



## CHAPTER 23

# Diet and Cancer

### Learning Objectives

After completing this chapter, the student should be able to:

1. List several correlations between dietary intake and cancers of specific sites.
2. Interpret dietary guidelines for the prevention of cancer.
3. Identify reasons that population correlations may not apply to subgroups or to individuals.
4. Name several factors thought to contribute to loss of appetite in cancer clients.
5. Discuss measures to increase oral intake for clients with cancer.

Cancer has been known and described for thousands of years. Amazingly, one substance now linked to prevention was used as a treatment in ancient Rome, where crushed cabbage leaves were applied to cancerous ulcers (Albert-Puleo, 1983). Now cabbage is one of the cruciferous vegetables in the diet associated with reduced risk of cancer.

### Definitions and Statistics

Cancer means “crab,” for the creeping way in which it spreads. Cancer is a general term for more than 100 types of malignant neoplastic disease.

### Terminology

A **neoplasm**, is a new and abnormal formation of tissue (tumor) that grows at the expense of the healthy organism. Two main divisions of neoplasms are **malignant** or cancerous tumors, which infiltrate surrounding tissue and spread to distant sites of the body, and **benign** tumors, which are localized but potentially dangerous if located in vital organs.

Two of the chief types of cancer are sarcomas and carcinomas. **Sarcomas** arise from connective tissue, such as muscle or bone, and are more common in young people. **Carcinomas** occur in epithelial tissue, including cancers of the lung, breast, prostate, and colon, and are more com-

mon in older people. The characteristics common to all types of cancer are uncontrolled growth and the ability to spread to distant sites (**metastasize**). Clinical Application 23–1 summarizes the transformation of normal cells into cancer cells.

### Occurrence and Mortality

Cancers in general are more common in older people. In 1999 to 2000, the prevalence of cancer by age group was as follows:

- Ages 18 to 44 years — 2 percent
- Ages 45 to 64 years — 7.4 percent,
- Ages 65 to 74 years — 17.3 percent,
- Ages 75 years or older — 22.8 percent (National Center, 2004).

Cancer is the second most common cause of death in the United States after diseases of the heart and is expected to become the leading cause of death in the next decade. In 2001, the age-adjusted death rate for cancer already exceeded that for heart disease in four states: Alaska, Minnesota, Montana, and Oregon. In 1990 to 2000, the five primary sites with the highest age-adjusted death rates for males were lung/bronchus, prostate, colon/rectum, pancreas, and leukemia; for females, lung/bronchus, breast, colon/rectum, pancreas, and ovary. Overall, cancer mortality is higher among men compared with women and higher among black populations compared with whites (Centers for Disease Control, 2004). The incidence of the five most common cancers for men and women is illustrated in Figure 23–1, which shows that lung cancer, colorectal cancer, and non-Hodgkin’s lymphoma occupy the same ranks regardless of gender. Figure 23–2 exhibits the mortality rates by gender for whites and blacks for all cancers in the United States.

Clients who are alive and without recurrence of cancer 5 years after diagnosis are considered cured. This is termed the *5-year survival rate*. Depending on the site in which the cancer occurs, the survival rates vary greatly, but socioeconomic status affects the stage at which the cancer is diagnosed as well as survival rates. In a Michigan

### Clinical Application 23-1

#### Transformation of Normal Cells Into Cancer Cells

Cancer is basically uncontrolled replication of cells. Normal cells divide in the processes of growth and maintenance but stop dividing at appropriate points. Even in normal cell division, mistakes in deoxyribonucleic acid (DNA) transcription are made and corrected. Hundreds of incidents of oxidative damage to cell components, such as DNA, are estimated to occur in a cell daily, but this oxidative damage has not been directly linked to cancer. Obviously, not all of these mistakes go on to turn cells cancerous. Multiple enzyme systems inactivate the damaging elements, and various mechanisms repair the DNA (Slupphaug, Kavli, and Krokan, 2003). Deficiencies in DNA-damage signaling and repair pathways are fundamental to the etiology of most, if not all, human cancers (Khanna and Jackson, 2001). Several genes within a cell must be changed or **mutated** for cancer to occur.

Transformation of normal cells into cancer cells is a two-step process. The first step is **initiation**. The second step is promotion. Physical forces, chemicals, or biologic agents can damage genes. If the damage is not repairable, the gene has mutated, and if cancer develops later, the cancer cells are descendants of that mutated cell (Weinberg, 1996). The alteration may not be significant until the second step of the conversion to cancerous cells, **promotion**, takes place. The time period between initiation and promotion in some cases is 10 to 30 years but may be shorter if a mutated cancer-causing gene is inherited from a parent. Substances that enhance the expression of the altered gene are called promoters. They must be present at high levels for a prolonged period. Promoters are tissue specific, such as saccharin for cancer of the urinary bladder (in rats) and bile acids for colon cancer. In contrast to initiation, which results in permanent change, the process of promotion is reversible. Reducing exposure to high levels of promoters allows the body to repair the damaged cells.

Genes are carried in the DNA of the chromosomes in the cell nucleus. Two classes of genes play major roles in the life cycle of cells: **proto-oncogenes** and **tumor-suppressor genes**. In normal cells, proto-oncogenes support the growth and division of the cell, whereas tumor-suppressor genes inhibit those processes. Both proto-oncogenes and tumor-suppressor genes may be mutated and thus contribute to cancer development. The proto-oncogenes become carcinogenic **oncogenes** that stimulate excessive reproduction, and the tumor-suppressor genes become inactivated and unable to stop the multiplication of cells. As more is learned about the molecular basis of cancer, therapies can be developed that target the aberrant cells much more accurately than the treatments currently available. Several genes within a cell must undergo **mutation** for cancer to occur.

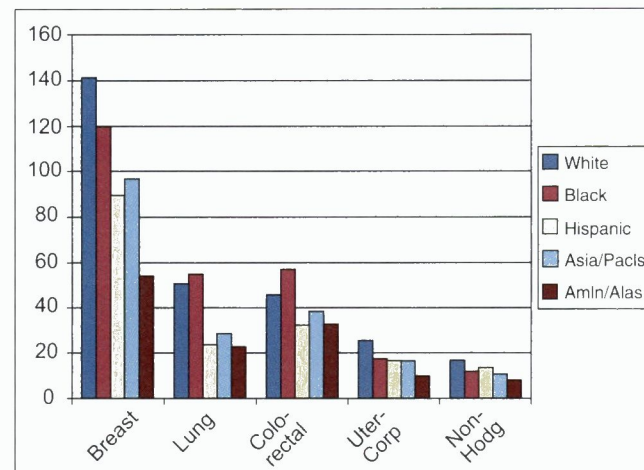
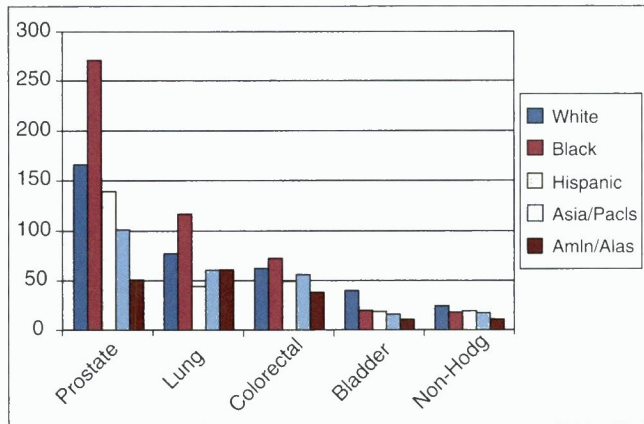


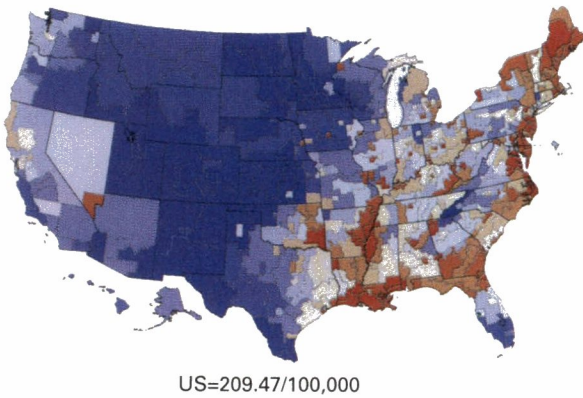
Figure 23-1 The five most common invasive cancers for men and women in the United States, 1997–2001. These are age-adjusted rates per 100,000 persons. Overall, about two-thirds of invasive cancers developed in the sites shown here. In men these sites are prostate, lung, colon and rectum, bladder, and non-Hodgkin's lymphoma; and in women, breast, lung, colon and rectum, corpus and uterus, and non-Hodgkin's lymphoma. The race/ethnicity groupings are white, black, Hispanic, Asian/Pacific Islander, and American Indian/Alaskan native. (Data derived from National Cancer Institute, 2004.)

study of female breast, cervix, lung, prostate, and colon carcinoma, persons over 65 years of age who were insured by Medicaid had the greatest risk of late-stage diagnosis and death (Bradley, Given, and Roberts, 2001). Similarly, national cervical cancer incidence and mortality rates increased with increasing poverty and decreasing education levels for the total population as well as for non-Hispanic white, black, American Indian, Asian/Pacific Islander, and Hispanic women. Patients in lower socioeconomic census tracts had significantly higher rates of late-stage cancer diagnosis and lower rates of cancer survival (Singh et al, 2004).

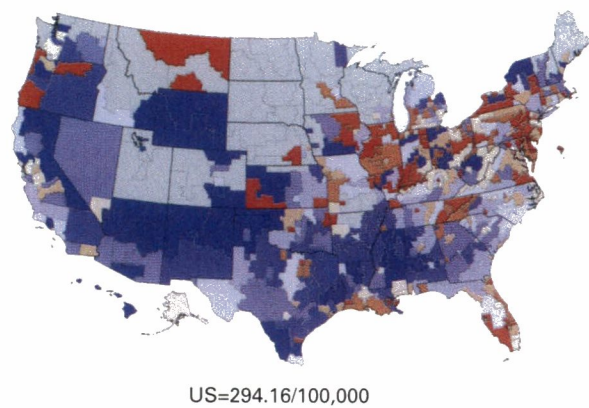
The causes of cancer are complex and often incompletely understood. Certain cancers appear in great numbers in particular countries. Clinical Application 23-2 summarizes some of these findings. In addition to people

Cancer mortality rates by state economic area (age-adjusted 1970 US population)

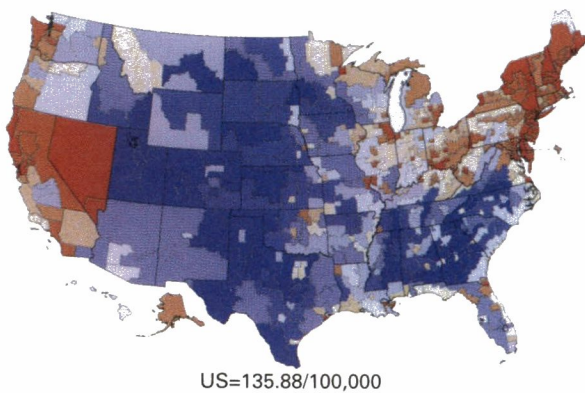
(a) All cancers: white males, 1970-94



(b) All cancers: black males, 1970-94



(c) All cancers: white females, 1970-94



(d) All cancers: black females, 1970-94

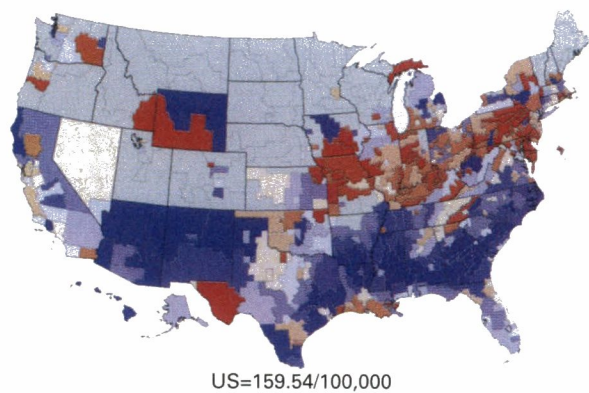


Figure 23-2 Mortality rates for all cancers in the United States, 1970-1994, by race and sex. Depicted here are mortality rates for all cancers for (a) white males, (b) black males, (c) white females, and (d) black females. Note that the legend colors denote different rates per 100,000 age-adjusted population for each map. The brightest red is assigned to the highest 10 percent of each group, so that it indicates rates of 230 to 266/100,000 population for white males but 339 to 908/100,000 for black males. This Web site also contains maps of mortality rates for about 50 specific cancers, maps by county, and maps for the years 1950-1969 (Devesa et al, 1999).

