach cancers.<sup>18</sup> A diet including many vegetables and fruits might also be beneficial for reducing the risk for cancer recurrence or increasing survival, but few studies exist of this relationship in cancer survivors. The benefits of eating a variety of vegetables and fruits probably exceed the health-promoting effects of any individual component, because it is likely that the various vitamins, minerals, and other phytochemicals in these whole foods act in synergy to reduce cancer risk.

It is reasonable for cancer survivors to adopt the general dietary recommendations issued by the ACS and many other organizations to eat at least five servings of vegetables and fruits each day. Vegetables should be especially encouraged because they are more nutrient dense than most fruits. Micronutrient- and phytochemical-rich vegetables in a variety of deep colors and flavors should be selected. Selection of a variety of colors is a simple way to ensure that the diet includes a variety of different phytochemicals. Frozen and canned vegetables and fruits may be more readily available and less expensive than fresh vegetables and fruits, and they are nutritionally comparable to fresh. Because chemotherapy can impair the

immune response, raw vegetables may increase the risk for infection in some patients during treatment as a result of pathogens on these foods.<sup>50</sup> Steaming or otherwise cooking vegetables increases the absorption of many nutrients and other phytochemicals, improves tolerance, and decreases the risk for infection. A serving size of vegetables or fruits is defined as one medium piece of fruit; one-half cup of chopped, cooked or canned fruit; one-quarter cup of dried fruit; 6 ounces of 100% fruit or vegetable juice; one cup of raw leafy vegetables; or one-half cup of cooked or raw vegetables.

#### *Alcohol*

Substantial evidence indicates that alcohol intake has both positive and negative health effects.<sup>51-53</sup> For this reason, it is important for the health care provider to tailor advice on alcohol consumption to the individual cancer survivor. The cancer type and stage of disease, treatment, risk factors for recurrence or new primary cancers, and comorbid conditions should be considered in making recommendations. For example, alcohol, even in the small amounts found in mouthwashes, can be irritating to survivors with oral mucositis and can exacerbate that condition. Therefore, it is reasonable to recommend that alcohol intake should be avoided or limited among survivors with mucositis and among those beginning head and neck radiotherapy or chemotherapeutic regimens that put them at risk for mucositis.

Many studies have found a link between alcohol intake and risk for some primary cancers, including cancers of the mouth, larynx, esophagus, liver, breast, and possibly colon.<sup>51,52,54</sup> In persons who have already received a diagnosis of cancer, alcohol intake could also affect the risk for new primary cancers of these sites. Alcohol intake can increase the circulating levels of estrogens, which theoretically could increase the risk for recurrence of breast cancer, but in studies conducted to date this increased risk has not been observed.<sup>34</sup> Therefore, the degree of risk present should be considered in recommendations regarding individual alcohol consumption.

TABLE 2

## General Guidelines for Food Safety

- Wash hands thoroughly before eating.
- Keep all aspects of food preparation clean, including washing hands before food preparation and washing fruits and vegetables thoroughly.
- Use special care in handling raw meats, fish, poultry, and eggs; thoroughly clean all utensils, countertops, cutting boards, and sponges that have contacted raw meat; keep raw meats and ready-to-eat foods separate.
- Cook to proper temperatures; meat, poultry, and seafood should be thoroughly cooked, and beverages (milk and juices) should be pasteurized.
- Store foods promptly at low temperatures to minimize bacterial growth (below 40°F).
- When eating in restaurants, avoid foods that may have bacterial contamination such as salad bars, sushi, and raw or undercooked meat, fish, shellfish, poultry, and eggs.
- If there is any question or concern about water purity (eg, well water), it can be checked for bacterial content by contacting local public health departments.

In the general population, consistent evidence links modest alcohol intake of one to two drinks per day with a lower risk for cardiovascular disease.<sup>53</sup> One drink is defined as 5 ounces of wine, 12 ounces of beer, or 1.5 ounces of hard liquor. Because some cancer survivors are at risk for cardiovascular disease and for cancer recurrence and new primary cancers, the potential benefits and risks of alcohol use must be weighed carefully on an individual basis.

#### Food Safety

Food safety is of special concern for cancer survivors, especially during episodes of iatrogenic immunosuppression.<sup>50</sup> During any immunosuppressive cancer treatment, survivors should be particularly careful to avoid eating foods that may contain unsafe levels of pathogenic microorganisms. To make food as safe as possible, survivors should follow the general guidelines for food safety as shown in Table 2.

#### Dietary Supplements

Dietary supplements include vitamins, minerals, herbs, botanicals, amino acids, and glandular products. The use of dietary supplements is reported in 25% to 80% of cancer survivors.<sup>55,56</sup> One of the rationales for dietary supplement use stems from observations of lower cancer risk among those who eat diets rich in vegetables and fruits. There is little evidence, however, that dietary supplements can reproduce the benefit of a nutrient-rich diet. Few studies have examined the efficacy of dietary

supplements as an alternative or complementary cancer treatment.

During and after cancer treatment, there is a probable benefit of taking a standard multiple vitamin and mineral supplement that contains approximately 100% of the Daily Value because, during these times, it may be difficult to eat a diet with adequate amounts of these micronutrients.<sup>57,58</sup> In contrast, the use of very large doses of vitamins, minerals, and other dietary supplements can cause physical harm.<sup>59,60</sup> The Dietary Reference Intakes provide recommendations of amounts of most vitamins and minerals needed for optimal health as well as the established Upper Tolerable Limits for most healthy persons.<sup>6</sup> Identification of upper tolerable limits and toxic effects is important because, for some, the practice of dietary supplementation has moved beyond the goal of health promotion and disease prevention to include speculation that dietary supplements may be instrumental in cancer prevention and treatment. There is reason for caution in taking high-dose supplements. Although many observational epidemiologic studies found that dietary beta-carotene was associated with lower risk for lung cancer,<sup>61</sup> two clinical trials showed that high-dose beta-carotene supplements actually increase (not decrease) the rate of occurrence of lung cancer.<sup>59,60</sup> In addition, another recent trial suggests that beta-carotene supplements may increase colorectal adenoma recurrence in persons who smoke cigarettes, consume alcohol, or both.<sup>62</sup> High doses of beta-carotene taken as a supplement do not appear to have the same effect as beta-carotene found in food.

