Nutrition Therapy for the Prevention of Diabetes and Cancer
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Abstract
Lifestyle choices can influence the risk of both cancer and diabetes. Common risk factors include age, glycemia, obesity, physical activity, gender, smoking, diet, and alcohol use. Many strategies that reduce the risk of cancer also decrease the risk of diabetes. For cancer prevention, encouraging individuals to maintain a weight within normal range, perform physical activity, and choose mostly a plant-based diet, which includes a variety of fruits, vegetables, whole grains and legumes while limiting energy-dense foods is key. In individuals with prediabetes, lifestyle interventions including modest weight loss (5-7% of body weight) and moderate physical activity (equivalent to 30 minutes of brisk walking on most days of the week) are effective in decreasing the risk of converting to diabetes by 29-67%.

Introduction
Cancer and diabetes are both leading causes of death worldwide, and are diagnosed within the same individual more frequently than would be expected by chance, even after adjusting for age (1). Type 2 diabetes and cancer share many common potential risk factors. Nonmodifiable risk factors common to both are age, gender, family medical history, genetics, and race/ethnicity. Modifiable risk factors include obesity, diet, physical inactivity, tobacco smoking, and alcohol use (1). However, potential mechanisms that mediate these associations have yet to be determined. Under investigation are the involvement of growth hormone, insulin-like growth factor (IGF-1), and insulin on tumor promotion and progression (2).

Although genetic susceptibility influences the risk of cancer, most of the variation in cancer risk across populations and among individuals is reported to be due to factors that are not inherited. Behaviors such as avoiding exposure to tobacco products, limiting or avoiding alcohol, maintaining a healthy weight, staying physically active throughout life, and consuming healthy foods can substantially reduce an individual’s lifetime risk of developing or dying from cancer (3). Genetic factors also affect the risk for diabetes, but in individuals with prediabetes, modest weight loss (5% to 7% of body weight) and moderate physical activity (equivalent to 30 minutes of brisk walking on most days of the week) have been shown to decrease the risk of converting to diabetes by 29% to 67% (4). Furthermore, the impact of maintaining lifestyle interventions in preventing and/or delaying the onset of type 2 diabetes can persist for at least 10 years (4).

Changing Modifiable Risk Factors
Intentional Weight Loss
Evidence suggests that weight gain is associated with an increased risk of some cancers, including cancers of the breast, esophagus, colon, pancreas, and prostate (5). Weight gain is also associated with insulin resistance and type 2 diabetes, and numerous studies have shown that weight loss decreases diabetes incidence and has the potential to restore euglycemia (6-7). The American Diabetes Association (ADA) recommends weight loss for all overweight or obese individuals who are at risk for diabetes (7).

It is estimated that in the United States (U.S.) overweight and obesity contributes to 14% to 20% of all cancer-related mortality (3). The American Cancer Society (ACS) recommends that individuals be as lean as possible throughout life without being underweight and avoid excess weight gain at all ages (3,8). The association between weight loss and subsequent cancer risk is less clear (1). A summary of the association of weight loss following bariatric surgery and cancer incidence noted limited evidence for the benefit of reducing cancer risk with weight loss (9). Although more research is needed on how weight loss changes cancer risk, intentional weight loss may reduce the risk of postmenopausal breast cancer, and possibly other cancers (10). The ACS states that for those who are currently overweight or obese, losing even a small amount of weight has health benefits and is a good starting point. An initial goal of 5% to 7% weight loss is generally recommended (8).

Physical Activity
Epidemiologic studies consistently show that higher levels of physical activity are associated with lower risk of colon, postmenopausal breast, and endometrial cancer (5,11), but a clear link between physical activity and other cancers has not been established. The protective role for increased physical activity in preventing and treating diabetes has been established (12).

