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American Cancer Society Guideline for Diet and Physical Activity for Cancer Prevention

This is a condensed version of the article describing the American Cancer Society (ACS) Guideline for Diet and Physical Activity for Cancer Prevention. The full article (including references), which is written for health care professionals, is available online in CA: A Cancer Journal for Clinicians at:

<https://acsjournals.onlinelibrary.wiley.com/doi/full/10.3322/caac.21591>

Cancer is the second leading cause of death in the United States, behind only heart disease. People with cancer also often experience physical effects (from the cancer itself and from treatment), distress, and a lower quality of life. Quality of life can also be affected for family members, caregivers, and friends of people with cancer.

For most Americans who do not use tobacco, the most important cancer risk factors that can be changed are body weight, diet, and physical activity. At least 18% of all cancers diagnosed in the US are related to excess body weight, physical inactivity, excess

- [American Cancer Society Guideline for Diet and Physical Activity](#)
- [Effects of Diet and Physical Activity on Risks for Certain Cancers](#)
- [Common Questions About Diet, Activity, and Cancer Risk](#)
- [Infographic: Diet and Activity Guidelines to Reduce Cancer Risk](#)

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At least 18% of all cancers and about 16% of cancer deaths in the US are related to excess body weight, physical inactivity, alcohol consumption, and/or poor nutrition. Many of these cancers could potentially be prevented by following the ACS recommendations on nutrition and physical activity.

ACS RECOMMENDATIONS FOR INDIVIDUAL CHOICES

Achieve and maintain a healthy weight throughout life.

- Keep your weight within the healthy range, and avoid weight gain in adult life.

Be physically active.

- **Adults:** Get 150-300 minutes of moderate intensity or 75-150 minutes of vigorous intensity activity each week (or a combination of these). Getting to or exceeding the upper limit of 300 minutes is ideal.
- **Children and teens:** Get at least 1 hour of moderate or vigorous intensity activity each day.
- Limit sedentary behavior such as sitting, lying down, watching TV, and other forms

of screen-based entertainment.

Follow a healthy eating pattern at all ages.

- A healthy eating pattern **includes**: Foods that are high in nutrients in amounts that help you get to and stay at a healthy body weight
A variety of vegetables – dark green, red and orange, fiber-rich legumes (beans and peas), and others
Fruits, especially whole fruits in a variety of colors
Whole grains
- A healthy eating pattern **limits or does not include**: Red and processed meats
Sugar-sweetened beverages
Highly processed foods and refined grain products

It is best not to drink alcohol.

- People who do choose to drink alcohol should have no more than 1 drink per day for women or 2 drinks per day for men.

ACS RECOMMENDATIONS FOR COMMUNITY ACTION

Public, private, and community organizations should work together at national, state, and local levels to develop, advocate for, and apply policy and environmental changes that:

- Increase access to affordable, healthy foods
- Provide safe, enjoyable, and accessible opportunities for physical activity
- Limit alcohol for individuals

Each part of the guideline is described in more detail below.

Achieve and maintain a healthy weight throughout life

- **Keep your weight within the healthy range, and avoid weight gain in adult life.**

Body weight and cancer risk

Being overweight or obese is clearly linked with an increased risk of several types of

cancer, including:

- Breast cancer (among women who have gone through menopause)
- Colon and rectal cancer
- Endometrial cancer (cancer in the lining of the uterus)
- Esophagus cancer
- Kidney cancer
- Liver cancer
- Ovarian cancer
- Pancreas cancer
- Stomach cancer
- Thyroid cancer
- Multiple myeloma
- Meningioma (a tumor of the lining of the brain and spinal cord)

Being overweight or obese might also raise the risk of other cancers, such as:

- Non-Hodgkin lymphoma
- Male breast cancer
- Cancers of the mouth, throat, and voice box
- Aggressive forms of prostate cancer

Being overweight or obese is largely the result of taking in too many calories (from both food and beverages) and not burning enough calories, although a person's genes and changes in their metabolism as they age are also factors.

- The dietary factors most often linked with excess body fat include sugar-sweetened beverages, fast foods, and "Western type" diets (diets high in added sugars, meat, and fat), whereas foods containing fiber and "Mediterranean" diet patterns may reduce risk.
- Aerobic physical activity, including walking, is linked with a lower risk of excess body weight, whereas sedentary behaviors (sitting and lying down) and more screen time (such as looking at a phone or computer, or watching TV) is linked with a higher risk.