In conclusion, although there is tremendous enthusiasm for expanding current cancer prevention and treatment options to include dietary supplements, and although supplement use is very common among cancer survivors, studies of the effect of nutritional supplements on cancer recurrence and survival are few. It is still prudent to encourage cancer survivors to obtain the potentially beneficial compounds from food. A daily multivitamin supplement in amounts equivalent to 100% of the Daily Value is a good choice for anyone who, for whatever reasons, cannot eat a healthful diet,<sup>57,58</sup> but the use of vitamin and mineral supplements in higher doses should be assessed and discussed on an individual basis.

#### Physical Activity Issues for Cancer Survivors

Physical activity may have benefits throughout the spectrum of living with cancer, but cancer survivors are often at increased risk for becoming too sedentary for several reasons. First, survivors tend to decrease their physical activity levels after the diagnosis of cancer, and most continue lower levels of activity through treatment and beyond, rarely returning to their prediagnostic levels of activity.<sup>63-65</sup> Second, some therapies may reduce the capacity to exercise because of adverse effects on cardiopulmonary, neurologic, and muscular systems. Third, being sedentary is a risk factor for the incidence of several of the most common types of cancer, such as breast cancer and colorectal cancer, and therefore persons with these cancers will tend to continue to be sedentary. Thus, reduced levels of fitness, stamina, and strength and the stresses of cancer diagnosis, treatment, and recovery challenge cancer survivors who want to increase their physical activity levels. For these reasons, exercise that is of low or moderate intensity for a healthy person may be of high intensity for some cancer survivors.

Physical activity capabilities and effects will differ among cancer survivors depending on their diagnosis, treatment modalities, and the spectrum of cancer survival.<sup>66</sup> Many cancer survivors are at increased risk for co-

morbid conditions that can be reduced through increased physical activity.<sup>22</sup> The effects of physical activity on cardiovascular disease and diabetes have not been studied in the population of cancer survivors, but there is no reason to believe that such outcomes would differ from those observed in the general population. Similarly, resistance exercise has been reported to improve bone strength in persons without cancer, but the effectiveness of resistance exercise programs on osteoporosis in cancer survivors is not yet known. Women who experience menopause during or after treatment and men with prostate cancer who are treated with long-term androgen-suppressive medications are at high risk for osteoporosis<sup>67,68</sup> and might therefore benefit from resistance training to increase bone strength. Additional positive outcomes of exercise training can include improved lean body mass and balance, with resulting reduced risk for falls and subsequent fractures. Clinical trials are underway that are testing the effects of aerobic and resistance exercise on bone density in postmenopausal breast cancer survivors.

Cancer survivors with lymphedema may also benefit from exercise, specifically range-of-motion exercises, with approval from their treating physicians. The benefits and risks of resistance training in survivors with lymphedema have not been investigated systematically. There have been some concerns that physical activity involving the affected limbs might have adverse effects on lymphedema. However, results of an early pilot clinical and a small cohort study suggest that resistance training does not increase the risk for new or worsening lymphedema.<sup>69,70</sup>

No large clinical trials or observational studies have reported the effect of physical activity on the risk for cancer recurrence or survival, but several clinical trials have assessed the effect of physical activity on quality-of-life and other psychosocial outcomes in cancer survivors. The exercise programs in these trials were primarily 3 days per week of moderate to vigorous activity that was progressively increased in duration to approximately 45-minute sessions during a period of 3 or 4 months. These studies have shown that such exercise programs can

TABLE 3

## Suggested Ways To Increase Physical Activity

- Use stairs rather than an elevator.
- If you can, walk or bike to your destination.
- Exercise with your family, friends, and coworkers.
- Take a 10-minute exercise break to stretch or take a quick walk.
- Walk to visit nearby friends or coworkers instead of sending an e-mail.
- Plan active vacations rather than only driving trips.
- Wear a pedometer every day and watch your daily steps increase.
- Use a stationary bicycle while watching TV.
- Plan your exercise routine to gradually increase the days per week and minutes per session.

reduce anxiety and depression, improve mood, boost self-esteem, and reduce symptoms of fatigue.<sup>14</sup>

Although some cancer survivors can adopt an exercise program independently, many will benefit from referral to an exercise specialist. A physical therapist is the appropriate resource for survivors with injuries, pain, or specific postsurgical issues such as lymphedema or amputation. Exercise physiologists receive college training and are certified by various professional organizations to develop individualized exercise programs. Personal trainers are also popular choices for persons who want to increase their fitness and activity levels. Personal trainers should have special training or certification, however, before working with cancer survivors.

In general, physical activity is likely to be beneficial for most cancer survivors. Recommendations on the type, frequency, duration, and intensity of exercise should be individualized to the survivor's age, previous fitness activities, type of cancer, stage of treatment, type of therapy, and comorbid conditions. Table 3 contains some suggested ways to increase physical activity.

Particular issues for cancer survivors may affect or contraindicate their ability to exercise. Effects of treatment may also promote the risk for exercise-related injuries and adverse effects. Specific precautions should be heeded:

- Survivors with severe anemia should delay exercise, other than activities of daily living, until the anemia is improved.