## Clinical Application 23-2

### History of Diet-Cancer Links in Various Populations

Particular cancers occur with greater frequency in some countries than others. When this was noted, the search began for dissimilarities in environment that could explain the differences. Because hereditary factors can confound the results when dissimilar populations are compared, the study of immigrants is especially enlightening.

In Japan there is more stomach cancer and less prostate and colon cancer than in the United States. In second-generation Japanese immigrants to the United States, however, the distribution of cancers becomes similar to that of other Americans. Similar findings are reported in Polish men for prostate cancer. On the other hand, migrants from Asia to the West, who maintain their traditional diet, do not have an increased risk of prostate cancer, attributed in part to phytoestrogens in vegetarian Asian diets (Vij and Kumar, 2004). See Clinical Application 23-6 for more information on phytoestrogens. Immigration, and presumed adoption of a Western diet, affects cancer development: age-adjusted breast cancer incidence rates per 100,000 Japanese women were 14 in Japan, 44 in Hawaii, and 57 in Los Angeles (Tomlinson, 1994).

Stomach and esophageal cancers are common where nitrates and nitrites are prevalent in food and water and where cured and pickled foods are popular. These areas include China, Japan, and Iceland. In Yangzhong, China, frequent intake of allium vegetables (garlic, onion, Welsh onion, and Chinese chives), raw vegetables, tomatoes, snap beans, and tea decreased the risk of stomach and esophageal cancer (Gao et al, 1999). Vitamins C and E and green tea can prevent formation of carcinogenic nitrosamines and nitrosamides (Greenwald, 1994; Ho et al, 1994; Kim et al, 1994). In Linxian County, China, where residents have one of the world's highest rates of esophageal and gastric **cardia** cancer; a 5-year trial of beta-carotene, vitamin E, and selenium reduced stomach cancer incidence by 20 percent and total mortality by 10 percent (Alberts and Garcia, 1995).

Elsewhere, a low rate of colon cancer is seen in Africa. The diet there is high in fiber, and the Africans pass bulky stools. The theory put forth was that the fiber both dilutes the carcinogens in the feces and pushes them out of the body faster than a low-fiber diet would. New research shows that black South Africans consume less than the RDA for fiber, so the low risk for colon cancer was then attributed to avoidance of excess animal protein and fat (O'Keefe et al, 1999). Avoidance is probably unintentional. The populations with high fiber intakes and low colon cancer rates also are seen in poor countries where obesity is uncommon, meat consumption is low, and physical activity is high.

This type of research is intriguing and offers a starting point for other investigations, but it cannot establish causation no matter how large the study.

in a given country possibly being influenced by similar environmental factors, including diet, they also may have **genes** that are similar compared with those found in people elsewhere. This chapter describes some examples of the associations that have been found and shows the difficulty of pinpointing the causative links and thus the difficulty of identifying a dietary behavior to adopt or to avoid with the goal of preventing cancer.

In the United States, about 33 percent of the 500,000 yearly cancer deaths are associated with cigarette smoking and about 33 percent with inappropriate nutritional and activity habits (Byers et al, 2002). This chapter considers diet and cancer. The relationship of diet to the development of cancer is explored first, followed by the nourishment of clients with cancer.

### Dietary Components Associated With Cancer

It is difficult to assess the role of dietary components without also considering other factors that might contribute to the development of cancer. Outside of tobacco use, diet is probably the most important factor in the etiology of human cancer, thought to be responsible for about one-third of all cases in developed countries (Blackburn et al, 2003; Ferguson, 2002). Illustrating the limits of present knowledge, however, despite an overall healthy lifestyle and long life expectancy, Adventist populations have high rates of breast and prostate cancers (Willett, 2003). Over time, the relationship of diet to breast cancer has become clearer, and it is elaborated upon in Clinical Application 23-3.

### Excesses of Certain Substances

Some substances and practices are associated with higher cancer rates. This is the case with energy and fatty acid intake, meat, alcohol, and certain cooking and preparation methods. These topics are addressed in the following section.

#### Energy and Fatty Acid Intake

Some of the end products of fat metabolism are thought to be carcinogenic, but dietary fat may contribute to the risk of cancer because of its energy density. Overweight and obesity increase the risk for cancers of the breast (postmenopausal), colon, endometrium, gallbladder, esophagus, pancreas, and kidney; however, moderate-to-vigorous exercise reduces colon and breast cancer risks independent of the effect of activity on weight (Byers et al, 2002). Obesity contributes to a poorer prognosis: men with BMIs of 40 or more had 52 percent higher death rates from all cancers than normal-weight men; for women, the corresponding rates were 62 percent higher (Calle et al, 2003).

Public health recommendations to decrease total fat intake for the prevention of cancer appear largely unwarranted (Kushi and Giovannucci, 2002), but additional information is needed regarding specific fatty acids in relation to causing or preventing cancer in particular sites. A high total fat intake is associated with a 24 percent increased risk of ovarian cancer whereas diets high in animal fat increased risk 70 percent, pointing out a need to clarify the

### Clinical Application 23-3

#### Breast Cancer and Diet

Mutations in certain genes greatly increase breast cancer risk, but these account for a minority of cases (Key, Verkasalo, and Banks, 2001). In fact, eight of nine women who develop breast cancer do not have an affected first-degree relative with the disease (Collaborative Group, 2001).

Large prospective studies have not found dietary fat per se or a diet high in red meats to be associated with breast cancer (Moyad, 2002; Terry, et al, 2001). Populations with high fat intakes generally have high rates of breast cancer, but studies of individual women have not confirmed an association of high-fat diets with breast cancer risk. The major risk factors for breast cancer are hormone-related, and the only generally recognized dietary risk factors are obesity and alcohol consumption.

Obesity increases breast cancer risk in postmenopausal women by about 30 percent, probably by increasing serum concentrations of bioavailable estradiol (Key et al, 2003). Breast cancer is associated with early menarche and late menopause, both effects of high estrogen levels, and with obesity in postmenopausal women since fat cells can produce estrogen. In Washington and New Mexico, women with BMIs above 30 had 130 percent higher concentrations of estradiol as those with BMIs lower than 22. Lastly, overweight and obese women with breast cancer have poorer survival compared with thinner women (McTiernan et al, 2003). Worldwide, 25 percent of breast cancer cases are due to overweight, obesity, and sedentary habits. Women who exercise 3 to 4 hours per week at a moderate to vigorous level have a 30 to 40 percent lower risk for breast cancer than sedentary women (McTiernan, 2003).

Moderate alcohol intakes increase breast cancer risk by about 7 percent per alcoholic drink per day, perhaps also by

increasing estrogen levels (Key et al, 2003). Alcohol use, even at moderate levels (two drinks per day), increases risk for both premenopausal and postmenopausal breast cancer (McTiernan, 2003) because the metabolism of alcohol produces DNA-damaging reactive oxygen species that subject cells to oxidative stress (Ambrosone, 2000) and mediates an increase in estradiols that may be partly responsible for breast cancer risk (Poschl and Seitz, 2004). Adequate folate levels may be particularly important for women who are at higher risk of breast cancer because of high alcohol consumption (Zhang, 2004).

Specific dietary components have been investigated without changing the aforementioned relationships. No strong association was found between the ingestion of milk or other dairy products and breast cancer risk (Moorman and Terry, 2004). Similarly, analysis of eight prospective studies discerned no significant association between intakes of total meat, red meat, white meat, total dairy fluids, or total dairy solids and breast cancer risk and an inconsistent relationship was found between egg consumption and risk of breast cancer (Missmer et al, 2002). While high bone mineral density (BMD) in elderly women is related to higher rates of breast cancer, BMD is also regarded as a marker for lifetime estrogen exposure (Van der Klift et al, 2003).

Although not obtained through diet, some derivatives of vitamin D have been developed that may inhibit proliferation of cells, including those of breast cancer (O'Kelly and Koeffler, 2003). These synthetic products have the growth-regulating effects but not the calcium-mobilizing actions of vitamin D, thus avoiding the hypercalcemia caused by large doses of the natural vitamin (Colston and Hansen, 2002).

factors that might contribute to the disparity (Huncharek and Kupelnick, 2001). In the case of bowel cancer, for instance, increased concentrations of short-chain fatty acids and eicosanopentaenoic acid (EPA) seem to protect against colorectal cancer, but increased concentrations of medium-chain fatty acids and arachidonic acid (AA) may be associated with increased risk (Nkondjock et al, 2003). Long-chain omega-3 polyunsaturated fatty acids from fish show promise as nutrients to possibly prevent prostate cancer, but in contrast, another omega-3 PUFA, alpha-linolenic acid, might be a risk factor (Astorg, 2004). Consuming one or more servings of fish per week protected against digestive tract cancers in Italy (Fernandez et al, 1999); however, to what extent the fish-containing meals reduced meat consumption was not reported, but once again, the evidence supports the healthfulness of a varied diet.

#### Meat

Prolonged high consumption of red and processed meat may increase the risk of cancer in the distal portion of the

large intestine. Over a ten year period, people consuming processed meat at the highest levels had a 50 percent higher risk of distal colon cancer than those consuming at the lowest levels. Likewise, high consumption of red meat was associated with a 40 percent higher risk of rectal cancer (Chao et al, 2005). Seventh Day Adventists and Mormons have a lower incidence of bowel cancer than other Americans, even when caffeine and alcohol differences between the study groups are equalized. Some Seventh Day Adventists eat meat, but those who did had higher rates of colon and prostate cancer than vegetarian members of the sect, and those who consumed the most beef had a higher risk of bladder cancer than those who consumed less (Fraser, 1999).

#### Alcohol

Alcohol intake greater than two drinks per day substantially increases risk for cancers of the mouth, pharynx, larynx, esophagus, liver, and breast and may be related to increased risk of colon cancer (Byers et al, 2002). Contrary to earlier reports linking alcohol to head and

neck cancers only in smokers, new research suggests that chronic alcohol consumption increases the risk of those cancers regardless of exposure to tobacco smoke (Riedel, Goessler, and Hormann, 2003). Beyond its relationship to occurrence, even less than one drink per day was associated with up to a 30 percent increase in breast cancer mortality among postmenopausal women compared with nondrinkers (Feigelson et al, 2001). Although the exact mechanisms by which chronic alcohol ingestion stimulates carcinogenesis are not known, experimental studies in animals suggest that alcohol is a cocarcinogen and/or tumor promoter. The metabolism of alcohol leads to the generation of free radicals and acetaldehyde that binds to DNA and proteins, destroys folate, and seems to contribute to cirrhosis of the liver (Eriksson, 2001).