Some studies have shown a link between weight loss and a lower risk of some types of cancer, such as breast cancer after menopause and endometrial cancer. The risk of some other cancers may also be lowered by weight loss. While there is still much to be

- Head and neck cancers
- Liver cancer
- Pancreas cancer
- Prostate cancer
- Ovarian cancer

Being active may also help to prevent weight gain and obesity, which may in turn reduce the risk of developing cancers that have been linked to excess body weight.

A physically active lifestyle may also lower a person's risk of other health problems such as heart disease, high blood pressure, diabetes, and osteoporosis (bone thinning).

Examples of moderate and vigorous intensity physical activities

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

Recommended amount of activity

Adults should get 150-300 minutes per week of moderate intensity activity or 75-150 minutes per week of vigorous intensity activity, or an equal combination. Getting to or exceeding the upper limit of 300 minutes is ideal.

When combining different types of activity, 1 minute of vigorous activity can take the place of 2 minutes of moderate activity. For example, 150 minutes of moderate activity, 75 minutes of vigorous activity, and a combination of 100 minutes of moderate activity

plus 25 minutes of vigorous activity all count as the same amount.

This level of activity has been shown to have clear health benefits, including lowering the risk of dying at an early age and lowering the chance of getting or dying from certain types of cancer. Higher amounts of physical activity may be even better for lowering cancer risk.

For people who are not active or just starting a physical activity program, activity levels below the recommended levels can still help your health, especially your heart. The amount and intensity of activity can then be increased slowly over time. Most children and young adults can safely do moderate and/or vigorous activities without checking with their doctors. But men older than 40 years, women older than 50 years, and people with chronic illnesses or risk factors for heart disease should check with their doctors before starting a vigorous activity program.

Children and teens should be encouraged to be active at moderate to vigorous intensities for at least an hour a day, every day. This should include muscle-strengthening activities at least 3 days a week. Activities should be age appropriate, enjoyable, and varied, including sports and fitness activities in school, at home, and in the community. To help reach activity goals, daily physical education programs and activity breaks should be provided for children at school, and "screen time" (TV viewing, playing video games, or time spent on the phone or computer) should be limited at home.

Limiting time spent sitting

There is growing evidence that the amount of time spent sitting is important, regardless of your activity level. Sitting time raises the risks of obesity, type 2 diabetes, heart disease, and some types of cancer, as well as of dying at a younger age.

Lifestyle changes and advances in technology have led to people being less active and spending more time sitting each day. This is true both in the workplace and at home, due to increased TV, computer, and other screen time. Limiting the amount of time spent sitting, as suggested in the table below, may help maintain a healthy body weight and reduce the risk of certain cancers.

Tips to reduce sitting time

- Limit time spent watching TV and using other forms of screen-based entertainment.
- Use a stationary bike or treadmill when you do watch TV.

- Use stairs rather than an elevator.
- If you can, walk or bike to your destination.
- Exercise at lunch with your coworkers, family, or friends.
- Take an exercise break at work to stretch or take a quick walk.
- Walk to visit coworkers instead of phoning or sending an e-mail.
- Go dancing with your spouse or friends.
- Plan active vacations rather than only sightseeing trips.
- Wear a pedometer every day and increase your number of daily steps.
- Join a sports team.

Follow a healthy eating pattern at all ages

A healthy eating pattern includes:

- **Foods that are high in nutrients in amounts that help you get to and stay at a healthy body weight**
- **A variety of vegetables – dark green, red and orange, fiber-rich legumes (beans and peas), and others**
- **Fruits, especially whole fruits in a variety of colors**
- **Whole grains**

A healthy eating pattern limits or does not include:

- **Red and processed meats**
- **Sugar-sweetened beverages**
- **Highly processed foods and refined grain products**

In recent years, the effects of dietary patterns on the risk of cancer (and other diseases) have taken on more importance, as opposed to the effects of individual nutrients.

In general, the dietary patterns showing the most health benefits are based mainly on plant foods (including non-starchy vegetables, whole fruits, whole grains, legumes, and nuts/seeds), healthy protein sources (higher in legumes and/or fish and/or poultry, and lower in processed meats and red meat), and include unsaturated fats (such as mono- and polyunsaturated fat). These patterns are also lower in added sugar, saturated and/or trans fats, and excess calories.

Studies have provided consistent and compelling evidence that such healthy dietary

patterns are linked with a lower risk of cancer, certain other diseases, and dying at a younger age.

Several components of healthy dietary patterns are also independently linked with cancer risk.

Vegetables and fruits

Vegetables (including beans) and fruits are complex foods, containing vitamins, minerals, fiber, and other substances that may help prevent cancer. Research is being done on the potential cancer-preventing properties of certain vegetables and fruits (or groups of these), including dark green and orange vegetables, cruciferous vegetables (such as cabbage, broccoli, cauliflower, and Brussels sprouts), soy products, legumes, allium vegetables (onions and garlic), and tomato products.