- Survivors with compromised immune function should avoid public gyms and other public places until their white blood cell counts return to safe levels. Survivors who have completed a bone marrow transplant are usually advised to avoid exposure to public places with risk for microbial contamination, such as gyms, for 1 year after transplantation.
- Survivors suffering from severe fatigue from their therapy may not feel up to an exercise program, so they may be encouraged to do 10 minutes of stretching exercises daily.
- Survivors undergoing radiation should avoid chlorine exposure to irradiated skin (eg, swimming pools).
- Survivors with indwelling catheters should avoid water or other microbial exposures that may result in infections as well as resistance training of muscles in the area of the catheter to avoid dislodgment.
- Survivors with significant peripheral neuropathies may have a reduced ability to perform exercises that use the affected limbs because of weakness or loss of balance. They may do better with a stationary reclining bicycle, for example, than walking outdoors.

For the general population, the ACS and other health organizations recommend at least 30 minutes of moderate physical activity at least 5 days per week to reduce the risk for cancer, cardiovascular disease, and diabetes.<sup>16,20,22</sup> These levels of activity have not been studied or tested specifically in cancer survivors, however. For the general population and for cancer survivors, any movement is likely beneficial. Therefore, although daily and regular activity may be preferred and may be a goal, any steps that are taken to move from a sedentary to an active lifestyle should be encouraged. For survivors wanting maximum benefit, the message should be that the health benefits of exercise are generally linear, with benefit related to higher intensity and duration, although extremely high levels of exercise might increase the risk for infections.<sup>71</sup>

### Nutritional Issues in Complementary and Alternative Medicine

Although the practices of complementary and alternative medicine include many types of therapies apart from those involving nutrition, only the more common practices that have significant nutrition and physical activity components are addressed here. Complementary approaches are those that are used in combination with standard medical treatment, whereas alternative approaches are those that are intended to replace standard treatment.<sup>72</sup> Complementary approaches can be useful to enhance a person's response to treatment and provide relief from symptoms without interfering with the effectiveness of standard cancer treatment. Survivors should share information on their use of complementary therapies with health care providers to ensure that the complementary therapies do not interfere with standard treatment. When possible, health care providers should consider recommending that survivors participate in a clinical trial testing the efficacy of the approach. An up-to-date listing of clinical trials and other studies on alternative medicine can be found on the National Institute of Health's National Center for Complementary and Alternative Medicine Web site ([www.nccam.nih.gov](http://www.nccam.nih.gov)).

A wide variety of complementary and alternative medical therapies are related to food and nutrition. Many supplements are marketed as dietary supplements to avoid the stricter regulations that pertain to foods or pharmaceuticals. Many of these are not based on nutrients or other compounds that occur naturally in foods. In general, there is little or no evidence supporting the use of these therapies among cancer survivors.

### Special Dietary Regimens

Although following the recommendations stated in the "American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention" provides a good basis for food choices for all persons, including cancer survivors,<sup>16</sup> other dietary regimens have been promoted as alternatives or adjuncts to cancer

therapy. The evidence examining the effectiveness of these regimens during and after cancer treatment is sparse. A brief description of some of the more common regimens follows. None should be regarded as an alternative to standard cancer treatment.

#### *Gerson Therapy*

Gerson therapy is based on the belief that cancer is the result of poor metabolism of carbohydrate, protein, and fat, leading to toxin accumulation and an imbalance of sodium and potassium. The treatment involves a raw vegetable and fruit diet, hourly consumption of raw vegetable and fruit juices, detoxification treatments with coffee enemas, and various dietary supplements. The therapy previously included raw calves' liver juice, but this feature has been discontinued because of several cases of severe illness from pathogenic contamination. The biologic, nutritional, or immunologic bases for this therapy are not supported by established scientific principles.<sup>73</sup> There is no scientific evidence that this therapy reduces cancer progression or improves survival.

#### *The Gonzalez Regimen*

This regimen, originally developed by Dr. William Kelley and now promoted by Dr. Nicholas Gonzalez, involves an intensive diet and supplement regimen intended to remove toxins from the body.<sup>74</sup> This program classifies persons with cancer into one of three metabolic types, and diets are then prescribed by metabolic type. This regimen can use as many as 150 supplements daily along with multiple daily detoxification treatments. To date there is no documented evidence of the efficacy for cancer survivors, although its effectiveness is currently being examined in a study funded by the National Cancer Institute based on a recent report of increased survival in 11 individuals with inoperable pancreatic cancer.<sup>75,76</sup> At this point, it is not known whether the treatment is either effective or safe.

*Livingston-Wheeler Therapy*

Proponents of this treatment believe that when the immune system has been weakened, bacteria spread can lead to the development of cancer.<sup>77</sup> Proponents of Livingston-Wheeler therapy claim that it stimulates the survivor's immune system to allow the body to fight the cancer. The treatment consists of antibiotics, vitamin and mineral supplements, digestive enzymes, detoxifying enemas, and a vegan diet. Vaccines were once used but are no longer allowed in California, the only location in the United States where this treatment is provided. One study involving advanced cancer survivors showed no difference in survival compared with conventional therapy.<sup>78</sup> There is no evidence supporting beneficial effects of this therapy, nor has it been shown to improve the quality of life for cancer survivors.