Another mechanism by which alcohol stimulates carcinogenesis is the induction of cytochrome P4502E1, which is associated with an increased production of free radicals and enhanced activation of procarcinogens found in alcoholic beverages. The consequences include nutritional deficiencies and alterations in the **immune system** resulting in an increased susceptibility to certain viruses such as hepatitis B and C viruses (Poschl and Seitz, 2004). Alcohol-induced cirrhosis, with resulting increased liver cell turnover, is associated with liver cancer. The combination of high alcohol and low folate intake increases the risk of colorectal tumors more than either factor alone. In addition, genetic variation in a gene necessary to folate metabolism that is found in Japanese people may explain the high rates of colorectal cancer in that population (Giovannucci, 2004).

Excessive beer consumption is associated with rectal cancer, possibly due to the formation of a nitrosamine compound during direct-fire drying of barley malt. This discovery led to modification of the brewing process (Sugimura and Wakabayashi, 1999). A possible pathophysiological reason for the correlation between alcohol and breast cancer is found in Clinical Application 23–3.

### **Certain Cooking and Preparation Methods**

Temperatures at which food is cooked and at which it is consumed has been related to the occurrence of cancer. Other techniques of preserving food also have been linked to cancer in particular populations.

#### **VERY HOT SERVING TEMPERATURES**

Very hot drinks and foods probably increase the risk for cancers of the oral cavity, pharynx, and esophagus, so drinks and foods should not be consumed when they are scalding hot (Key et al, 2004). Indeed, consumption of high-temperature food was found to be an independent risk factor for stomach cancer and positively associated with esophageal cancer in India (Mathew et al, 2000; Phukan et al, 2001).

#### **PRESERVATION METHODS**

Epidemiological evidence supports an association between the risk of developing gastric cancer and the intake of salt and salt-preserved foods (Riboli and Norat,

2001). Additives used to preserve appearance and prevent bacterial contamination of processed meats, nitrites, when converted to nitrosamines in the stomach may increase risk of gastric cancer. Vitamin C-rich foods impede this conversion of nitrites and are suggested as a dietary means of modifying risk.

Cancers of the esophagus and stomach are correlated with large intakes of pickled and smoked foods. It is postulated that smoked foods may absorb tar similar to that in tobacco smoke. Charcoal broiling presents the same type of danger, in that **carcinogens** may be deposited on the surface of the food.

#### **HIGH TEMPERATURE COOKING**

Frying, broiling, and grilling meat, poultry, game, and fish produce carcinogens, substances known to cause cancer in animals when given at very high doses. These heterocyclic amines (HCAs) are produced by high temperature cooking of muscle meats. One kind of HCA has been on the Department of Health and Human Services' list of cancer-causing agents since 2002 and three more HCAs that arise from grilling meat were added to the list in 2005 (American Institute for Cancer Research, 2005). The amount of HCAs in cooked foods is small, but other components in the diet such as omega-6-polyunsaturated oils (see again Figure 20–6) have powerful promoting effects in target organs of HCAs. Conversely, foods containing antioxidants may decrease the action of HCAs (Weisburger, 2002).

Another class of carcinogens on the list of cancer-causing agents are polycyclic aromatic hydrocarbons (PAHs) that are formed when fat drips onto hot coals or stones. These potent carcinogens are deposited back onto food by smoke and flare-ups (American Institute for Cancer Research, 2005).

Low-temperature, high-moisture cooking, such as stewing and pot-roasting, does not produce the same level of carcinogens. Even when pan frying, using lower temperatures and turning ground beef patties every minute reduced the carcinogen levels while safely inactivating bacteria (Salmon et al, 2000). Marinades have been found to reduce the amount of HCAs, formed on grilled meats, by 92 to 99 percent, possibly by acting as a barrier to the flames or because of the vitamins C and E in the citrus juices and oils of the marinade (American Institute for Cancer Research, 2002). Although the amount of carcinogens in foods ordinarily consumed is low and insufficient to explain human cancer, some experts recommend avoiding exposure to these carcinogens or reducing their effects by cooking in microwave ovens (Sugimura et al, 2004).

#### **INDIVIDUAL DIFFERENCES IN METABOLISM**

Many studies related diet to risk of cancer, but frequently the follow-up intervention studies did not show the expected protection against cancer, possibly because the biological diversity of the participants was not controlled (Rennert, 2003). In the case of colon cancer, researchers have demonstrated genetic differences related to enzymes that catalyze the formation of carcinogens from meats cooked for a long time at high temperatures. People who

were classified as *fast acetylators* based on these enzymes have shown a consistent trend towards higher risks for colorectal cancer with higher intakes of meat (Roberts-Thomson, Butler, and Ryan, 1999). Heterocyclic amines require activation by the enzymes CYP1A2 and N-acetyltransferase (NAT)2 or NAT1 before they can bind to DNA. Since smoking is known to induce CYP1A2, a study tested the relationships of smoking to preference for well-done meat and colorectal cancer. In people who had ever smoked, preference for well-done red meat was associated with an 8.8-fold increased risk of colorectal cancer among subjects with the NAT2 and CYP1A2 rapid phenotypes compared with smokers with low NAT2 and CYP1A2 activities who preferred their red meat rare or medium. No similar association was found in never-smokers, and there was no increased cancer risk associated with (1) well-done meat among smokers with a rapid phenotype for only one of these enzymes or (2) smokers with both rapid phenotypes who did not prefer their red meat well-done (Le Marchand et al, 2001).

The carcinogen does not have to be consumed. Even exposure to cooking oil fumes containing relatively high amounts of heterocyclic amines has been related to a greater than two-fold increase lung cancer occurrence in never-smoking females with NAT2 *fast acetylator* genotype in Taiwan (Chiou et al, 2005).

### Protective Dietary Components

A number of natural foodstuffs, especially fruits and vegetables, contain substances that have potential to prevent cancer. Antioxidants, such as vitamins C and E and beta-carotene, can reduce the risk of cancer. Besides the antioxidants, several other components in cruciferous vegetables protect against the effects of reactive oxygen species. Overall, cruciferous vegetables rank among the most promising dietary items to prevent cancer, and identification of active constituents may stimulate development of highly protective Brassica varieties (Steinkellner et al, 2001). In addition, legumes, grains, and green tea are under investigation as possibly containing substances protective against DNA damage (Abdulla and Gruber, 2000).

#### Fruits and Vegetables

Fruits and vegetables probably reduce the risk for cancers of the oral cavity, esophagus, stomach, and colorectum, and diets should include at least 400 grams per day of total fruits and vegetables (Key et al, 2004). That is not a huge quantity: one quarter-pound unpeeled apple is approximately 100 grams. Following are examples of research findings relating fruit and vegetable intake to various cancers. It is undoubtedly unrealistic to expect diet alone to prevent cancer, but it may contribute to a lessened risk.

#### BLADDER CANCER

Diets low in fruits increased the risk of bladder cancer by 40 percent, and low intakes of vegetables increased risk by 16 percent (Steinmaus, Nunez, and Smith, 2000). Cigarette smoking substantially increases the risk of bladder cancer,

but total fruit consumption is probably associated with a small decrease in risk (Zeegers et al, 2004).

#### BREAST CANCER

Studies of foods and nutrients in relation to breast cancer showed high consumption of vegetables associated with a 25 percent decreased risk, of fruit with a 6 percent decrease, of vitamin C with a 20 percent decrease, and of beta-carotene with a 18 percent decrease (Gandini et al, 2000).

#### COLON CANCER

Epidemiologic, experimental (animal), and clinical investigations suggest that diets high in total fat, protein, kilocalories, alcohol, and meat (both red and white) and low in calcium and folate, are associated with an increased incidence of colorectal cancer (National Cancer Institute, 2005). Folate from dietary sources alone was related to a modest reduction in risk for colon cancer. Research most strongly supports high folic acid intake as reducing risks of colon and breast cancers, possibly explained by a variation in the gene for an enzyme involved in folic acid metabolism that is associated with colon cancer (Willett, 2000).

#### LUNG CANCER

A 50 percent decreased risk of lung cancer was associated with higher intake of white grapefruit and onions and a 40 percent decreased risk was associated with apples, all attributed to the flavonoids contained in the foods (Le Marchand et al, 2000). Among male smokers, higher consumption of fruits and vegetables was associated with a 27 percent lower risk of lung cancer, with the greatest effect from **lycopene** (Holick et al, 2002). As became evident in the Alpha-Tocopherol study (1994), beta-carotene can have pro-oxidant effects under certain conditions, such as high oxygen pressures and oxidative stress found in the lungs of smokers (Kamat and Lamm, 2002). In sum, the best preventive strategy for lung cancer is smoking cessation.

#### ORAL, PHARYNGEAL, AND ESOPHAGEAL CANCER

Vegetable intake, including green vegetables, cruciferous vegetables, and yellow vegetables, total fruit intake, and citrus fruit intake are protective against these cancers. Specifically, carotene, vitamins C and E, and selenium are protective, most likely in combination with each other and other micronutrients (Chainani-Wu, 2002). In a study of British women, a high BMI in early adulthood and low consumption of fruit were risk factors for adenocarcinoma of the esophagus (Cheng et al, 2000).

#### OVARIAN CANCER

Of ovarian cancer cases in 50-year-old or older Italian women, 24 percent were attributed to low intake of green vegetables (Parazzini, et al, 2000). Moreover, supplements of vitamins C and E reduced the risk of ovarian cancer by 60 and 67 percent respectively (Fleischauer et al, 2001) and high dietary intake of beta-carotene was

associated with a 16 percent decrease in ovarian cancer risk (Huncharek, Klassen, and Kupelnick, 2001).

#### PROSTATE CANCER

Studies have shown that tomato products may help prevent prostate cancer. Consuming large amounts of raw tomato reduced its risk 11 percent, and consuming large amounts of cooked tomato products reduced its risk 19 percent (Etminan, Takkouche, and Caamano-Isorna, 2004). Cooking breaks open the tomato cells and evaporates water to increase the concentration of lycopene. Additionally, ingestion of three servings per week of cruciferous vegetables, compared with less than one serving per week, was associated with a 41 percent decrease in prostate cancer (Cohen, Kristal, and Stanford, 2000).

#### A VARIETY OF WHOLE FOODS

It is possible that all the micronutrients and phytochemicals in fruits and vegetables have not been identified or that several of the components produce synergistic effects. A deficiency of eight nutrients (folic acid, vitamin B<sub>12</sub>, vitamin B<sub>6</sub>, niacin, vitamin C, vitamin E, iron, or zinc) mimics the radiation damage to DNA. Micronutrient deficiency may help to explain why the quarter of the population that eats the fewest fruits and vegetables has about double the rate for most types of cancer compared with the quarter of the people with the highest intake. A level of folate deficiency causing chromosome breaks was found in approximately 10 percent of the United States' population, with a much higher percentage in the poor (Ames, 2001). At this stage of understanding, however, eating a variety of whole foods, not individual micronutrients, is the appropriate formula to decrease the risk of cancer. Clinical Application 23-4 elaborates upon vegetable intake in relation to cancer, but Clinical Application 23-5 cautions against overenthusiastic supplementation.