Vegetables and fruits may also lower cancer risk by their effects on calorie intake and body weight. Many vegetables and fruits are low in calories and high in fiber, as well as having a high water content. This may help lower overall calorie intake, and thus help with weight loss and keeping unwanted weight off.

Eating plenty of vegetables and fruits has also been linked with a lower risk of other chronic diseases, especially heart disease.

For cancer risk reduction, the ACS advises following the US Dietary Guidelines, which is to consume at least 2½ to 3 cups of vegetables and 1½ to 2 cups of fruit each day, depending on a person's calorie requirements.

Legumes (including kidney beans, pinto beans, black beans, white beans, garbanzo

grains. The ACS guideline recommendation to choose whole grains is consistent with these guidelines.

Fiber

Dietary fiber, found in plant foods such as legumes, whole grains, fruits and vegetables, and nuts and seeds, is probably linked with a lower risk of colorectal cancer, as well as

Added sugars and other high-calorie sweeteners (such as high-fructose corn syrup) are often used in sugar-sweetened beverages and energy-dense foods (for example, traditional “fast food” or heavily processed foods). They are linked with a higher risk of weight gain and being overweight or obese, which increase the risk of many types of cancer.

Energy-dense and highly processed foods are also often higher in refined grains, saturated fat, and sodium.

The US Dietary Guidelines recommend limiting calories from added sugars and saturated fat, and specifically getting less than 10% of your calories a day from added sugars.

Processed foods

The health impact of highly processed foods is an area of increasing public concern. Some types of processing—such as peeling, cutting, and freezing fresh vegetables and fruit for later consumption—have important health benefits that increase the safety, convenience and taste of foods. But there is a spectrum of food processing, from **less processed foods** such as whole grain flour and pasta, to **highly processed foods** that include industrially produced grain-based desserts, ready-to-eat or ready-to-heat foods, snack foods, sugar-sweetened beverages, candy, and other foods that often do not resemble their original plant or animal sources.

Highly processed foods tend to be higher in fat, added sugars, refined grains, and/or sodium, and have been linked with unwanted health outcomes, including cancer, in a small number of studies. Still, up to 60% of the calories consumed per day in US households is from highly processed foods and beverages.

Calcium, vitamin D, and dairy products

Some research has linked diets high in **calcium and dairy products** to a lower risk of colorectal cancer, and possibly breast cancer as well. However, some studies have also suggested that calcium and dairy products might increase prostate cancer risk. Because the intake of dairy foods may lower the risk of some cancers and possibly increase the risk of others, the ACS does not make specific recommendations on dairy food consumption for cancer prevention.

Vitamin D, which is made by the body when the skin is exposed to ultraviolet (UV) rays, is known to help maintain bone health. Dietary sources include a few foods in which it is found naturally (such as fatty fish and some mushrooms), as well as foods fortified with

vitamin D (such as milk and some orange juices and cereals) and supplements. Some studies have suggested a potential role of vitamin D in lowering cancer risk, especially colorectal cancer. However, large studies have not found that vitamin D supplements lower the risk of colorectal polyps (pre-cancerous growths) or cancer.

Most Americans do not get enough vitamin D in their diets, and many have low vitamin D levels in their blood. While the role of vitamin D in lowering cancer risk is still an active area of research and debate, avoiding low vitamin D levels is recommended. People at higher risk of having low vitamin D levels include those with darker skin, those living in Northern latitudes, and those who stay indoors and who do not consume sources of vitamin D.

Dietary supplements

Dietary supplements are a diverse group of products defined under current US laws and regulations as containing vitamins and minerals as well as amino acids, herbs/botanicals, and other kinds of ingredients. Vitamin and/or mineral supplements can have important health benefits for people who don't get enough of these micronutrients from foods, or for those with malabsorption disorders.

But many other products that are marketed as dietary supplements are not truly "dietary" because they come from sources other than foods and contain substances not found in foods. They are also not "supplemental" because they do not increase intake of micronutrients that have been scientifically shown to be important for human health. Furthermore, current laws and regulations do not guarantee that products sold as dietary supplements actually contain substances in the quantities claimed on their labels, or that they are free from undeclared substances that can be harmful to human health.

Although a diet rich in vegetables, fruits, and other plant-based foods may reduce the risk of cancer, there is limited and inconsistent evidence that dietary supplements can reduce cancer risk. Further, some studies have found that high-dose supplements containing nutrients such as beta-carotene and vitamins A and E can actually increase the risk of some cancers. Nonetheless, more than half of US adults use one or more dietary supplements.