*Macrobiotic Diet*

Although the macrobiotic diet and lifestyle is not primarily aimed at cancer survivors, many persons first encounter the macrobiotic diet in the context of cancer. Macrobiotic diets are based on whole grains and cereals, vegetables, sea vegetables, beans, fermented soy products, fruits, nuts, seeds, soups made from these ingredients, small amounts of fish, and teas.<sup>79</sup> Individualized diets are based on whether a cancer is classified, according to the Eastern classification system, as relatively "yin" or "yang." Macrobiotic diets can be consistent with a healthful diet, but survivors consuming a macrobiotic diet should take care to consume adequate calories and to obtain sufficient nutrients, which may be difficult for nutritionally compromised survivors. Although some research supports the health benefits of macrobiotic diets, outcome studies in cancer have been limited and remain controversial. No data support the claim that a macrobiotic diet reduces cancer incidence or recurrence to a greater degree than following ACS dietary and physical activity guidelines for cancer prevention. For persons who are well nourished, macrobiotic diets may be used as an adjuvant to conventional treatment with careful planning to ensure nutritional variety and adequacy.

**Special Foods or Supplements**

In addition to more comprehensive dietary regimens, cancer survivors are often interested in supplementing their diets with specific foods or dietary supplements that they may have heard can offer beneficial effects. Some of these specific foods or supplements are highlighted here.

*Flaxseed*

Flaxseed has been virtually absent from the modern diet, but it has a unique nutrient profile because it is the most concentrated source of both plant-based omega-3 fatty acids and dietary lignans (fiber-related polyphenolic compounds with estrogenic activity). In vitro studies in human cancer cell lines and studies in animal model systems suggest that flax-derived compounds hinder cancer cell growth.<sup>80,81</sup> Only one small, nonrandomized study conducted in men with prostate cancer has shown lower rates of tumor cell proliferation and increased rates of apoptosis in those who followed a flaxseed-supplemented, low-fat diet before prostatectomy.<sup>82</sup> More data are needed before any recommendations can be made to include flaxseed in the cancer survivors' diet. If survivors choose to consume flaxseed, using the whole seed (rather than only the flaxseed oil) provides the potential benefits of both the omega-3 fatty acids and fiber, but the seed coat must be broken (either through grinding or soaking) to liberate the omega-3 fatty acids. Because of the high propensity of flaxseed oil to oxidize, it should be consumed or refrigerated shortly after the seed coat is broken.

*Garlic*

Studies in progress are investigating the possible cancer prevention, antibacterial, or antifungal effects of garlic, but to date no conclusive evidence to support these effects has been identified.<sup>83</sup> Because of the small amounts of garlic included in most diets, a therapeutic response to low doses is difficult to ascertain. However, some potentially harmful effects of consumption of large quantities of garlic or garlic supplements include stomach pain, gas, vomiting, and inhibi-

tion of platelet function. Survivors who are taking anticoagulant medications such as warfarin or aspirin, who have altered platelet function, and those who are thrombocytopenic should be cautioned against consuming large quantities of garlic or garlic supplements.

### Ginger

Ginger has some antinausea properties and is useful in the management of motion sickness. It may not be an effective antinausea agent during chemotherapy treatment, however, because it acts on the stomach rather than on the central nervous system, which is the source of chemotherapy-induced nausea.<sup>84,85</sup> Even so, the taste and aroma of ginger and ginger-containing foods and beverages may have a calming effect for some persons. Ginger, however, has antiplatelet activity, and large doses have been shown to prolong bleeding time.<sup>85</sup>

### Tea

Tea consumption has been promoted as a cancer prevention measure because of its antioxidant content. In animal studies, some teas have been shown to reduce cancer risk, but epidemiologic studies have had mixed findings.<sup>86,87</sup> Because tea catechins and polyphenols can affect the growth of cancer cells in vitro, tea remains an area of active investigation for cancer prevention.<sup>88</sup> Very little research has been done on the specific effects of tea consumption among cancer survivors. A recently published clinical trial on prostate cancer survivors funded by the National Cancer Institute showed not only a lack of benefit from tea but increased nausea and diarrhea, as well.<sup>89</sup> A wide variety of medicinal and culinary plants are infused into teas and may be useful for nausea or other common symptoms experienced by cancer survivors. These include ginger for improvement of appetite, chamomile for gastrointestinal discomfort, and peppermint as a digestive aid. Certain medicinal herb teas may be problematic if they contain adulterants, contaminants, hepatotoxic compounds, or are prepared in such way that food safety is compromised.<sup>90</sup> The therapeutic benefit of green

and black tea and tea supplements continues to be investigated.

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## NUTRITION AND PHYSICAL ACTIVITY ISSUES BY SELECTED CANCER SITES

### Breast Cancer

Excess body weight may be the most important avoidable factor related to nutrition and physical activity that affects breast cancer survival. Two independent reviews of studies conducted within the past decade found that increased adiposity is a significant risk factor for recurrent disease and/or decreased survival among persons with breast cancer.<sup>34,91</sup> The extent of the association between obesity and adverse breast cancer outcome is substantial and appears to vary by stage and by diagnosis. In a large cohort study, women with Stage I breast cancer whose weight placed them in the upper quintile of body mass index had a 70% increased risk for dying of breast cancer, and a 40% increased risk was seen among women with Stage II breast cancer who were in the upper quintile. Among women with late Stage III and Stage IV cancer, body mass index was not associated with an increased risk for death.<sup>92</sup> Little research has been done to examine the relation of weight gain after diagnosis and prognosis. A study of premenopausal women found that those who gained more than approximately 13 pounds were 1.5 times more likely to relapse and 1.6 times more likely to die than were women who gained less weight.<sup>37</sup> Unfortunately, weight gain after the diagnosis of breast cancer is a common occurrence.<sup>34,38</sup>