#### Fiber and Fluid

The relationship of dietary fiber to colon cancer has been studied for 30 years without clear-cut conclusions, possibly because separate fiber sources were not considered and colon cancers were not defined by location (Hill, 2003). Colon cancers are not identical in pathology, and all fiber may not be equally protective. A Cochrane Review reported that there is currently no evidence from randomized controlled trials to suggest that increased dietary fiber will reduce the incidence or recurrence of adenomatous polyps (precursor of colon cancer) within a 2- to 4-year period (Asano and McLeod, 2002). Conversely, studies show that highest intakes of dietary fiber (which were still below the recommended 25 grams per day) reduced the risk of colon cancer by 42 percent, with the greatest effect displayed in the left colon and the least effect in the rectum (Bingham et al, 2003).

Regarding a different site, a high intake of cereal fiber may significantly decrease the risk of gastric cardia cancer (Roth and Mobarhan, 2001). Whether fiber offers specific protection from cancer or not, adequate intake contributes

### Clinical Application 23-4

#### The Role of Vegetables in Cancer Prevention

Low intakes of vegetables have been associated with stomach and colon cancers. In Japan, smokers who ingested yellow or green vegetables every day had 20 to 30 percent lower lung cancer rates than smokers who did not consume those vegetables every day. Vegetables contain many substances that may contribute to cancer prevention. Some of these substances are carotene, indoles, and antioxidants.

Carotene, the precursor of vitamin A, is present in many green and deep-yellow vegetables. Vitamin A helps to maintain epithelial tissue, protects against oxidation, may influence host **immune** defenses, and assists in the control of cellular differentiation, a process that is faulty in the rapidly growing cancer cell. Thus, an adequate intake of carotene may be instrumental in preventing cancer. The fact that beta-carotene *supplements* were associated with increased morbidity and mortality from lung cancer (Clinical Application 23-5) should not deter someone from consuming vegetables rich in this nutrient (Alpha-Tocopherol, 1994).

Cruciferous vegetables, those of the cabbage family, are correlated with the prevention cancer in many organs (Murillo and Mehta, 2001). Among the phytochemicals that these vegetables contain are **indoles** that activate enzymes to destroy carcinogens. Members of the cruciferous family include broccoli, Brussels sprouts, cabbage, cauliflower, collards, kohlrabi, and kale.

Antioxidants prevent oxidation of molecules by becoming oxidized themselves. Some molecules become very unstable when oxidized and damage nearby molecules. This reaction could modify a cell's DNA to set in motion the uncontrolled reproduction of cancer cells. Many vegetables contain carotene and vitamin C, which are antioxidants. Additionally, some spices have antioxidant capability. From the most active to the least active are cloves, cinnamon, pepper, ginger, and garlic. Curcumin, the active ingredient in turmeric, is reported to be several times more potent than vitamin E as a free radical scavenger (Lampe, 2003). More is not better, however, because high intakes of very spicy foods and chili were found to be risk factors for esophageal and stomach cancers in India (Mathew et al, 2000; Phukan et al, 2001).

It is unclear which of these substances contributes the most to cancer prevention. Indeed, several of them may work together more effectively than individually or may work in different ways to halt carcinogenesis. Perhaps another, yet untested substance in the vegetables is more valuable for cancer prevention than those mentioned here. For these reasons, taking supplements is not recommended. Eating a variety of vegetables, including those linked to low cancer incidence, is the better method of protecting a person's health.



### Clinical Application 23–5

#### More Is Not Better: Beta-Carotene and Lung Cancer

Evidence from observational studies linking lower rates of lung cancer to people eating more fruits and vegetables and people having higher serum beta-carotene concentrations stimulated clinical trials with supplements. In Finland, when testing beta-carotene and vitamin E as cancer-preventive agents for lung cancer, the intervention produced the surprising finding of a 16 percent *increase* in lung cancer and an 8 percent *increase* in total mortality in the beta-carotene group (Alpha-Tocopherol, 1994). Similar results occurred, a 28 percent higher than expected incidence of lung cancer and 17 percent higher mortality, when beta-carotene and retinol were given to men and women who had been heavy smokers and to men with extensive occupational asbestos exposure (Omenn et al, 1994 and 1996).

to lipid and weight control and can be recommended on that basis.

Although essential with a high fiber diet, fluid alone has been associated with health benefits. Drinking 2531 milliliters of fluid daily compared with 1290 milliliters was linked to a 49 percent decrease in bladder cancer (Kamat and Lamm, 2002). Next to water, tea is the most popular beverage in the world, and the cancer-preventive effects of this beverage have been suggested related to the antioxidant polyphenols it contains. Epidemiological studies have shown decreased cancer occurrence in individuals who drink green tea regularly (Kazi et al, 2002), and drinking up to 1.5 cups of tea daily was linked to a 43 percent decrease in the risk of colon cancer, with greater effects seen in men (Su and Arab, 2002). In animal studies, some teas, including green, have reduced cancer risk, but the effect is unproven in humans (Byers et al, 2002).

#### Vitamin E

Vitamin E and selenium are both antioxidants that protect cells against breakdown. These two nutrients can substitute for one another, so relating one alone to cancer is a complicated process. Prospective studies are consistent with a protective role for selenium, and possibly vitamin E, in the etiology of prostate cancer (Dagnelie et al, 2004). The Alpha-Tocopherol study mentioned earlier also showed 34 percent fewer cases of prostate cancer and 16 percent fewer cases of colorectal cancer than expected in the men receiving vitamin E (Greenwald and McDonald, 1997), but an adverse effect was the increased deaths from hemorrhagic stroke in those receiving vitamin E (Alpha-Tocopherol, 1994).

#### Calcium

In both animals and humans, calcium seems to protect against some colon cancers. Higher calcium intake was

associated with a 27 percent reduction in distal colon cancer in women and a 42 percent reduction in men but was not associated with reductions in proximal colon cancer (Wu et al, 2002). Experts theorize that calcium reduces cell turnover rates and chemically interferes with bile acids and fatty acids to possibly reduce their toxicity. Many studies use colorectal adenomatous polyps as an endpoint due to the large number of patients and the long follow-up required if colon cancer were the endpoint. Calcium supplements of 1200 to 2000 milligrams per day for 3 to 4 years resulted in a 26 percent reduction in recurrent adenomatous polyps; however, general use is not recommended (Weingarten, Zalmanovici, and Yaphe, 2004).

On the other hand, a very high calcium intake, more than 2000 milligrams per day, appears to increase the risk of prostate cancer (Dagnelie et al, 2004). A component of foods recently receiving attention as having a possible role in cancer prevention is phytoestrogens or plant estrogens. These substances, found in a variety of foodstuffs, are considered in Clinical Application 23–6.

### Questionable Relationships to Cancer

Studies have produced inconclusive data or conflicting reports on the relationship of certain substances to cancer. These include coffee, caffeine and aflatoxin-contaminated peanuts or corn.

In Massachusetts and New Hampshire, *increased* risk for epithelial ovarian cancer was associated with consumption of coffee and caffeine but only among premenopausal women (Kuper et al, 2000). In contrast, an Australian study found that compared to no intake, consumption of four or more cups of coffee daily was associated with a 49 percent

### Clinical Application 23–6

#### Phytoestrogens

These naturally occurring compounds, including several groups of nonsteroidal estrogens, such as isoflavones and lignans, are widely distributed in plants. There is evidence to suggest that they have a protective effect against prostate tumors (Vij and Kumar, 2004). The few studies conducted in humans clearly confirm that soy isoflavones can exert hormonal effects that may help prevent breast and prostate cancers; however, there are few guidelines on optimal doses for specific health outcomes (Cassidy, 2003).

Some experts warn that caution is warranted because studies do not unequivocally support benefits from soy isoflavones. Breast cancer survivors in particular are advised to consume only moderate amounts of soy foods and to avoid high levels and concentrated sources of soy (Byers et al, 2002). The role of isoflavones in cancer prevention, particularly of tumors under endocrine control (breast, prostate, and others), is only supported by weak to nonexistent clinical evidence. In addition, disturbing data have been reported on potential negative effects of soy isoflavones on cognitive function in the aged, particularly regarding tofu intake (Sirtori, 2001).

decrease in risk of epithelial ovarian cancer but was not attributable to caffeine (Jordan et al, 2004).

Again, the explanation may involve genetics, illustrating that general dietary advice may not be appropriate for everyone. In Hawaii, regular coffee, but not tea or soda, was associated with an 80 percent increase in the risk of ovarian cancer, an association that may be modified by CYP1A2 genotype and exposures, such as cruciferous vegetable consumption, that influence CYP1A2 expression. CYP1A2 is a key enzyme in the metabolism of coffee and in the activation of heterocyclic aromatic compounds that may be carcinogenic so that somewhat stronger relationships of coffee and caffeine intake to increased risk were found among women with cruciferous vegetable consumption above the median (Goodman et al, 2003).

In contrast, breast cancer was unrelated to coffee or caffeine. In Sweden, the country with the world's highest per capita coffee consumption, a study of 59,036 women showed no association between intake of coffee, tea, and caffeine and breast cancer incidence (Michels et al, 2002).

**Aflatoxins**, contaminants of improperly stored food caused by molds, are inconclusively linked to cancer as sole risk factors. Aflatoxin contamination of peanuts and corn is related to primary liver cancer, especially in Africa and Asia, but interpreting this information is complicated because hepatitis B is endemic to both continents. The cancer may be caused by the aflatoxins, by hepatitis B virus, or by both since they act synergistically to amplify risk (Kensler et al, 2004). No evidence relates aflatoxins to cancer risk in the United States. A brief summary of the work on cancer vaccines appears in Box 23-1.

### Dietary Practices to Reduce Cancer Risk

Cancer evolves from genetic and environmental factors, of which diet is only one. Nevertheless, certain dietary prac-

tices are widely recommended to decrease the risk of cancer. For the most part, these practices have been incorporated into the Dietary Guidelines and MyPyramid and are exemplified in the New American Plate (Fig. 23-3), an educational tool from the American Institute for Cancer Research. Previous chapters detailed the extent to which Americans are not complying with dietary recommendations. The AICR sponsors research, disseminates findings, and offers educational materials, including recipes, to health professionals and the public. Its Web site is <http://www.aicr.org>.

Good evidence supports the possible or probable benefit of fruits and vegetables in minimizing cancer risk. Other desirable food practices relate to red meat consumption and the choice of beverages. Lastly, physical activity and weight control offer a means to decrease cancer risk.

#### Increase Fruit and Vegetable Intake

Without question, the predominant advice emphasizes fruit and vegetable intake for prevention of many types of cancer. A variety of fruits and vegetables should be the goal but regular consumption of cruciferous vegetables might be a step toward the goal. Fruits and vegetables rich in Vitamin C could possibly mitigate the undesirable effects of processed meats.

A logo developed for a California program to increase fruits, vegetables, and fiber intake is shown in Figure 23-4. That campaign used broadcast and print media and point-of-sale reminders, posters, and recipes to educate consumers (Foerster et al, 1995).

#### Prudent Meat Selection and Preparation

Red meat should be limited to small, lean portions. Poultry, fish, and legumes should be primary protein

#### Box 23-1

##### Vaccines in Cancer

Several cancers are related to viruses: primary liver cancer to hepatitis B virus and hepatitis C virus, cervical cancer to human papillomavirus, lymphoma to Epstein-Barr virus, Kaposi sarcoma (see Chapter 25) to certain types of human herpesvirus, and leukemia and lymphoma to human T-cell lymphotropic virus. In the case of cervical cancer, the human papillomavirus is considered to be a necessary cause and evidence is mounting as to viral causation in some of the other conditions (Heymann, 2004). A logical question becomes, why not vaccinate against these viruses? In fact, vaccination against hepatitis B has greatly reduced the incidence of hepatocellular cancer in southeast Asia (King, 2004).