Many different types of compounds are found in vegetables and fruits, and it's likely that these compounds work together to have healthful effects. There are likely to be important, but as yet unknown, components of whole foods that aren't included in dietary supplements.

Some supplements are described as containing the nutritional equivalent of vegetables

and fruits. However, the small amount of dried powder in such pills often contains only a small fraction of the levels in the whole foods, and there is very little evidence supporting a role of these products in lowering cancer risk. Food is the best source of vitamins, minerals, and other important food components. If a dietary supplement is used for general health purposes, the best choice is a balanced multivitamin/mineral supplement containing no more than 100% of the “daily value” of nutrients.

At this time, the ACS does not recommend the use of dietary supplements for cancer prevention.

It is best not to drink alcohol

- **People who do choose to drink alcohol should have no more than 1 drink per day for women or 2 drinks per day for men.**

Alcohol use is the third most important preventable risk factor for cancer, after tobacco use and excess body weight. Alcohol use accounts for about 6% of all cancers and 4% of all cancer deaths in the United States. Despite this, public awareness about the cancer-causing effects of alcohol remains low.

A drink of alcohol is defined as 12 ounces of beer, 5 ounces of wine, or 1½ ounces of 80-proof distilled spirits (hard liquor). In terms of cancer risk, it is the amount of alcohol (ethanol) consumed that is important, not the type of alcoholic drink.

These daily limits do not mean you can drink larger amounts on fewer days of the week, since this can lead to health, social, and other problems.

Alcohol is a known cause of cancers of the:

- Mouth
- Throat (pharynx)
- Voice box (larynx)
- Esophagus
- Liver
- Colon and rectum
- Breast

Alcohol may also increase the risk of cancer of the stomach.

Alcohol also interacts with tobacco use to increase the risk of cancers of the mouth,

larynx, and esophagus many times more than the effect of either drinking or smoking alone.

Some research has shown that consuming *any* amount of alcohol increases risk of some types of cancer, most notably breast cancer.

Recommendations for community action

Public, private, and community organizations should work together at national, state and local levels to develop, advocate for, and implement policy and environmental changes that:

- **Increase access to affordable, nutritious foods**
- **Provide safe, enjoyable and accessible opportunities for physical activity**
- **Limit alcohol for all individuals**

For more information, see the full ACS Guideline at <https://acsjournals.onlinelibrary.wiley.com/doi/full/10.3322/caac.21591>².

Hyperlinks

1. acsjournals.onlinelibrary.wiley.com/doi/full/10.3322/caac.21591
2. acsjournals.onlinelibrary.wiley.com/doi/full/10.3322/caac.21591

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Effects of Diet and Physical Activity on Risks for Certain Cancers

This table provides a summary of the current evidence on how the risks for certain types of cancer* might be affected by diet and physical activity, as outlined in the American Cancer Society Guideline for Diet and Physical Activity for Cancer Prevention. The full version of the Guideline is available online at <https://acsjournals.onlinelibrary.wiley.com/doi/full/10.3322/caac.21591>¹.

Cancer Site	Body Weight	Physical Activity	Diet	Alcohol
Breast	Weight gain during adult life and/or excess body fatness increases risk after menopause. Weight loss <i>may</i> lower risk.	Physical activity, especially moderate to vigorous, lowers risk for post-menopausal cancer and <i>may</i> also lower risk for pre-menopausal cancer. Regular vigorous physical activity	Dietary patterns rich in plant foods and low in animal products and refined carbohydrates lower risk. The Mediterranean Diet pattern lowers risk. Consumption of non-starchy vegetables and/or vegetables rich in carotenoids	Alcohol use increases the risk for both pre- and post-menopausal breast cancer.

		lowers risk for pre-menopausal cancer.	may lower risk of estrogen receptor-negative breast cancer. Diets higher in calcium and calcium-rich dairy <i>may</i> reduce risk.	
Colorectal	Excess body weight is a strong risk factor.	Regular moderate to vigorous physical activity can reduce risk of colon, but not rectal, cancer. Reducing sedentary behavior may lower risk of colon cancer, but not the risk of rectal cancer.	A healthy eating pattern with whole grains, higher fiber, and less added sugar lowers risk. Eating non-starchy vegetables and whole fruit probably lowers risk. Processed meat intake, even in small amounts, and red meat in moderate to high amounts, increases risk. Consuming non-starchy vegetables and whole fruit probably lowers risk. Diets higher in calcium, calcium-rich dairy foods, and supplemental calcium may lower risk. Low blood levels of vitamin D may increase risk.	Alcohol use increases risk.
Endometrial	To reduce risk,	Participating in	Eating a diet with low	