Avoiding or reversing this type of weight gain may be especially responsive to exercise interventions, particularly those that emphasize resistance training.<sup>93-95</sup> Because weight gain adversely affects the risk for cardiovascular disease and diabetes, to reduce the risk for breast cancer recurrence and to increase chances for long-term survival, appropriate weight control may be particularly beneficial for breast cancer survivors.<sup>96,97</sup> Because obesity has been shown to adversely affect prognosis, breast cancer sur-

vivors should be encouraged to achieve and maintain a healthy weight that is appropriate for their height.<sup>17</sup> Even if an ideal weight is not achieved, it has been established in the general population that a weight loss of 5% to 10% over 6 to 12 months is sufficient to reduce the levels of risk factors associated with disease risk, such as elevated plasma lipids and high fasting insulin levels. The weight gain experienced by women who have been treated with adjuvant chemotherapy appears to be the result of increases in adipose tissue mass only, with no change or a decrease in lean body mass.<sup>98-101</sup> Among women who are overweight, modest weight loss (1 to 2 pounds per week) can be pursued safely, as long as it is approved by the treating oncologists, monitored closely, and does not interfere with treatments.<sup>102,103</sup>

Women should be encouraged to curb weight gain during treatment. After treatment, safe weight loss via increased physical activity and healthful food choices should be encouraged for overweight or obese breast cancer survivors. Moderate physical activity during and after treatment may help survivors maintain lean muscle mass while avoiding excess body fat.

The evidence for dietary fat in affecting the risk for recurrence and survival is not strongly or consistently supportive, especially when total calories and the degree of obesity are considered.<sup>42,43</sup> Two major randomized clinical trials are testing the hypothesis that a low-fat dietary pattern can favorably influence the course of breast cancer after diagnosis (the WINS<sup>46</sup> and WHEL studies).<sup>47</sup> The WINS study has randomized postmenopausal women within 12 months of primary surgery for breast cancer to either usual diet or a diet low in fat ( $\leq 15\%$  of energy from fat). The WHEL study has randomized women to usual diet or a diet that is both low in fat but also very high in fiber, vegetables, and fruit. These studies will provide more definitive data on whether changes in diet, including reduced fat, can influence the risk for recurrence and survival after the diagnosis of early-stage breast cancer. Results from these studies are expected after 2006.

Eating more vegetables is inconsistently related to reducing breast cancer risk, and the

evidence for fruit is also weak.<sup>104,105</sup> Vegetables in the diet can reduce the total energy density, and both vegetables and fiber are associated with improved satiety. Inadequate folate status (determined in large part by inadequate dietary intake of fruits, vegetables, and grains) has been hypothesized to be related to increased breast cancer risk.<sup>106-108</sup> Folate might ameliorate the adverse effects of alcohol on breast cancer risk, because some studies have shown that the increased risk associated with alcohol is more pronounced among women with lower folate intake.<sup>108-110</sup> What effect folate (whether from supplements or from food sources) might have on recurrence or survival among breast cancer survivors is not known.

Although alcohol intake has been linked with a modest increase in the risk for primary breast cancer,<sup>54</sup> there is limited evidence from studies of breast cancer survivors of a relationship with the risk for recurrence and survival.<sup>34</sup> Theoretically, however, alcohol intake can affect the risk for a second primary breast cancer, for which all breast cancer survivors are at increased risk. Alcohol is an unusual factor, however, because it presents both risks and benefits. In the general population, clear and consistent evidence links modest alcohol intake (1-2 drinks per day) with a lower risk for cardiovascular disease.<sup>53</sup> For breast cancer survivors, then, the decision to drink alcoholic beverages at moderate levels is complex, as they must consider their levels of risk for both cardiovascular disease and breast cancer.

There is considerable public and scientific interest in the role of soy foods in the prevention of breast cancer, although scientific support for such a role is remarkably inconsistent.<sup>111-114</sup> The interest in soy foods stems from the observation that they are used commonly in most Asian countries, where the rates of breast cancer are lower than in the United States, and several epidemiologic studies in Asia or in Asian American populations suggest that soy food intake may decrease the risk for breast cancer. Soy contains high levels of plant isoflavones that exert a variety of anticancer activities in laboratory studies.<sup>111</sup> Perhaps because soy has the potential to produce both estrogenic and antiestrogenic effects,

studies on soy and breast carcinogenesis have produced conflicting results.<sup>111-114</sup> For the breast cancer survivor, current epidemiologic and laboratory evidence suggests neither specific benefits nor harmful effects when soy is provided in the diet consistent with amounts in a typical Asian diet.<sup>111</sup> That amount would be provided by as many as three servings per day of soy foods such as tofu and soy milk. Because higher doses of soy may have estrogenic effects<sup>114</sup> and because higher levels of estrogens clearly increase the risk for breast cancer progression,<sup>111</sup> it is prudent for breast cancer survivors to avoid the high doses of soy and soy isoflavones that are provided by more concentrated sources such as soy powders and isoflavone supplements.

More than 30 studies have examined exercise during and after treatment in breast cancer survivors.<sup>14</sup> Few studies are large randomized clinical trials, but the evidence consistently suggests a benefit from exercise during and after breast cancer treatment on various measures of quality of life. The studies have focused primarily on physical fitness (eg, cardiovascular endurance, flexibility, and body composition) and factors such as self-esteem, anxiety, depression, and fatigue. No data exist on the relation between physical activity and cancer recurrence, risk for other diseases, or overall survival among cancer survivors. Compelling data exist, however, on the benefits of physical activity for the primary prevention of breast cancer, heart disease, diabetes, and overall mortality rate. It is reasonable to assume that such relations also hold for breast cancer survivors.