One reason vaccines are slow in coming relates to the same reason influenza vaccine is redesigned every year. Viruses can mutate or change characteristics so the antibodies produced by an old vaccine are no longer effective. Tumor cells also can change their characteristics slightly to avoid detection by the immune system. In addition, to illustrate the size of the problem, more than

500 tumor antigens have been identified. In spite of this, Canada has approved one vaccine for stage IV melanoma (King, 2004).

To take advantage of the interaction between antigens and the immune system, therapeutic cancer vaccines are being developed to treat disease by stimulating both **cellular immunity** and **humoral immunity** and show promise but thus far, have not improved survival or freedom from disease (King, 2004). Development of cancer vaccines is proceeding on two fronts: *allogeneic vaccines* that are manufactured from tumor cells of several people and *autologous vaccines* made from the client's own tumor cells. The process is exacting and may require fresh tumor tissue transported on ice overnight to the manufacturer. Even if DNA or RNA samples are used, at most they can only be preserved by freezing and cannot be treated with paraffin or formalin (King, 2004). Comprehensive information on clinical trials and other subjects can be found on the National Cancer Institute's Web site accessed at <http://www.cancer.gov/cancertopics/pdq/cancerdatabase>.

Table 23-1

## Dietary Interventions That May Contribute to Reduced Cancer Risk

	CHOOSE	LIMIT
Fruits and vegetables	5 or more daily servings Regular consumption of cruciferous vegetables If juices taken, choose 100% juice	Fried vegetables High-fat snacks
Grains	Whole grains	Refined carbohydrates Sugar
Meats	Fish, poultry, legumes Small portions of lean meat Vitamin C-rich foods with grilled or processed meats Microwaved, baked, broiled, poached, low-temperature, or marinated cooking methods	Red meat Processed meats Fried foods Charbroiled foods High-temperature cooking Heavy salt use
Beverages	Water Tea, especially green	Alcohol Sweetened drinks Scalding hot beverages and foods
Activity	30 minutes 5 days/week	Sitting Riding
Weight Control	See Chapter 18	

sources. Processed meats and salted meats should be consumed very occasionally.

Slow, moist, low temperature cooking methods are preferred. To minimize the heterocyclic amines (HCAs) in grilled or fried meats and fish, briefly microwave them before frying or broiling. Marinades decrease HCA formation and grilling on foil or dampening flare-ups with water spray decrease PAH formation (American Institute for Cancer Research, 2001). Food safety dictates basting marinade be fresh, not that in which the raw meat was soaked.

Lastly, trimming off and discarding charred portions is a healthful practice.

### Choose Beverages Carefully

Alcohol consumption should be limited to two standard drinks per day for men and one standard drink per day for women and lighter weight men. Water and green tea may be preferable to coffee. Regardless, scalding hot beverages should be avoided.

$\frac{2}{3}$  (or more)  
vegetables,  
fruits,  
whole grains  
and beans

$\frac{1}{3}$  (or less)  
animal  
protein

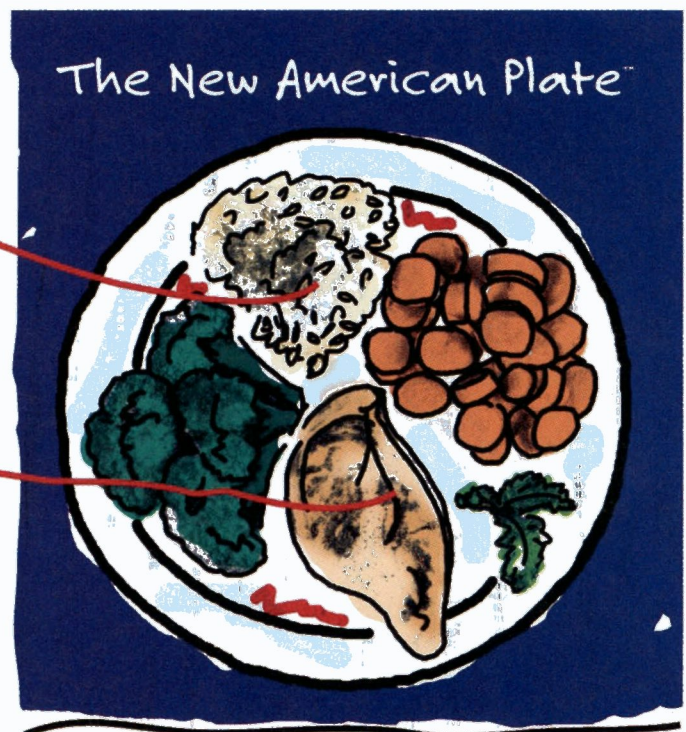


Figure 23-3 Vegetables, fruits, whole grains and beans cover two-thirds (or more) of the New American Plate with the remaining one-third (or less) of the plate reserved for fish, poultry, meat, and lowfat dairy foods. The New American Plate® is a registered trademark of the American Institute for Cancer Research, 2000 (reprinted with permission).



Figure 23–4 National 5-a-Day program logo. The program logo and slogan are registered service marks. To use them, food industry and state health authority partners sign a license agreement to follow guidelines that maintain the scientific integrity of all messages and other communications to the public. (Reprinted from Foerster et al, 1995, with permission.)

### Control Weight Through Physical Activity

Changing behavior to avoid a possible future illness is difficult but avoiding recurrence of cancer should provide strong motivation. In fact, walking just 3 to 5 hours per week at an average pace after a diagnosis of breast cancer reduced the risk of death from the disease (Holmes et al, 2005). Nevertheless, overweight and obese women diagnosed with breast cancer reported low **self-efficacy** for exercise and eating, suggesting that interventions should focus on increasing self-efficacy to encourage behavior change (Pinto et al, 2002). The most important incentives to exercise in women with a history of breast cancer were

expectation of benefit and sense of responsibility, whereas the most important barriers were lack of time and inertia (Leddy, 1997).

Box 23–2 outlines some of the factors to consider when confronted with research findings concerning nutrition. There are no guarantees, even with an optimal diet and favorable lifestyle, that one will not develop cancer. Nevertheless, the general guidelines for a healthy diet are nearly congruent for preventing the two major causes of death in the United States, heart disease and cancer. Table 23–2 summarizes the benefit versus risk evaluation by the American Cancer Society of the evidence available pertaining to dietary interventions to prevent various cancers. A somewhat different interpretation of the evidence for antioxidant supplementation came from the U.S. Preventive Services Task Force (2003) that declared the evidence was insufficient to recommend for or against the use of antioxidant vitamin supplements to prevent cardiovascular disease or cancer. It did specifically recommend against using beta-carotene supplements because of lack of benefit to middle-aged and older adults as well as demonstrated associations with higher incidence of lung cancer and higher all-cause mortality in heavy smokers.

### Nutrition for Cancer Clients

Once a person has cancer, nutrition becomes part of the treatment. Despite the possible role of diet in preventing cancer, dietary manipulation has not been shown to cure cancer. The dietary goal is to maintain the client's strength to endure the treatment of the cancer. Energy needs based on body weight are 25 to 35 kcal/kg/day including 1 to 2 g/kg/day of protein (Wilkes, 2000). A study in Germany found 24.2 percent of hospitalized clients to be malnourished, with significantly higher prevalence in those with malignant disease and older clients. Malnourished clients also had 40 percent longer hospital stays (Pirlich et al, 2003). Optimal nutrition may enhance medical treatment,

#### Box 23–2 Research Findings: Probabilities Not Certainties

There is a natural progression in research from descriptive to experimental studies that reflects increasing certainty that the findings display reality. Unfortunately, the significance and practical applications of research results are often overstated and publicized in the general press before being reviewed and replicated by other scientists. A single study may be interesting but should not be the basis for radical behavior changes. Peer scientists should examine all research for its strengths and weaknesses. Possible shortcomings affecting all research include:

- Inaccurate measurements. Recall data from questionnaires, although showing statistical differences in large studies may not accurately reflect dietary intake or other behaviors. Even blood levels may be insensitive to small differences and may not correlate with cellular levels in certain organs.
- Imperfect statistical controls. Although extraneous variables are often held constant by statistical manipu-

lation, the process is not perfect and all extraneous variables may not be considered.

- Incorrect assumptions. An underlying physiological basis for a given effect increases the credibility of research. New methods to test physiological effects often challenge earlier assumptions and conclusions. For instance, the mechanism supporting the value of cranberry juice in decreasing bladder infections was determined to be inhibition of *E. coli*. The earlier anecdotal evidence regarding cranberry juice was dismissed by scientists who assumed that the mechanism of action would have to be acidification of the urine and cranberry juice did not make that much difference in pH.

The following table lists some of types of studies (under three major categories—descriptive, correlational, and experimental), their distinguishing qualities, and examples of individual studies focusing on nutrition and cancer.

<b>TYPE OF STUDY</b>	<b>CHARACTERISTICS</b>	<b>APPLICATION TO NUTRITION</b>	<b>LIMITATIONS</b>	<b>EXAMPLE</b>
<u>DESCRIPTIVE</u> (Observational)	Reports naturally occurring events	Examines a population in relation to presence of risk factors, average intake of nutrients, cancer rates and mortality, utilization of health care, etc.	Cannot establish causation. Diet is just one of many influences on health outcomes. Even less certainty results if the population is diverse (Heaney, 2000).	In a 1999 United States Renal Data System survey of 3468 new dialysis patients, 46 percent indicated that they had not consulted with a dietitian before the initiation of dialysis (Moore et al, 2003).
<u>CORRELATIONAL</u>	Compares phenomena in groups with particular outcomes.	Determines the existence of systematic relationships between consumption of specific foods or supplements and cancer occurrence.	Correlation does not establish causation. An untested variable may be causing the relationship.	
<i>Cross-Sectional</i>	Compares behavior of different groups using the same measures at one point in time.		The point in time may not be typical.	In 35,955 subjects from 10 European countries, total fish consumption varied six- to seven-fold, with the lowest consumption in Germany and the highest in Spain (Welch, 2002).
<i>Case Control</i>	Compares reported behavior by cancer clients with reported behavior by a control group of similar people without cancer.		Controls may differ from cases in significant ways that were not considered and in ability to recall behavior accurately.	Increased risk for epithelial ovarian cancer was associated with consumption of coffee and caffeine but only among premenopausal women (Kuper et al, 2000).
<i>Prospective (Cohort)</i>	Measures phenomena of interest in a large population. Much later compares those with particular outcome to those without it in relation to the earlier determined practice.	Determines usual diet and other pertinent traits of large group of people at Point A. Waits until illness of interest develops in an adequate number of the people. Compares the groups with disease and without it in relation to the early diet.	Requires very large groups to obtain sufficient cases. May take years for illness of interest to develop, and diet may have changed in the interim.	Coffee, tea, and caffeine was not associated with breast cancer incidence in 59,036 Swedish women (Michels, 2002).
<u>EXPERIMENTAL</u>	Compares results of an intervention administered to one group but not to another.	Administers vitamin or specific food to one group, placebo or none to another. Measures changes in illness, symptoms, blood levels, etc.	Component selected for intervention may not be the one that gave the effect when whole foods were investigated.	