			High-dose beta-carotene supplements increase risk, particularly among people who smoke and those exposed to asbestos.	
Ovary	Excess body weight may increase risk. Adult weight gain increases risk.	Regular physical activity may reduce risk.		
Pancreas	Excess body weight increases risk. Adult weight gain increases risk.	Regular physical activity may reduce risk.	Processed and red meats, as well as saturated fats in general, <i>may</i> increase risk. Sugar-sweetened beverages may increase risk.	
Prostate	Obesity is linked with higher risk for advanced prostate cancer.		Higher consumption of dairy products and calcium (> 2,000 mg/day) may increase risk.	
Thyroid	Obesity is linked with increased risk. Adult weight gain increases risk.			
Stomach	Excess body weight increases risk for gastric cardia cancer.	Regular physical activity may reduce risk.	Regular intake of processed, grilled, or charcoaled meats increases risk for non-cardia gastric cancer.	Alcohol use probably increases risk.

			Intake of non-starchy vegetables and whole fruit, especially citrus fruit, probably lowers risk.	
Mouth, throat, esophagus	Evidence suggests excess body weight increases risk for mouth cancer, esophageal adenocarcinoma.	Esophageal adenocarcinoma risk <i>may</i> be lowered with regular physical activity.	Eating non-starchy vegetables and whole fruit probably lowers risk.	Alcohol use increases risk for mouth, throat, and esophageal cancer.

*This is not a complete list of cancer types that might be affected by diet or physical activity.

Hyperlinks

1. acsjournals.onlinelibrary.wiley.com/doi/full/10.3322/caac.21591

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Common Questions About Diet, Activity, and Cancer Risk

These questions and answers are part of the American Cancer Society (ACS) Guideline for Diet and Physical Activity for Cancer Prevention. The full guideline article (including references), which is written for health care professionals, is available online in *CA: A Cancer Journal for Clinicians* at:

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Acrylamide

What is acrylamide, and is it linked with an increased risk of cancer?

[Acrylamide](#)² is a chemical used in industrial processing. It is also found in some foods

and in tobacco smoke. Acrylamide in food is formed as a by-product when the amino acid asparagine reacts with certain sugars when they are heated to high temperatures. The major sources of acrylamide in our diets are French fries, potato chips, crackers, bread, cookies, breakfast cereals, canned black olives, prune juice, and coffee.

Acrylamide is classified by the International Agency for Research on Cancer (IARC) as a “probable carcinogen,” based mainly on experiments in animals. However, a large number of studies in humans have found no strong evidence that dietary acrylamide is linked with an increased risk of any type of cancer.

Antioxidants

What are antioxidants, and what do they have to do with cancer?

The body uses certain nutrients and other compounds to help protect against damage to tissues that is constantly occurring as a result of normal metabolism. Because this type of damage is linked with increased cancer risk, some antioxidants are thought to protect against cancer. Antioxidants in the diet include vitamin C, vitamin E, carotenoids (compounds related to vitamin A), and many other food components. Studies suggest that people who eat more vegetables and fruits, which are rich sources of antioxidants, may have a lower risk for some types of cancer. But this does not mean that the benefits of vegetables and fruits are from their antioxidant content, rather than from other food components.

Most clinical trials of antioxidant supplements have not found they reduce cancer risk. In fact, some studies have found an increased risk of cancer among those taking supplements.

When it comes to reducing cancer risk, the best advice is to get your antioxidants through whole food sources rather than supplements.

Arsenic

What is arsenic? Does it cause cancer?

The International Agency for Research on Cancer (IARC), the US National Toxicology Program (NTP), and others have classified [arsenic](#)³ as carcinogenic to humans. Arsenic is a naturally occurring element that can be found in rocks and soil, water, air, plants, and animals, as well as in industrial and agricultural compounds.

Arsenic is found in two forms:

- **Inorganic arsenic compounds** are used in industry and in building products (such as some “pressure-treated” woods) and are found in arsenic-contaminated water. This tends to be the more toxic form of arsenic and has been linked to cancer.
- **Organic arsenic compounds** are thought to be much less toxic than the inorganic arsenic compounds and are not thought to be linked to cancer.

The main sources of human exposure to arsenic are water and food.

- **Water** in some areas of the United States, especially in the Southwest, New England, and the Upper Midwest, may be higher in arsenic. Natural arsenic levels tend to be higher in drinking water that comes from ground sources, such as wells.
- For most people, **food** is the largest source of arsenic, although much of this is likely to be in the less dangerous, organic form. The highest levels of arsenic in foods are found in seafood, rice and other rice products, mushrooms, and poultry, although many other foods, including some fruit juices, can contain arsenic.