As we await results from studies such as WINS<sup>46</sup> and WHEL,<sup>47</sup> it is important to remember that limiting intake of saturated fat is a well-established strategy to reduce the risk for cardiovascular disease, for which breast cancer survivors are at increased risk.<sup>20,96</sup> Nutrition and physical activity recommendations to reduce the risks for primary breast cancer and heart disease are especially important for breast cancer survivors. Diets should emphasize vegetables and fruits, low amounts of saturated fats, soy foods in moderation, and moderate or no alcohol. Most important in those recommendations is to strive to achieve and maintain a

healthy weight through appropriate diet and regular physical activity.

### Colorectal Cancer

Many epidemiologic studies indicate that colorectal cancer risk is increased by diets high in red meat (especially processed meats) and saturated fats and low in vegetables and fruits and by sedentary lifestyles and obesity. Excess alcohol consumption may also increase the risk for this cancer.<sup>115</sup> Whether these or other dietary factors also influence prognosis of colorectal cancer is largely unknown. Only a few studies have tried to determine whether dietary factors influence prognosis after colorectal cancer diagnosis, and their findings have varied. Findings from two studies suggest that increased body weight is associated with shorter survival.<sup>32,33</sup>

Because colorectal cancers arise from adenomatous polyps, the prevention of polyp recurrence has been a focus of considerable clinical research. To date, trials have failed to show benefits in preventing new polyp growth during a 3- or 4-year period from antioxidant vitamins, fiber supplements, or modest dietary changes to increase fruit and vegetable intake.<sup>116</sup> Calcium supplements, however, provided a modest benefit in preventing polyp recurrence.<sup>117</sup> One trial showed benefits of beta-carotene supplementation on adenoma recurrence among those who were nonsmokers and nondrinkers. The risk for recurrence increased slightly in smokers and in persons who drank one alcoholic beverage per day and increased markedly in smokers who also consumed more than one alcoholic beverage per day.<sup>62</sup> Clinical trials testing the effects of folic acid are underway. After a diagnosis of colorectal cancer, the most important determinants of survival seem to be adherence to the full treatment regimen (especially if chemotherapy is recommended) and colonoscopic surveillance to identify new lesions.

Three studies have shown the benefits of exercise on quality of life among colorectal cancer survivors.<sup>64,118,119</sup> No studies have examined the effects of exercise on colorectal cancer recurrence or survival in colorectal

cancer survivors. The evidence for a relation between physical activity and the primary prevention of colon cancer is convincing.<sup>21</sup> Given this documented relation, benefits to quality of life, and other studies linking exercise to reduced risk for other chronic diseases and better overall survival, exercise is probably beneficial to reduce the risk for a second primary colorectal cancer and to increased overall survival after colorectal cancer.

Colorectal cancer survivors should be advised to maintain a healthy weight, eat a well-balanced diet consistent with guidelines for cancer and heart disease prevention, and participate in regular physical activity. Colorectal cancer survivors with chronic bowel problems or surgery that affects normal nutrient absorption should be referred to a registered dietitian to modify their diets to accommodate these changes and maintain optimal health.

#### Lung Cancer

Lung cancer is largely due to cigarette smoking, but diets low in vegetables and fruits have also been associated with increased lung cancer risk, even after accounting for tobacco use.<sup>61</sup> This observation led to the idea that perhaps the antioxidant beta-carotene, found in vegetables and fruits, might reduce lung cancer risk, but two large randomized clinical trials showed that high-dose beta-carotene supplementation actually increased the risk for lung cancer.<sup>59,60</sup> The possible effect (either beneficial or harmful) of nutritional supplements other than beta-carotene after the diagnosis of lung cancer has not been studied. One clinical trial of selenium and skin cancer noted a reduced incidence of lung cancer with selenium supplements.<sup>120</sup> A new clinical trial is now underway to attempt to replicate and extend this work among lung cancer survivors.<sup>121</sup>

Few studies have examined the relation between dietary factors and lung cancer prognosis. Two small studies sought to determine whether dietary intervention with selected vegetables improved survival among those with Stage III or IV non-small-cell lung cancer.<sup>122,123</sup> Weight loss was less and survival was longer in the intervention groups in those studies. Although these results are encouraging,

these findings need to be confirmed by other investigators and in larger studies. Three randomized clinical trials that included lung cancer survivors, among others, encouraged participants to increase energy intake.<sup>124–126</sup> Although successful in increasing energy intake, none of the strategies used within these studies prevented weight loss.

Lung cancer treatment is often aggressive and causes adverse effects. Furthermore, many lung cancer survivors have low blood nutrient levels even before diagnosis as a result of inadequate diets, and/or the adverse effects of smoking on micronutrients. During treatment and the immediate recovery period, lung cancer survivors may benefit from eating foods that provide concentrated calories and are easy to swallow. Small, frequent meals may be easier to manage than three large meals per day. Medications, omega-3 fatty acid supplements, and additional nutritional support may be helpful for those experiencing weight loss.<sup>26</sup> If nutrient deficiencies are present or survivors cannot eat enough to adequately meet micronutrient needs, a multivitamin-mineral supplement is advisable, either in pill or liquid form.

Recommendations for nutrition and physical activity for persons who are living with lung cancer are best made based on individual needs. Striving toward a healthy weight by adjusting food intake and physical activity is a reasonable goal, as is ensuring that micronutrient needs are met with a well-balanced diet and a multivitamin-mineral supplement, if needed.

#### Prostate Cancer

Most research on diet and prostate cancer has focused on prostate cancer incidence.<sup>127,128</sup> The same dietary factors that are associated with reduced prostate cancer incidence might also reduce the rate of prostate cancer growth after diagnosis, thus preventing or slowing progression of early-stage prostate cancer. In recent years, few studies have tried to determine directly whether such dietary factors may prolong survival from prostate cancer or may influence other factors (eg, prostate-specific antigen levels) that are associated with outcomes for men with prostate cancer.