Recommendations are that all adults perform at least 150 minutes per week of moderate-intensity or 75 minutes per week of vigorous-intensity aerobic physical activity (12). Additional health benefits, including improved weight loss/maintenance, can be attained by increasing to 300 minutes (5 hours) per week of moderate-intensity or 150 minutes (2.5 hours) per week of vigorous-intensity aerobic activity. Muscle-strengthening activities, such as resistance training, that involve all major muscle groups should be performed on 2 or more days per week.

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<th>Recommendations</th>
<th>American Diabetes Association</th>
<th>American Cancer Society, American Institute for Cancer Research</th>
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| **Body Weight**       | • Structured programs that emphasize lifestyle changes, including moderate weight loss (7% body weight)  
                        • Weight loss, if recommended, for all overweight and obese individuals  
                        • Dietary strategies that include reduced calorie and dietary fat are recommended | • Achievement and maintenance of a healthy weight throughout life  
                        • Maintenance of leanness throughout life without being underweight  
                        • Avoidance of excess weight gain at all ages; for those who are overweight or obese, losing even a small amount of weight has health benefits and is a good starting point  
                        • Regular physical activity and limited intake of high-caloric foods and drinks to maintain a healthy weight |
| **Physical Activity** | • Physical activity and behavior modification are important components of weight loss programs and are most helpful in maintaining weight loss  
                        • Regular physical activity (150 min/week)                                             | • At least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity activity each week (or a combination of these), preferably spread throughout the week (30 minutes every day)  
                        • Limiting of sedentary behavior such as sitting, lying down, watching TV, and forms of screen-based entertainments |
| **Fiber**             | • Attempt to achieve the United States Department of Agriculture recommendations for dietary fiber (14 g fiber/1,000 kcal) and foods containing whole grains (50% of grain intake) | • Consumption of whole grains instead of refined grain products |
| **Fruits and Vegetables** |                                                                                              | • Consumption of at least 2½ cups of vegetables and fruits each day  
                        • Consumption of a variety of vegetables, fruits, whole grains, and legumes such as beans |
| **Red Meat and Processed Meats** |                                                                                              | • Consumption of no more than 18 oz (cooked weight) per week of red meats such as beef, pork, and lamb and avoidance of processed meat such as ham, bacon, salami, hot dogs, and sausages |
| **Sugar-sweetened Beverages** | • Limited intake of sugar-sweetened beverages                                                                 | • Avoidance of sugary drinks  
                        • Limited consumption of energy-dense foods |
| **Alcohol**           | • If individuals choose to drink alcohol, limit intake to a moderate amount (1 drink per day or less for adult women and 2 drinks or less per day for adult men)  
                        • If consumed at all, limit to 1 drink per day for women and 2 drinks per day for men |                                                                                       |
| **Tobacco**           | • Avoid smoking  
                        • Include smoking cessation counseling and other forms of treatment as needed | • Avoid smoking or chewing tobacco |
Healthy Eating Pattern

A number of studies suggest that a predominantly plant-based eating pattern emphasizing a wide variety of vegetables, fruits, whole grains, and legumes and lower intake of red and processed meat is associated with a lower risk of many types of cancers (3,5). Foods high in dietary fiber may protect against colorectal cancer and also provide a wide range of nutrients and phytochemicals that may act in a variety of pathways, possibly synergistically, to reduce the development of many cancers (5).

Randomized, controlled trials (RCTs) of nutrition interventions for diabetes prevention document benefits from low-fat, low-calorie diets plus-minus high-fiber diets (6). Since completion of the trials, several reviews of observational studies have demonstrated an inverse relationship for the risk of type 2 diabetes and consumption of whole grains, although the number of RCTs is limited (4). The Dietary Guidelines Advisory Committee (DGAC) 2010 states that limited evidence supports the association of whole grain consumption with reduced risk of type 2 diabetes (13). The committee also concluded that strong evidence suggests that a diet high in saturated fatty acids and trans fatty acids is associated with increased markers of insulin resistance and risk for type 2 diabetes, whereas unsaturated fatty acid intake is inversely associated with risk of diabetes.