(Continued on the following page)

**Box 23-2 Research Findings: Probabilities Not Certainties (Continued)**

TYPE OF STUDY	CHARACTERISTICS	APPLICATION TO NUTRITION	LIMITATIONS	EXAMPLE
Cell and Tissue Cultures			Laboratory results may not be duplicated in animals or humans.	A flavonoid fraction from cranberry extract inhibited proliferation of eight human tumor cell lines of multiple origins (Ferguson et al, 2004).
Animals			Very large doses may be used that are unrealistic to extrapolate to humans.	Adequate intakes of vitamin E and protein prevent increases of oxidative damage to DNA, lipids, and protein induced by total body irradiation in mice (Shin and Yamada, 2002).
Humans			Difficult to shield participant from knowing their intervention or control status. May take a long time to see an effect. Ethical considerations limit the withholding of treatment from the control group.	Ten days of preoperative and 9 days of postoperative TPN reduced the complication rate by approximately one-third and prevented mortality in patients with gastric or colorectal tumors and preoperative weight loss of 10 percent or more (Bozzetti et al, 2000).

In summary, careful reading of research reports is required to make wise judgments about the applicability to health practices. Occasionally, an intervention trial is terminated early to permit an obviously effective treatment to be extended to the control group, as in the folic acid–neural tube defect study (MRC Vitamin Study Research Group, 1991), or to prevent harm, as in the

beta-carotene/vitamin A–lung cancer trial (Redlich et al, 1998). Even in these rare situations, the complete reasons for the effect shown by the overwhelming evidence are not always clear. A broad perspective is necessary to guide a person's behavior toward healthy choices for a lifetime.

**Table 23-2 Benefit Versus Risk Evaluation by the American Cancer Society (for the General Public)**

INTERVENTION	ORAL OR							
	BLADDER	BREAST	COLORECTAL	ENDOMETRIAL	ESOPHAGEAL	PANCREAS	PROSTATE	STOMACH
Increased fruit and vegetable intake	A3	A3	A2	A3	A2	A3	A3	A2
Limited red meat intake	C	B	A2	B	B	A3	A3	C
Increased physical activity	B	A1	A1	A2	B	B	B	B
Overweight avoidance	C	A1	A1	A1	A2	A3	C	C
Limited alcohol intake	C	A2	A3	B	A1	A3	C	C
Soy food consumption	B	B	B	B	B	B	B	B
Beta-carotene supplements	B	B	B	B	B	B	C	B
Vitamin E supplements	B	B	B	B	B	B	A3	B
Vitamin C supplements	B	B	B	B	B	B	B	B
Folic acid supplements	B	A3	A3	B	B	B	B	B
Selenium supplements	B	B	A3	B	B	B	A3	B

A1 = convincing evidence of benefit; A2 = probable benefit; A3 = possible benefit; B = insufficient evidence of benefit or risk; C = evidence of lack of benefit; D = evidence of harm.

The few instances of *convincing evidence of benefit* show there is much research remaining to be done. Perhaps, for many reasons, some of them ethical, definitive answers may not be found. Adapted from Byers et al, 2002.

although conclusive evidence is lacking. A review of studies of pelvic radiotherapy found no evidence to support the effectiveness of nutritional interventions in controlling bowel symptoms; however, further research was recommended into low-fat diets, probiotic supplements, and elemental diets (McGough et al, 2004).

With modern treatment, many people are cancer survivors. In the United States, approximately 9.5 million persons are cancer survivors, and 62 percent of Americans with cancer survive more than 5 years after diagnosis (Brown et al, 2003). These individuals may be especially motivated to improve their lifestyles to prevent recurrences or new primary cancers. A summary of the benefits or risks of some interventions possible for cancer survivors is listed in Table 23-3. There is less empirical evidence pertaining to surviving cancer than there is regarding preventing it, but still some rationale exists for particular choices. No consensus has been reached regarding antioxidant supplementation because some experts believe antioxidants could be used by the tumor cells to repair damage by treatments whereas other experts believe the benefit to bolstering normal cells would outweigh the theoretical assistance to the cancer cells. Nevertheless, a prudent course would be to confine antioxidant intakes to the ULs or less when receiving therapy (Brown et al, 2003).

### Cachexia

A state of malnutrition and wasting is called **cachexia**. Often seen in up to two-thirds of cancer clients, it is also

associated with other diseases, including AIDS, alcoholism, heart failure, malaria, rheumatoid arthritis, and tuberculosis. The client loses weight involving both adipose tissue and skeletal muscle, but the wasting is not due to malnutrition, which preferentially depletes lipids from adipose tissue (see Chapter 24). Overall skeletal muscle protein breakdown rates in cancer patients have not been found to be different from controls, but the rate of muscle protein synthesis is reduced, thereby producing net muscle protein loss (Barber and Rogers, 2002). In cancer, cachexia occurs, despite efforts to nourish the client, because of the tumor's effects on the client's metabolism in which increased resting energy expenditure can occur despite the reduced dietary intake, indicating a malfunction of metabolism that rarely can be explained by the actual energy demands of the tumor (Plata-Salaman, 2000). Several substances produced by the tumor have been identified as mediators of tissue wasting in cachexia. A lipid-mobilizing factor stimulates lipolysis and increases energy expenditure. Cachexia-inducing tumors also produce a chemical that causes protein catabolism in skeletal muscle, while visceral protein is preserved (Tisdale, 2001b). Of particular relevance to nutrition is that a polyunsaturated fatty acid, *eicosapentaenoic acid (EPA)*, weakens the activity of this proteolytic-inducing factor and prevents loss of skeletal muscle (Tisdale, 2001a). Specifically, fish oil-enriched nutritional supplements given to clients with pancreatic cancer produced a median weight gain of 1 kilogram over 3 weeks and significantly affected serum mediators of catabolism (Barber et al, 2001). Ross

**Table 23-3** Benefit Versus Risk Evaluation for Cancer Survivors by the American Cancer Society

	Breast		Colorectal		Lung		Prostate	
	RECURRENCE	QUALITY OF LIFE	RECURRENCE	QUALITY OF LIFE	RECURRENCE	QUALITY OF LIFE	RECURRENCE	QUALITY OF LIFE
Striving for HBW during treatment	A3	B	A3	B	A3	A2	B	B
Striving for HBW after treatment	A2	A2	A3	A2	A3	A3	B	A3
Increasing physical activity* during treatment	B	A2	B	A2	B	B	B	A3
Increasing physical activity* after treatment	A3	A2	A3	A2	B	A3	B	A2
Limiting total fat	B	B	B	B	B	B	B	B
Limiting saturated fat	B	A3	A3	B	B	B	A3	B
Increasing fruits and vegetables	A3	B	A3	B	A2	B	A3	A3
Increasing fiber	B	B	B	B	B	B	B	B
Increasing omega-3 fatty acids	B	B	B	B	B	B	B	B
Increasing soy	B†	B†	B	B	B	B	B	B

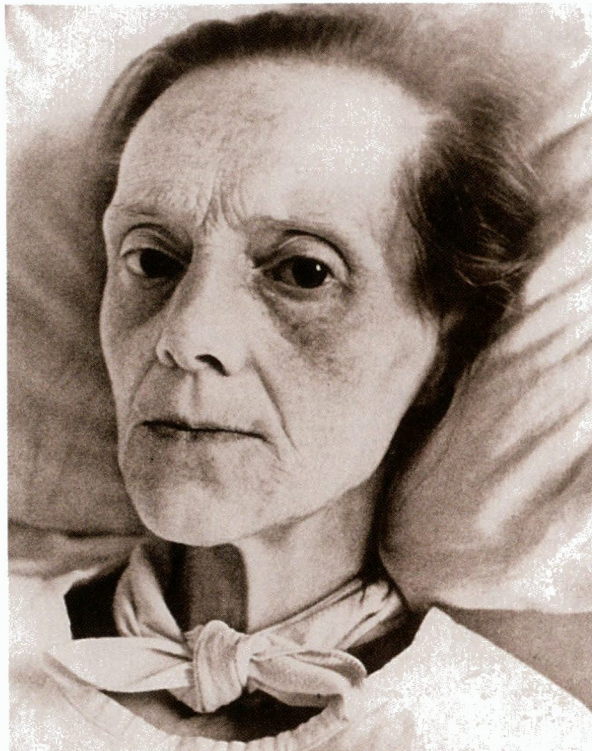
A1 = convincing evidence of benefit; A2 = probable benefit; A3 = possible benefit; B = insufficient evidence of benefit or risk; C = evidence of lack of benefit; D = evidence of harm\*\*.

\*What is low-intensity exercise for a healthy person may be high-intensity for the cancer survivor.

†Avoid concentrated sources of soy and soy isoflavones.

\*\*For the factors and cancers listed, there is no convincing evidence of benefit to clients during or after treatment for cancer, but neither is there evidence of lack of benefit or of harm.

SOURCE: Adapted from Brown et al, 2003.



**Figure 23–5** This woman is cachectic, showing signs of malnutrition and wasting. (Reproduced from *Nutrition Today*, 16(3), cover, © Williams & Wilkins, 1981, with permission.)

Laboratories has marketed a nutritional supplement for cancer clients containing EPA (ProSure(R) Shake); however, instructions state it should be used under medical supervision even though it is an over-the-counter product. Figure 23–5 shows a woman with cachexia.

Cancer also changes the client's carbohydrate metabolism. Insulin resistance is common. The client can no longer produce glucose efficiently from carbohydrate but instead uses tissue protein for energy. In traumatized non-cancer clients, catabolism of fat for fuel gradually replaces protein breakdown, but the cancer client's body does not make this adaptive change. By contrast, see starvation in Chapter 24.

Another likely causative factor in cachexia is the body's inflammatory response to the tumor. Treatment with anti-inflammatory drugs seems to have an anabolic effect (Barber, 2002).

### Assessment Considerations

Unexplained weight loss is one of the seven danger signals of cancer, but it is not a universal sign. Compared to 80 percent of clients with cancers of the stomach and pancreas who experienced weight loss, just 31 to 40 percent of those with breast or hematologic cancers or sarcomas and 54 to 64 percent of those with cancers of the colon, lung, and prostate were so affected. Anorexia and changes in the sense of taste often precede the diagnosis of cancer. Because the tumor alters the person's metabolism, it is possible for weight loss to occur without a reduction in

food intake. Involuntary weight loss of more than 10 percent is associated with poorer survival rates (Shils and Shike, 1999), and percentage of weight loss is a sensitive and specific tool that can effectively screen and identify malnutrition in cancer clients (Ravasco et al, 2003). In addition, compared to 10 percent of those remaining disease-free, unexplained weight loss occurred in 84 percent of breast cancer clients who developed recurrences, and the weight loss preceded the diagnosis of recurrence by 4 to 12 months (Marinho, Rettori, and Vieira-Matos, 2001). As cancer clients often develop ascites as well as other third-space sequestering of fluids, interpreting the weight gain or loss may be difficult. Nevertheless, weight is an important measure of progress in treating ascites.

Serum proteins, particularly albumin, reflect skeletal muscle and visceral protein status. Increased breakdown of the body's tissues and catabolism of the albumin produces low serum albumin levels. Hypoalbuminemia also may be caused by nephrotic syndrome or loss of proteins from removal of third-space fluids. Serum transferrin is also used as a marker for protein status. Because its half-life is 8 days, compared with 20 days for albumin, serum transferrin levels reflect the client's responses to stress or to nutritional support faster than serum albumin levels.

### Common Nutritional Problems in Cancer Clients

Some nutritional problems in cancer clients are due to the disease, and others are due to treatment modalities. Common problems affecting the consumption of meals and nourishment of cancer clients are early satiety and anorexia, taste alterations, local effects in the mouth, nausea, vomiting and diarrhea, and altered immune response.