A high intake of foods from animal sources, especially foods high in saturated fat, has been associated with increased prostate cancer risk.<sup>43,127</sup> Whether this increased risk is due to saturated fat per se or to consumption of red meat and high-fat dairy products is unclear. The observation that fatty fish intake may decrease the prostate cancer mortality rate suggests that if fat is important, the type of fat may play a key role. There are now two follow-up studies of survival in prostate cancer survivors. One found that saturated fat intake (but not total fat) is associated with worse survival,<sup>129</sup> and the other found that monounsaturated fat intake is associated with better survival.<sup>130</sup> Based on what we currently know and the role of saturated fat in cardiovascular disease, decreasing saturated fat intake is probably beneficial.<sup>19,20</sup>

Most studies of prostate cancer prevention have not shown an association between vegetable and fruit intake and prostate cancer risk.<sup>16,18,128</sup> A possible beneficial effect of lycopene, found in tomatoes and tomato products, has captured attention,<sup>131</sup> but it is unclear whether this association is causal or spurious.<sup>132</sup> Lycopene or tomato intake has not been examined in follow-up studies of prostate cancer survivors.<sup>133,134</sup> Although benefits to prostate health from vegetables and fruits are far from certain, a diet high in vegetables and fruits has been found to reduce the risk for cardiovascular diseases.<sup>20</sup> Therefore, it is probably beneficial for prostate cancer survivors to eat plenty of micronutrient- and phytochemical-rich vegetables.

Increased consumption of soy foods (eg, tofu and soy milk) containing active phytoestrogens is often recommended for prostate cancer survivors. Although some studies suggest that soy foods may decrease the risk for prostate cancer, no rigorous studies have examined the effects of soy or other phytoestrogens on the growth of prostate cancer after diagnosis, although studies are underway. One small study examined the effects of flaxseed, a concentrated source of lignan phytoestrogens, on prostate cancer growth in prostate cancer survivors.<sup>82</sup> Although this study suggested some potentially beneficial effects on prostate-specific antigen levels, it is not known whether these findings result in better prognoses for men with prostate cancer.

Several epidemiologic studies have shown that men who have high levels of calcium in their diets, from both supplements and dairy products, might be at increased risk for prostate cancer and aggressive disease.<sup>135</sup> The possible effects of calcium after prostate cancer treatment, however, are not known. Prostate cancer survivors undergoing androgen-suppressive therapy are at high risk for osteoporosis. It is not known if calcium or vitamin D supplements would be useful or detrimental in these cases. The role of vitamin D and related compounds in the prevention of prostate cancer is being studied; two preliminary studies suggest that vitamin D may reduce prostate-specific antigen levels, given either separately or in conjunction with chemotherapy, although further research is needed to determine the effect of this treatment.<sup>136,137</sup>

Vitamin E supplementation in a large prevention trial intended to affect lung cancer was shown to be associated with a reduced risk for primary prostate cancer and for more aggressive disease, but vitamin E had no effect on survival in the men in whom prostate cancer developed in that study.<sup>59,138</sup> Selenium supplements reduced prostate cancer incidence in a small trial intended to prevent skin cancers.<sup>120,139</sup> Trials are now underway to assess the effects of both vitamin E and selenium on both prostate cancer prevention and suppression of tumor growth after diagnosis.<sup>140,141</sup>

Studies that have examined the association between the degree of obesity or physical activity and the risk for primary prostate cancer have not shown a consistent relation,<sup>21</sup> although one large cohort study did find that prostate cancer survivors who were overweight had higher mortality rates.<sup>36</sup> Three follow-up studies of men in whom prostate cancer was diagnosed have not found a relation between obesity and the risk for recurrence and survival.<sup>129,130,142</sup> There is only one published study that examined the benefits of exercise in prostate cancer survivors and found improved muscle strength with training, but the study was not large enough or long enough to assess cancer recurrence.<sup>143</sup> Data from other population studies suggest that there may be substantial benefits of both weight control and exercise in

preventing other chronic diseases and increasing overall survival in prostate cancer survivors.

Men in whom prostate cancer has been diagnosed should consume diets that are rich in vegetables and fruit and low in saturated fat and pursue a physically active lifestyle. Although the evidence relating these recommendations to prostate cancer recurrence is limited, there are likely substantial other benefits, most prominently decreasing cardiovascular disease risk, which is the major cause of death in prostate cancer survivors.

#### Upper Gastrointestinal and Head and Neck Cancers

The research on prevention of head and neck, esophageal, gastric, and pancreatic cancers suggests the importance of diets that emphasize vegetable and fruit intake and, in the case of pancreatic cancer, prevent obesity.<sup>144–147</sup> After the diagnosis of these cancers, however, little is known regarding whether such dietary patterns or other dietary or physical activity factors may affect prognosis.

Studies on the etiology of head and neck cancers suggest that vegetable and fruit intake may be associated with decreased risk for these cancers, but few studies have considered whether these dietary factors or physical activity influence prognosis in survivors with these cancers. A clinical trial of the effects of a beta-carotene supplement (versus placebo) among survivors with head and neck cancers found that those receiving beta-carotene had no changes in cancer recurrence rates.<sup>148</sup>

Persons with esophageal or gastric cancer may have symptoms that compromise food and nutrient intake and absorption, and the effects of treatment may result in long-term nutritional complications. A common problem in survivors with esophageal cancer is reflux.<sup>3</sup> Eating a high-protein, low-fat, high-carbohydrate diet helps increase lower esophageal sphincter pressure. Chocolate, fat, alcohol, coffee, spearmint, peppermint, garlic, and onion may decrease lower esophageal sphincter pressure and should be avoided. Acidic foods, such as tomato-based products and orange juice, may cause irritation. Nutritional management for persons who have

gastric cancer is based on determining what portion of the stomach is involved or has been surgically altered. For example, if the pyloric sphincter has been affected, rapid transit of food through the stomach may occur.