Cohort studies and a clinical trial have also reported an inverse risk of diabetes with adherence to a Mediterranean-style diet, an eating pattern that for some persons may be a palatable alternative to the low-fat diets used in diabetes prevention trials (4).

Of interest is a study showing that a combination of healthy lifestyle factors lowers the risk of developing type 2 diabetes (14). Results from the study of 207,479 people in the National Institutes of Health/American Association of Retired People (NIH AARP) Diet and Health Study revealed that participants who adhered to all five healthy lifestyle factors (a healthy eating pattern, participation in regular physical activity, maintaining a normal body weight, moderate alcohol intake, and being a nonsmoker) reduced their risk of developing type 2 diabetes by as much as 84% for women and 72% for men (14).

Because energy-dense and sugary foods contribute to overweight and obesity, the ACS, the World Cancer Research Fund/American Institute for Cancer Research, and the ADA recommend limiting consumption of these foods (3,5,6). Based on evidence, the ADA specifically recommends limiting intake of sugar-sweetened beverages (6).

The ADA recommendations for primary prevention of diabetes (6) along with the ACS Guidelines on Nutrition and Physical Activity for Cancer Prevention (3) and the World Cancer Research Fund/American Institute for Cancer Research (5) recommendations for a healthy lifestyle to prevent cancer are summarized in Table 1.

Alcohol

Alcoholic beverage consumption, even in moderate amounts, has been shown to increase the risk of many types of cancers, including those of the oral cavity, pharynx, larynx, esophagus, liver, colon/rectum, and female breast (15). The biologic mechanisms by which alcohol consumption may lead to cancer are not fully understood (3). Alcohol consumption may increase blood concentrations of estrogens or other hormones that increase breast cancer risk; reducing alcohol consumption is a widely recognized method of reducing the risk of breast cancer.

While excess alcohol consumption is a risk factor for diabetes, moderate alcohol consumption is associated with reduced diabetes incidence (4) and has been shown to increase insulin sensitivity. The ADA, ACS, and DGAC all recommend that if persons choose to drink alcoholic beverages, they should limit their intake to up to 1 drink per day for women and up to 2 drinks per day for men. However, they also caution that evidence does not support recommendations for individuals who are not currently consuming alcohol to start doing so based on potential benefits.

Tobacco Use

Tobacco use is clearly related to the development of many cancers (1). Smoking is also an independent risk factor for the development of diabetes (16), and has an adverse effect on diabetes-related complications (17).

Metformin

Metformin, which is commonly used in the management of type 2 diabetes, reduces insulin resistance, improves glycemic control, and can be combined safely with other antidiabetic drugs. In recent years, observational studies have suggested that metformin may be useful in the prevention and treatment of cancer due to its potential to inhibit the growth of cancer cells (18-19). However, this relationship has been questioned because of important methodological shortcomings in these studies (20-22). The studies are mostly retrospective and nonrandomized; metformin concentrations used in many experiments exceed those achieved with conventional doses used for diabetes treatment; and the studies have time-related biases. Therefore, further research is needed to evaluate any potential anticancer benefit of metformin.

Summary

Recommendations for weight management, physical activity, and a healthy eating pattern for diabetes and cancer prevention have many similarities. Clinicians in each specialty appreciate the importance of engaging in regular physical activity and maintaining weight within normal ranges for prevention of both diseases. However, cancer health organizations emphasize the importance of consuming a plant-based diet and

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limiting or avoiding alcohol intake, while moderate alcohol intake has been associated with a reduced risk of type 2 diabetes. Of note, the ACS and ADA guidelines for prevention of cancer and diabetes are consistent with those published by the American Heart Association (23) for the prevention of coronary heart disease and those for general health promotion, as defined by DGAC 2010 (13) and the 2008 Physical Activity Guidelines for Americans (12). For the public to experience health benefits from these recommendations, it is essential for RDs to promote their dissemination and implementation.

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References