Studies have found that exposure to arsenic in drinking water may cause lung, bladder, and skin cancers. Because arsenic has been linked to cancer and other unwanted health effects, several US government agencies regulate arsenic levels and exposures.

While arsenic is a naturally occurring element and can't be avoided completely, there are things people can do that may lower their exposure. Those whose drinking water comes from a public source can obtain publicly-available information about the levels of certain substances in drinking water, including arsenic. People who get their water from a private source such as a well can have arsenic levels tested by a reputable laboratory. Those who live in areas with high levels of arsenic in the water may consider using alternate sources of drinking water, such as bottled water. Common household water filters do not effectively remove arsenic. Avoiding excess consumption of foods known to contain high levels of arsenic, including seafood, rice and rice products, and fruit juice can also help lower exposure, and maintaining adequate folate levels is important for the elimination of arsenic in the body.

Coffee

Does drinking coffee affect cancer risk?

Whether coffee lowers or raises the risk of different types of cancer has been an active area of research. Studies have suggested that drinking coffee likely lowers the risk of liver and endometrial cancers, although the link to endometrial cancer may be

Academy of Sciences, and the American Association for the Advancement of Science have all taken the stance that current evidence suggests that foods containing genetically engineered ingredients are safe.

Gluten-free diet

Does eating a gluten-free diet help reduce cancer risk?

Gluten is a protein in wheat, rye, and barley. In most people, it causes no ill effects.

For people with

is elevated in relation to intake of a specific food item.

A lot of research has looked at the potential impact of the glycemic load of a diet and cancer risk. Most recent reports have found that eating a dietary pattern high in glycemic load is linked with a higher risk of endometrial cancer. More research is needed to determine the impact on other types of cancer.

Inflammation and anti-inflammatory strategies

Do anti-inflammatory diets reduce cancer risk?

Inflammation has long been recognized as the body's response to tissue injury, and its link to infections was recognized hundreds of years ago. However, the role of inflammation in causing cancer has been recognized more recently, and the relationships between diet, inflammation, and the risk of cancer (as well as heart disease and dying at an earlier age) are still an evolving area of research.

A combination of lab and human studies has identified certain foods and chemicals in them that promote inflammation in certain body tissues. This is the basis of anti-inflammatory dietary patterns, which share some traits with the recommendations in this guideline, such as being high in vegetables and fruits and low in red and processed meats.

Irradiated foods

Why are foods irradiated, and can these foods increase cancer risk?

Food irradiation (applying ionizing radiation to food) is a technology that improves the safety and extends the shelf life of foods by reducing or eliminating germs and insects. Like pasteurizing milk and canning fruits and vegetables, irradiation can make food safer. Irradiation does not make foods radioactive, affect nutritional quality, or noticeably change the taste, texture, or appearance of food. In fact, changes made by irradiation are so minimal that it is not easy to tell if a food has been irradiated.

The US Food and Drug Administration (FDA) has evaluated the safety of irradiated food for more than 30 years and has found the process to be safe. The World Health Organization (WHO), the US Centers for Disease Control and Prevention (CDC), and the US Department of Agriculture (USDA) have also endorsed the safety of irradiated food. There is currently no evidence that irradiation of foods causes cancer or has harmful human health effects.

Juicing/cleanses/detox

Can periods of limiting food intake to juices remove toxins and help protect against cancer?

Fruit and vegetable juices can be a convenient way to get some healthy food components from vegetables and fruits. In moderation, they can be a worthwhile part of healthful dietary patterns. However, juices contain less fiber, lower levels of some other healthy nutrients, and more naturally occurring sugar than the whole fruits and vegetables they are made from, so they are not the best way to get nutrients from plant-based foods.

There is no scientific evidence to support claims that consuming *only* juices for one or more days, known as **juice cleansing** or **juice detoxification**, reduces cancer risk or provides other health benefits. This kind of diet is promoted as a way to remove “toxins” from the body, but this claim is not supported by scientific evidence. Toxins that enter our body through foods and beverages are constantly removed by the kidneys and liver, regardless of whether a person is consuming liquid or solid foods. Although vegetable juicing may be one way to increase nutrient intake, a diet limited to juice may also be lacking in some important nutrients, and in select cases it may contain dangerous levels of some substances that can cause kidney damage and other health problems.

Microwaving food and general food preservation, preparation, and storage

Can using microwave ovens or other cooking methods increase cancer risk?