In the case of pancreatic cancer, there is limited evidence that supplementation with omega-3 fatty acids has a favorable effect on short-term weight status, performance status, or related factors.<sup>28</sup> A preliminary study examined the Gonzalez dietary and supplementation regimen, with results suggesting an improvement in survival rates. Because these results were in a self-selected group of patients, findings are not definitive. However, a study funded by the National Cancer Institute is underway to determine whether this regimen has a beneficial effect.<sup>76</sup> Another study suggested that the macrobiotic diet may also improve survival in persons with pancreatic cancer.<sup>149</sup> This study also has several methodologic limitations, and better designed studies are needed before any recommendations regarding the macrobiotic diet are possible.

Head and neck cancers can directly compromise food intake. Comprehensive care of these survivors includes appropriate nutritional assessment and support and physical activity and physical therapy to improve overall health before, during, and after treatment. Poor nutrient intake can stem from difficulties in biting, chewing, and swallowing that follow surgery and from dry mouth, mucositis, and taste alterations resulting from radiation therapy. During and after treatment, the texture, temperature, consistency, nutrient content, and frequency of oral feedings may need to be changed. Acidic, salty, spicy, and very hot or cold foods may not be well tolerated. Sugar-free gums and mints and the use of oral rinses and gels may provide limited relief of symptoms and enhance appetite. Liquid, pureed, or juiced foods may be better tolerated during treatment and recovery. Health care providers may offer alternate forms of feeding if eating and drinking by mouth cannot support nutritional needs.

In the absence of more definitive information, survivors of head and neck and upper gastrointestinal cancers should strive to follow the ACS nutrition and physical activity guide-

TABLE 4

| ACS Expert Committee's Grading of Evidence for Benefit Versus Harm for Breast, Colorectal, Lung, and Prostate Cancers |               |         |      |                   |         |      |             |         |      |                 |         |      |
|---|---------------|---------|------|-------------------|---------|------|-------------|---------|------|-----------------|---------|------|
|   | Breast Cancer |         |      | Colorectal Cancer |         |      | Lung Cancer |         |      | Prostate Cancer |         |      |
|   | Cancer        | Overall | QOL† | Cancer            | Overall | QOL† | Cancer      | Overall | QOL† | Cancer          | Overall | QOL† |
| Striving for healthy weight   |               |         |      |                   |         |      |             |         |      |                 |         |      |
| during treatment  | A3            | B       | B    | A3                | B       | B    | A3          | A2      | A2   | B               | B       | B    |
| after treatment   | A2            | A2      | A2   | A3                | A2      | A2   | A3          | A2      | A3   | B               | A2      | A3   |
| Increasing physical activity  |               |         |      |                   |         |      |             |         |      |                 |         |      |
| during treatment  | B             | B       | A2   | B                 | A3      | A2   | B           | B       | B    | B               | B       | A3   |
| after treatment   | A3            | A3      | A2   | A3                | A2      | A2   | B           | A2      | A3   | B               | A2      | A2   |
| Limiting  |               |         |      |                   |         |      |             |         |      |                 |         |      |
| total fat   | B             | B       | B    | B                 | B       | B    | B           | B       | B    | B               | B       | B    |
| saturated fat   | B             | A2      | A3   | A3                | A3      | B    | B           | A3      | B    | A3              | A2      | B    |
| Increasing vegetables and fruits  | A3            | A3      | B    | A3                | A3      | B    | A2          | A3      | B    | A3              | A2      | A3   |
| Increasing  |               |         |      |                   |         |      |             |         |      |                 |         |      |
| fiber   | B             | B       | B    | B                 | A3      | B    | B           | B       | B    | B               | B       | B    |
| omega 3 fatty acids   | B             | B       | B    | B                 | B       | B    | B           | A3      | B    | B               | B       | B    |
| soy   | B             | B       | B    | B                 | B       | B    | B           | B       | B    | B               | B       | B    |

\*Includes deaths from heart disease.

†QOL = Quality of life.

Grading System:

A1 = Convincing evidence for a benefit in cancer survivors.

A2 = Probable benefit in cancer survivors.

A3 = Possible benefit in cancer survivors.

B = Insufficient evidence to conclude benefit or risk in cancer survivors.

C = Evidence of lack of benefit in cancer survivors.

D = Evidence of harm in cancer survivors.

lines for the prevention of cancer. Because food intake can be compromised due to the effects of disease or therapy, consultation with a registered dietitian for individualized recommendations is recommended.

AMERICAN CANCER SOCIETY EXPERT COMMITTEE  
GRADING OF EVIDENCE FOR BENEFIT VERSUS HARM

To summarize the strength of the scientific evidence, the ACS Expert Committee 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. Then they characterized those recommendations on a five-point grading scheme as to the strength of the evidence: good for recommending, fair for recommending, in-

sufficient to recommend for or against, fair for not recommending, good for not recommending. The American Institute of Cancer Research-World Cancer Research Fund project summarized the nature of the scientific evidence for nutritional factors in cancer prevention as Convincing, Probable, Possible, or Insufficient. The ACS committee used a method to summarize the evidence that was similar to the methods of both groups. For each issue, the committee judged the likelihood of benefit to cancer survivors 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

The ACS Expert Committee's grading for nutritional and physical activity evidence of benefit versus harm for breast, colorectal, lung, and prostate cancers is summarized in Table 4.

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