#### Early Satiety and Anorexia

Although they may look starved, cancer clients may take a few bites of food and declare that they are full. They may say that they have no appetite at all. The main source of this symptom is the cancer itself, by mechanisms that are beginning to be understood. Control of the disease improves the appetite. Sometimes, though, the physical pressure from the tumor or third-space fluid accumulation may give a feeling of fullness. Relieving that problem may improve food intake.

Some additional factors may interfere with appetite. The psychological stress of dealing with cancer may produce anxiety or depression. The person may be grappling with a body image change or may be going through the grieving process for the loss of a body function or the potential loss of life itself.

#### Taste Alterations

Cancer clients often have changes in taste perceptions, particularly a decreased threshold for bitterness. Accordingly, they will often say that beef and pork taste bitter or metallic. Some clients report a decreased sensation of sweet, salty, and sour tastes, and they desire increased seasonings. These taste changes are caused by the cancer and the various modes of therapy.



### Local Effects in the Mouth

Clients who are being treated with radiation for head and neck cancers often experience mouth ulcers, decreased and thick saliva, and swallowing difficulty. Any of these may interfere with nutritional intake.

### Nausea, Vomiting, and Diarrhea

This triad of symptoms often accompanies radiation treatment or chemotherapy, as well as certain types of tumors. Since the gastrointestinal tract cells normally are replaced every few days, these rapidly dividing cells are more vulnerable to the cancer treatments than are more slowly reproducing body cells. Not all clients suffer these side effects to the same extent, and they generally cease when the treatment is completed.

*Radiation enteritis* involves injury to the intestine. Clients at greater risk of radiation enteritis are those who are thin; who have had previous abdominal surgery; who have hypertension, diabetes mellitus, or pelvic inflammatory disease; or who receive chemotherapy along with the radiation. Delays in onset of symptoms of 20 years have been reported (Turtel and Shike, 1999). A case was reported of a client whose anal ulcer caused by radiotherapy was healed in 7 weeks with oral vitamin A (Levitsky et al, 2003).

### Altered Immune Response

Sometimes, antineoplastic agents also suppress the client's immune system. Clients receiving them are at risk of overwhelming infections from organisms that would not affect other persons. Clients receiving radiation therapy or radiation as part of bone marrow transplantation also are at high risk of infections and need to be protected from all organisms, even those that are harmless to most healthy people. Clinical Application 23-7 details the role of the immune system in preventing cancer.

### Nutritional Interventions

Based on the problem areas just listed, dietary alterations are suggested. Parenteral therapy and tube feedings are covered in detail in Chapter 15, and dietary management of a long list of symptoms common in terminally ill clients is included in Box 26-2.

### For Early Satiety and Anorexia

Many nutrient-dense feedings are offered to the cancer client. For instance, adding 1 1/3 cups of instant dry skim milk powder to 1 quart of liquid milk increases the nutrient density, with little or no change in palatability. Similarly, 1 tablespoon of dry skim milk powder can be added to foods such as mashed potatoes and puddings.

Cancer clients should be encouraged to eat whether they are hungry or not. Appropriate exercise before meals may help to stimulate appetite. Attractively prepared food served in a pleasant environment is enticing. Very small servings, offered frequently, may increase the client's intake. For clients in the hospital or hospice, receiving favorite foods from home or sharing a meal with the family

## Clinical Application 23-7

### Role of the Immune System in Cancer

The immune system can recognize and eliminate tumor cells, but the tumors also can interfere with and evade immune responses by multiple mechanisms (Blattman and Greenberg, 2004; Rodriguez, Zea, and Ochoa, 2003). The increased incidence of cancer in AIDS clients and in organ transplant clients on immunosuppressive drugs demonstrates the consequence of a weakened immune system.

Part of the body's immune defense is provided by certain white blood cells called **T-lymphocytes**. These cells have the task of recognizing foreign materials, including cancer cells, as "non-self" and acting to destroy the invaders. Some of the T-lymphocytes develop into killer cells, which bind to the foreign cell membrane and release lysosomal enzymes into the cancer cell that destroys it. The T-lymphocytes mature in the **thymus** gland in the chest, hence the name, thymic lymphocytes. Contributing to the development of cancer in the elderly is the deterioration of the immune system, since the thymus gland begins to shrink at sexual maturity and by age 50 only 10 percent of the original gland remains.

The gastrointestinal system encompasses almost 50 percent of the mass of the immune system and 70 to 80 percent of immunologic-secreting cells and yet can be affected not only by tumor growth but by cancer treatments (Bloch, 2003). Consequently, efforts to maintain the integrity of gastrointestinal tract could contribute to the person's health in ways that go beyond nutrition.

may help overcome the client's aversion to food and offer the family the opportunity to contribute to a loved one's care. Unfortunately the case was not proved in one study that found neither calorie nor protein intake differed significantly between two groups of pediatric oncology clients eating with their caregivers versus alone, but satisfaction with food service was significantly higher in the social dining group (Williams et al, 2004). Children sometimes can be coaxed to eat by decorating their food with faces or serving it in the form of designs such as cars or dolls or the child's name. Involving the child in food preparation or in choosing the menu can help to stimulate the appetite. Reorganizing a pediatric oncology unit to provide "room service" improved the children's energy intake significantly and their protein intake by 18 percent as well as their satisfaction with the hospital food service (Williams, Virtue, and Adkins, 1998).

For the severely anorexic client, offering 1 ounce of a complete nutritional supplement every hour can be effective in promoting nourishment. Clients with severe, chronic anorexia who can tolerate oral intake may benefit from drug therapy with *megestrol acetate*, a semi-synthetic progesterone, one of the most effective appetite stimulants for clients with cancer anorexia. Despite the fact that weight gain stimulated by progesterone agents is primarily fat and not lean body mass (MacDonald, 2003), overall

quality of life was improved in most clients with cancer who took megestrol for 2 to 8 weeks (Tomiska et al, 2003). When treating a terminally ill client, improving quality of life through some enjoyment of food and family is an appropriate goal. Nourishing the terminally ill client is the subject of Chapter 26.

### To Combat Bitter or Metallic Tastes

Oral hygiene before meals freshens the mouth. Sometimes lemon-flavored beverages improve taste sensations. Cooking in a microwave oven or in glass utensils may minimize the metallic taste. Experiment with plastic table service if metal utensils are a problem. As protein sources, eggs, fish, poultry, and dairy products may be better received than beef or pork. Serving meat cold or at room temperature lessens the bitter taste. Sweet sauces and marinades added to the meat may improve its palatability.

### For Local Effects About the Mouth

A single canker sore can be remarkably painful. A cancer client with multiple oral ulcerations may complain of severe pain on food ingestion. In addition, some clients also have a dry mouth and difficulty swallowing. For all of these problems, good oral hygiene, before and after meals, is essential.

### MOUTH ULCERATIONS

Foods should be soft and mild. Sauces, gravies, and dressings may make foods easier to eat. Cream soups and milk provide much nutrition for the volume ingested. Cold foods have a somewhat numbing effect and may be better tolerated than hot food. Taking liquids with meals helps wash down the food. Drinking straws may help get the liquids past mouth ulcerations. Substances likely to irritate the mouth ulcerations should be avoided. These may include hot items, salty or spicy foods, acidic juices, and alcohol (even in mouthwash). To maintain oral intake, it may be necessary to resort to an anesthetic mouthwash. If the mouth is anesthetized, clients should be instructed to chew slowly and carefully to avoid biting their lips, tongue, or cheeks.

### DRY MOUTH

Adequate hydration helps keep the mouth moist. Food lubricants can be of value: gravy, butter, margarine, milk, beer, or bouillon may aid in consuming a near-adequate diet when the mouth is dry. Synthetic salivas are available also, but they have caused allergic reactions (Kandala and Playfor, 2003). In addition, many clients prefer sips of water to the synthetic products. Sugarless hard candy, chewing gum, or popsicles also may stimulate saliva production.

### SWALLOWING DIFFICULTY

This problem may linger throughout a course of treatment. To combat it, clients should make swallowing a conscious act. They should inhale, swallow, and exhale. They should experiment with head position. Tilting the head backward or forward may help. Foods for these clients should be nonsticky and of even consistency. Lumpy gravy and mixed vegetables, for example, are hard to manage.

Dunking bread products in beverages helps lubricate the passage.

### For Nausea, Vomiting, and Diarrhea

Antiemetic medications should be given an appropriate number of hours before chemotherapy begins and continued on a regular schedule. These drugs are most effective if given prophylactically before the client becomes nauseated. Identifying the pathway inducing nausea and vomiting helps to select effective medications, which might include a derivative of marijuana, *dronabinol* (Haughney, 2004). Similarly, medications for pain and insomnia must be given liberally, but an opioid regimen also necessitates measures to prevent constipation. Because nausea and vomiting frequently accompany pain in clients without cancer, so, too, controlling the cancer client's pain may alleviate nausea. In addition to administering antiemetic drugs, the nurse should monitor the client's hydration and electrolyte status.

As with morning sickness, eating dry crackers before arising may alleviate the nausea. Liquids taken between meals, rather than with them, reduce the volume in the stomach. Similarly, a low-fat diet is digested faster, leaving less content in the stomach to cause nausea or to be vomited. Clients should eat slowly and chew thoroughly. Resting after eating and taking liquids 30 to 60 minutes after solid food helps to control nausea. Foods the client especially likes should be saved for times when the client feels well, so that these favorite foods do not become associated with vomiting and are thereafter avoided. Food aversions develop in more than half of chemotherapy clients, usually involving two to four foods, but they may be accepted several weeks or months after the completion of therapy (Utermohlen, 1999).

Avoid strong cooking odors by selecting milder foods, ventilating the kitchen, and using microwave or boil-in-bag preparation. As with the client who has gastrointestinal upset, clear liquids should be tried first, after vomiting ceases, and the diet progressed as tolerated. Unconventional mealtimes may be instituted to ensure that the client receives nourishment when nausea is minimal. If this means that breakfast is eaten at 2 AM and lunch at 6 AM, so be it. This accommodation is truly individualized care.

Maintenance of fluid and electrolyte intake is critical in the client with diarrhea, and early recognition and treatment can modify this complication. Among the dietary modifications that may be used are the following:

- Adding pectin-containing foods to the client's intake
- Implementing a low-residue diet
- Testing for and treating lactose intolerance
- Restoring intestinal bacteria with active cultures of yogurt

A concentrated freeze-dried living bacteria compound was effective in preventing diarrhea in clients receiving 6 to 7 weeks of pelvic radiation (Delia et al, 2002). Pancreatic secretions and bile acids in the bowel seem to increase the susceptibility of the small bowel to radiation. Nourishing clients enterally with amino acids or partially digested protein and very little fat helped to decrease diarrhea and weight loss and to minimize interruptions to the treatment

schedule. Such feedings are not recommended routinely because of the inconvenience but may be appropriate for malnourished clients or those with severe radiation toxicity (Turtel and Shike, 1999).

### For Altered Immune Response

Clients may be placed in protective isolation to minimize their exposure to microorganisms. As for dietary interventions, fresh fruits and fresh vegetables may be restricted since they cannot be disinfected adequately. Raw and undercooked entrees and appetizers such as smoked and pickled fish as well as unpasteurized foods may be off limits. Yogurt also may have to be avoided because of the possibility of translocation of bacteria from the intestine to the bloodstream. Other measures are similar to those taken to protect AIDS clients and are included in Chapter 25.