Microwaves are a form of non-ionizing electromagnetic radiation, and their use in cooking does not increase cancer risk. On the other hand, grilling, smoking, or pan-frying meats (including red meats as well as poultry and fish) at high temperatures can cause chemical reactions that form cancer-causing heterocyclic amines.

Goals of food **preservation, processing, and preparation** that are relevant to individual and public health include:

- Removing or inactivating any harmful chemical or microbiological contaminants
- Avoiding addition or production of harmful substances
- Maintaining the amount and availability of nutrients

For example, proper canning or freezing methods can help maintain the nutrient content

of vegetables and fruits, which can expand consumers' access to these products. On the other hand, certain methods of preserving red meats introduce nitrates into them, which can be converted in the stomach into cancer-causing N-nitroso compounds.

Contamination of foods by substances from storage containers or cookware is another concern of some consumers. Plastic containers can release substances such as phthalates (some of which are classified as possible carcinogens) or phenolic compounds such as bisphenol A (a probable carcinogen) during storage of food or during cooking in a microwave oven. Use of Teflon-coated cookware may release perfluorooctanoic acid (PFOA, a possible carcinogen) into foods. These substances have been found to have negative biological effects in some lab studies, and they may influence onset of puberty, a possible factor in the long-term risk of some cancers such as breast cancer. However, evidence of the impact of long-term exposure to these chemicals on cancer risk in human studies is lacking. Nonetheless, people who are concerned about possible harm from these exposures can choose glass or metal storage containers and cookware.

Non-nutritive sweeteners/sugar substitutes

Do non-nutritive sweeteners/sugar substitutes cause cancer?

Non-nutritive sweeteners are substances used instead of sugars like sucrose, corn syrup, honey, agave nectar to sweeten foods, beverages and other products. Several non-nutritive sweeteners are now approved by the FDA, including [aspartame](#)⁴, acesulfame potassium, saccharin, sucralose, and stevia. These sweeteners contain few or no calories, or nutrients. They may be derived from herbs and other plants, or sugar itself, and typically are many times sweeter than sugar, allowing smaller amounts to be used. Other sugar substitutes include sugar alcohols such as sorbitol, xylitol and mannitol.

There is no clear evidence that these sweeteners, at the levels typically consumed in human diets, cause cancer. Questions about artificial sweeteners and cancer risk arose when early studies showed that saccharin caused bladder cancer in lab animals, but studies in humans have shown no increased cancer risk.

People with a rare genetic disorder called phenylketonuria (PKU) aren't able to metabolize aspartame normally, which can result in nervous system toxicity, so they should avoid aspartame in their diets. With this exception, all these sweeteners appear to be safe when used in moderation, although larger amounts of sugar alcohols may cause bloating and abdominal discomfort in some people.

Organic foods

Are foods labeled “organic” more effective in lowering cancer risk?

The term “organic” is used to designate foods grown without the addition of artificial chemicals. Under USDA regulations, animal-derived foods that are labeled as organic come from animals raised without the addition of hormones or antibiotics to the feed they eat. Plant foods that are organic come from agricultural methods that do not use most conventional pesticides or herbicides, chemical fertilizers, or sewage sludge as fertilizer. Organic foods also exclude the use of industrial solvents or food irradiation in processing, and genetically modified foods are also excluded.

A main benefit of consuming organic foods is to support environmentally sustainable agricultural practices. Many consumers also believe that organic foods may provide health benefits, but there is little evidence that organic produce has higher nutrient levels than conventionally grown produce.

Little research has been done on the link between organic food consumption and cancer risk, although a recent study found eating more organic produce was linked with a lower risk of non-Hodgkin lymphoma. While this finding needs to be confirmed by other studies, it is in line with the strong and consistent link between workplace pesticide exposure and this type of cancer.

Washing conventionally grown produce can remove some of the pesticide residue. It's also important to wash all produce to limit the risk of health effects from microbial contamination.

Because organic produce is often more expensive than similar conventionally produced items, it's important that people with limited resources recognize that meeting the recommendation for vegetable and fruit intake is a higher priority for cancer prevention and overall health than choosing organic produce.

Pesticides and herbicides

Do pesticides in foods cause cancer?

Insecticides and herbicides can be toxic when used improperly in industrial, and foods that are labeled as organic.

diazinon is linked with a higher risk of lung cancer.

Currently, scientific evidence supports the overall health benefits and cancerprotective effects of eating vegetables and fruits, regardless of whether they are grown using organic or conventional practices. Washing conventionally grown produce can remove some of the pesticide residues, and is also important to minimize the risk of microbial contamination.