### Total Parenteral Nutrition or Tube Feedings

The principles of tube feeding and total parenteral nutrition (TPN) apply to cancer clients as well as to clients generally. Clients should be started on appropriate feeding methods before they become severely malnourished. A client whose weight is 5 kilograms below a healthy body weight and whose serum albumin is less than 3 grams per 100 milliliters should be considered as a candidate for intensive nutritional support. Other individuals deserve early interventions because of the location of the cancer. As an example, increased dietitian supervision of clients with head and neck cancer, including the time between surgery and the start of chemotherapy, reduced the weight loss these clients sustained (Dawson et al, 2001). The Charting Tip in Box 23-3 advocates forethought when documenting cancer clients' at-home treatments and diet plans.

### Other Nursing Interventions

Oral hygiene before and after meals may help clients to eat better. Oral hygiene with isotonic saline alone or combined with soda bicarbonate is recommended. Alcohol and glycerin products dry the mucosa, and hydrogen peroxide damages new tissue.

Physical therapy may prevent further loss of muscle tissue due to weight loss. Massage and relaxation exercises may assist clients in coping. Depending on the techniques

#### Box 23-3 Charting Tip

- When admitting a client who provides much of his or her own care at home, try to learn all about treatments and dietary preferences and document them. If the client becomes less self-sufficient after surgery or after beginning cancer therapy, the staff will not have to ask multiple questions before providing care. Recording this information ensures that others besides the nurse who obtained it will be able to meet the client's needs.

used, massage can either stimulate or relax a person. Besides the local effects, the client receives the benefit of touch from another person. This can be very valuable, because cancer clients sometimes feel, rightly or wrongly, that they are being shunned. In one type of relaxation exercise, clients are coached to relax areas of the body in sequence. Others focus the client's mind on controlled breathing or mental images. These procedures have the added advantage of assisting the client to achieve some control over an oppressive situation. Clients respond differently to nursing interventions. No single technique works in every situation.

Music therapy has been effective in alleviating the distress of cancer clients and has the advantage of not requiring training or active participation to implement. A comparison of routine hospice care with or without music therapy affirmed the value of music to an improved quality of life (Hilliard, 2003). Moreover, clients receiving a music intervention in addition to other antiemetic treatments during high-dose chemotherapy experienced less nausea and fewer instances of vomiting than those who did not receive the music (Ezzone et al, 1998).

Nursing cancer clients requires creativity and patience. It also exemplifies one of the most satisfying rewards of nursing. By entering clients' lives at critical times, the nurse often shares their hopes and fears and memories. As often as not, we can learn as much from them as they can from us. Cancer clients, by confronting a potentially fatal disease, can teach themselves, their families, and their caregivers the truth of the adage that life is a journey, not a destination.

## SUMMARY

Cancer is the second leading cause of death in the United States. Many different kinds of cancer exist, but all occur when normal cells reproduce uncontrollably both at the site of origin and in metastatic sites of the body. The two-step process of cancer development may evolve over decades, involving initiators that alter a cell's genes and promoters that then activate the altered genes to begin their unruly growth. As more is discovered about the molecular basis of cancer, more refined and individualized treatments will be possible.

Dietary guidelines to prevent cancer are similar to those included throughout this book. People should avoid obesity through controlled consumption of the energy nutrients and should limit intakes of alcohol, fat, and meats, especially those that are cured, smoked, or charbroiled. Positive dietary steps are to maintain generous intakes of fruits, vegetables, fiber, and fluid and adequate but not excessive intakes of vitamin E and calcium. Wellness Tip 23-1 summarizes general guidelines.

(Continued on the following page)

**SUMMARY** (Continued)

Cancer clients often present difficult nutritional challenges. Both the disease and its treatment can cause early satiety and anorexia, taste alterations, local effects in the mouth, nausea, vomiting, diarrhea, and altered immune responses. Creative interventions for these problems help make the client's life significantly more comfortable and can give a sense of accomplishment to the nurse and provide solace to the family.

**23-1** • Do not smoke.

• Choose a wide variety of fruits and vegetables. Eight to 10 servings a day as recommended in the DASH Diet for hypertension would also be suitable in attempts to minimize cancer risk.

- Choose whole grains, cereals, and legumes to provide half the kilocalories in the daily diet.

- Eat small portions (3 ounces/day) of fish, poultry, or meat and limit intake of cured, smoked, and charbroiled foods.
- Limit consumption of saturated fats in favor of monounsaturated and polyunsaturated forms.
- Confine salt intake to less than 6 grams (about 1 teaspoon) per day.
- Cook foods at low temperatures instead of frying or grilling.
- If alcohol is consumed, restrict it to one to two standard drinks per day, depending on age, gender, and body size.
- If supplemental vitamins and minerals are desired, pick a multivitamin/mineral product containing the nutrients at RDA levels rather than individual products.
- Avoid excess body weight.
- Exercise regularly.

**CASE STUDY 23-1**

Ms. X is admitted to the hospital for a third course of chemotherapy. She is divorced, with no children, and lives with her mother, who is very supportive. Hopeful that this therapy will stem the cancer, Ms. X is determined to complete the prescribed treatments. Nausea and vomiting in the past two courses of chemotherapy caused her to suspend treatment before it was completed.

Ms. X is 42 years old, 5 ft 5 in tall, and weighs 119 lb. Her elbow breadth is 2 1/4 in. The mucous membranes of her oral cavity are intact. Her favorite foods are ice cream and steak, although for the past 2 months beef has tasted bitter to her. A 24-hour recall indicated she consumed a relatively balanced diet that totaled approximately 1800 kilocalories.

**NURSING CARE PLAN**

**SUBJECTIVE DATA** History of intolerance to chemotherapy due to excessive nausea and vomiting

Taste alteration for beef  
Stated determination to complete treatment  
Estimated deficit of 400 kilocalories for previous day

**OBJECTIVE DATA** 94 percent healthy body weight (127 lb)

No breaks in mucous membranes of mouth

**NURSING DIAGNOSIS** NANDA: Imbalanced Nutrition: Less than Body Requirements (NANDA, 2003, with permission) related to side effects of chemotherapy as evidenced by body weight 6 percent under healthy body weight for height

**DESIRED OUTCOMES****EVALUATION CRITERIA**

NOC: Nutritional Status (Moorhead, Johnson, and Maas, 2004, with permission.)

Client will maintain current weight during chemotherapy treatments.

**NURSING ACTIONS/INTERVENTIONS**

NIC: Nutrition Therapy (Dochterman and Bulechek, 2004, with permission.)

Give antiemetics on scheduled basis for maximum effectiveness.  
Assess daily the times nausea occurs.  
Schedule meals at other times.

Offer dry crackers whenever nausea occurs.  
Give gentle oral hygiene every 4 hours.

**RATIONALE**

Antiemetics work better as preventive medicine than as curative.  
Individualizing meal schedules for clients at high risk of malnutrition should increase dietary intake.  
Some clients have received relief from nausea by eating dry crackers.  
Keeping the oral cavity clean and fresh helps to maintain intake.

DESIRED OUTCOMES EVALUATION CRITERIA	NURSING ACTIONS/INTERVENTIONS	RATIONALE
	Encourage client to eat slowly and chew thoroughly.	Eating slowly and chewing thoroughly reduce the incidence and severity of nausea.
	Provide a back rub and quiet time after meals.	Rest after eating will lessen pressure on stomach and intestines. Appropriate massage induces relaxation.
	Help client to select music that will relax her during treatments.	Music therapy has improved the effectiveness of an antiemetic regimen in chemotherapy clients.
	Teach relaxation exercises and controlled breathing to be used when nausea occurs.	These exercises give the client some control over her environment. Teaching the exercises before treatments begin will be more effective than trying to interrupt the cycle of nausea and vomiting once begun.
	If vomiting occurs, monitor weight, hydration, and electrolyte status.	Early identification and interruption of a pathological process permits easier and less invasive treatments. Loss of gastric secretions can cause fluid volume deficit and alkalosis.
	Consult with clinical dietitian and physician regarding supplements, high-protein, low-fat diet, enteral feeding, or TPN.	Although this client is not 10 percent below minimum body weight, if she loses an additional 5 lb, she will reach that benchmark. Aggressive nutritional support should begin before the client becomes severely malnourished.

### CTQ CRITICAL THINKING QUESTIONS

1. What additional assessment data might impact the design of Ms. X's nursing care plan?
2. How could you involve the client's mother in her care?
3. Later, the physician's chart notes indicate Ms. X's cancer has not responded to treatment. Ms. X is aware of her situation. She tells the nurse, "If this doesn't work, I'm going to starve it out by fasting and purging." How should the nurse respond?

### CHAPTER REVIEW

1. Research has identified which of the following factors as possibly explaining the conflicting results reported concerning dietary intakes and cancer development?
  - a. Erroneous classification of the tumor types
  - b. Genetic differences in the metabolism of the people studied
  - c. A time frame that extends over too many years
  - d. Too large a sample of people recruited to the study
2. Cruciferous vegetables that are specifically thought to protect against cancer are:
  - a. Corn, lima beans, and peas
  - b. Carrots, green beans, and tomatoes
  - c. Brussels sprouts, bean sprouts, and water chestnuts
  - d. Broccoli, cauliflower, and cabbage
3. Which of the following foods is likely to be well received by a cancer client with mouth ulcerations?
  - a. Hot chicken noodle soup
  - b. Orange juice with orange sherbet
  - c. Vanilla milkshake
  - d. Soda crackers with cream cheese
4. Which of the following is the best advice to increase oral intake for a chemotherapy client who suffers from nausea and vomiting?
  - a. Drink plenty of fluids with the meal
  - b. Eat high-fat, high-protein meals
  - c. Take only foods that are well liked
  - d. Eat slowly and chew thoroughly
5. If visitors brought all of the following to a client in protective isolation, which should the nurse question?
  - a. Fruit basket
  - b. Homemade vegetable soup
  - c. Apple pie
  - d. Malted milk and French fries



## CLINICAL ANALYSIS

Ms. R is a 70-year-old widow under treatment for breast cancer. She is being cared for by her daughter, Ms. S, with assistance from a home healthcare service. Despite fairly good oral intake at the daughter's urging, Ms. R continues to lose weight and now carries 95 pounds on her 5-foot, 4-inch frame. Her main complaint regarding food is its bitter taste.

1. Ms. S asks why her mother continues to lose weight when she is taking half the meals and more than half the supplements offered. Which of the following replies by the nurse would be most appropriate?
  - a. "Your mother must be too active and using more calories than she is taking in."
  - b. "Probably the medications are dehydrating her. We should increase her fluid intake."
  - c. "Frequently the tumor short-circuits the body's metabolism so that nutrients cannot be used normally."
  - d. "She doesn't take in enough protein to prevent loss of muscle. We should try supplements of amino acid powders."
2. Ms. S expressed interest in learning what she could do to lessen her own chances of developing a malignancy of the breast. Which of the following suggestions have the best evidence for preventing breast cancer?
  - a. Limit intake of red, processed, or charbroiled meats
  - b. Maintain a normal weight and minimize or avoid alcohol intake
  - c. Gradually increase fiber intake to 25 grams per day, accompanied by adequate fluid intake
  - d. Eat a variety of colorful fruits and vegetables every day
3. Which of the following interventions could alleviate the bitter tastes Ms. R is experiencing?
  - a. Serving meats cold or microwaved in glass dishes
  - b. Limiting the intake of dairy products
  - c. Avoiding sauces and marinades that could increase the bitter taste
  - d. All of the above

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