Sleep

How does sleep affect diet, physical activity, and cancer risk?

Increasing evidence suggests important interactions among sleep, diet, physical inactivity, and cancer risk:

- Disordered sleep has been linked with higher cancer risk, and sleep deprivation (usually defined as less than 7 hours a night) has been linked with a higher risk for obesity and overeating, as well as metabolic syndrome, which is a known risk factor for several types of cancer.
- Alternately, a healthy sleep pattern has been linked with better weight maintenance after weight loss.
- Studies have found high levels of sedentary time (time spent sitting or lying down) are linked with poor sleep quality and shorter sleep duration.
- Inadequate sleep has been linked with higher levels of stress hormones and inflammation, which are known mechanisms affecting cancer risk.

Soy and soy products

Can soybased foods reduce cancer risk?

As with other beans or legumes, soy and foods derived from soy are excellent sources of protein, so they provide a healthier alternative to meat. Soy contains several bioactive food components, including isoflavones, which have a similar structure to estrogens and can bind to estrogen receptors on cells. The effects of this binding can vary, depending on conditions, the specific body tissue, and the amount consumed.

There is some evidence from human and lab studies that consuming traditional **soy foods** such as tofu may lower the risk of breast and prostate cancer, but overall the evidence is too limited to draw firm conclusions. Many of the studies that have found

such links looked at Asian populations with high lifelong consumption of soy foods, and their relevance to soy consumption at lower levels and for shorter durations in Western populations remains uncertain.

There are no data to support the use of **supplements** containing soy phytochemicals or **soy protein powders** used in some food products for reducing cancer risk. In fact, a recent study found increased risk for estrogen receptor (ER)-negative breast cancer (an aggressive type) among users of soy supplements. Therefore, while soy from food sources appears to be safe and may even have beneficial health effects, soy supplements should be used with caution, if at all.

Sugar

Does sugar increase cancer risk?

Several types of sugars are found in foods and beverages. These sugars vary in their chemical structures, but once they are consumed, they all have similar metabolic effects in the body. All sugars in foods and beverages add to calorie intake, which can lead to obesity, so eating a lot of sugar can indirectly increase cancer risk. There is also evidence that a dietary pattern high in added sugars affects levels of insulin and related hormones in ways that may increase the risk of certain cancers.

Brown (unrefined) sugar contains the same chemical form of sugar (sucrose) as white (refined) sugar. It also contains extremely small amounts of other substances that affect its color and flavor, but they don't influence the unfavorable effects of sucrose on body weight or insulin levels.

Fructose, the natural sugar in fruit and in many sugar-sweetened beverages in the form of high-fructose corn syrup, is similar to sucrose in its effects on weight and insulin levels, as is honey, which contains a mixture of fructose and glucose (another form of sugar).

Lab studies have shown that metabolism of glucose (the main sugar used as an energy source in the body) is faster in cancer cells than in normal cells. This fact is often

secretion in people with metabolic conditions such as pre-diabetes or type 2 diabetes.

Vegetarian/vegan diets

Do vegetarian diets reduce cancer risk?

Vegetarian diets can include many healthy features:

- They tend to be low in saturated fat
- They tend to be high in fiber, vitamins, and other bioactive food components
- They do not include red and processed meats

Thus, vegetarian diets may be helpful for cancer risk reduction. Many studies of vegetarians indicate a lower risk of cancer overall, compared to people who also eat meat. But whether vegetarian diets confer any special health benefits over diets that include smaller amounts of animal products than are typically consumed in Western diets is less clear. Indeed, in a large British study, people who ate fish but not other meats appeared to have the same overall cancer risk as vegetarians.

The available evidence supports the recommendation of a dietary pattern that is mainly foods from plant sources, with limited if any intake of red and processed meats.

In addition to a modest level of risk reduction for some forms of cancer, vegetarian dietary patterns are linked with lower risks of heart disease and type 2 diabetes and are generally more affordable.

People on strict vegetarian diets that omit all animal products (including milk and eggs), referred to as **vegan diets**, often need supplementation with vitamin B12, zinc, and iron (or foods fortified with these nutrients), especially for children and premenopausal women. They should also aim to get enough calcium, as people consuming vegan diets with relatively low calcium content have been shown to have a higher risk of bone fractures compared with people consuming vegetarian or meat-containing diets.

It's important that people on strict vegetarian diets, referred to as vegan diets that do not include animal products (including milk and eggs), talk with their doctor or a dietitian or nutritionist about supplements they may need.

Hyperlinks

1. acsjournals.onlinelibrary.wiley.com/doi/full/10.3322/caac.21591

