

Cancer Prevention

Cancer prevention is defined as active measures to decrease the incidence of cancer. This can be accomplished by avoiding carcinogens or altering their metabolism, pursuing a lifestyle or diet that modifies cancer-causing factors and/or medical intervention (chemoprevention, treatment of pre-malignant lesions). The epidemiological concept of "prevention" is usually defined as either primary prevention, for people who have not been diagnosed with a particular disease, or secondary prevention, aimed at reducing recurrence or complications of a previously diagnosed illness.

Modifiable ("lifestyle") risk factors

Examples of modifiable cancer risk factors include alcohol consumption (associated with increased risk of oral, esophageal, breast, and other cancers), smoking (although 20% of women with lung cancer have never smoked, versus 10% of men), physical inactivity (associated with increased risk of colon, breast, and possibly other cancers), and being overweight (associated with colon, breast, endometrial, and possibly other cancers). Based on epidemiologic evidence, it is now thought that avoiding excessive alcohol consumption may contribute to reductions in risk of certain cancers; however, compared with tobacco exposure, the magnitude of effect is modest or small and the strength of evidence is often weaker. Other lifestyle and environmental factors known to affect cancer risk (either beneficially or detrimentally) include certain sexually transmitted diseases, the use of exogenous hormones, exposure to ionizing radiation and ultraviolet radiation, and certain occupational and chemical exposures.

Diet

The consensus on diet and cancer is that obesity increases the risk of developing cancer. Particular dietary practices often explain differences in cancer incidence in different countries (e.g. gastric cancer is more common in Japan, while colon cancer is more common in the United States). Studies have shown that immigrants develop the risk of their new country, often within one generation, suggesting a substantial link between diet and cancer. Whether reductions in obesity in a population also reduce cancer incidence is unknown.

A 2005 secondary prevention study showed that consumption of a plant-based diet and lifestyle changes resulted in a reduction in cancer markers in a group of men with prostate cancer who were using no conventional treatments at the time. These results were amplified by a 2006 study in which over 2,400 women were studied, half randomly assigned to a normal diet, the other half assigned to a diet containing less than 20% calories from fat. The women on the low fat diet were found to have a markedly lower risk of breast cancer recurrence, in the interim report of December, 2006.

Vitamins

The concept that cancer can be prevented through vitamin supplementation stems from early observations correlating human disease with vitamin deficiency, such as pernicious anemia with vitamin B12 deficiency, and scurvy with Vitamin C deficiency. This has largely not been proven to be the case with cancer, and vitamin supplementation is largely not proving effective in preventing cancer. The cancer-fighting components of food are also proving to be more numerous and varied than previously understood, so patients are increasingly being advised to consume fresh, unprocessed fruits and vegetables for maximal health benefits.

The Canadian Cancer Society has advised Canadians that the intake of vitamin D has shown a reduction of cancers by close to 60%, and at least one study has shown a specific benefit for this vitamin in preventing colon cancer.

Vitamin D and its protective effect against cancer has been contrasted with the risk of malignancy from sun exposure. Since exposure to the sun enhances natural human production of vitamin D, some cancer researchers have argued that the potential deleterious malignant effects of sun exposure are far outweighed by the cancer-preventing effects of extra vitamin D synthesis in sun-exposed skin. In 2002, Dr. William B. Grant claimed that 23,800 premature cancer deaths occur in the US annually due to insufficient UVB exposure (apparently via vitamin D deficiency). This is higher than 8,800 deaths occurred from melanoma or squamous cell carcinoma, so the overall effect of sun exposure might be beneficial. Another research group estimates that 50,000–63,000 individuals in the United States and 19,000 - 25,000 in the UK die prematurely from cancer annually due to insufficient vitamin D.

Results reported in JAMA in 2007 indicate that folic acid supplementation is not effective in preventing colon cancer, and folate consumers may be more likely to form colon polyps.

Chemoprevention

The concept that medications could be used to prevent cancer is an attractive one, and many high-quality clinical trials support the use of such chemoprevention in defined circumstances.

Daily use of tamoxifen, a selective estrogen receptor modulator (SERM), typically for 5 years, has been demonstrated to reduce the risk of developing breast cancer in high-risk women by about 50%. A recent study reported that the selective estrogen receptor modulator raloxifene has similar benefits to tamoxifen in preventing breast cancer in high-risk women, with a more favorable side effect profile.

Raloxifene is a SERM like tamoxifen; it has been shown (in the STAR trial) to reduce the risk of breast cancer in high-risk women equally as well as tamoxifen. In this trial, which studied almost 20,000 women, raloxifene had fewer side effects than tamoxifen, though it did permit more DCIS to form.

Finasteride, a 5-alpha-reductase inhibitor, has been shown to lower the risk of prostate cancer, though it seems to mostly prevent low-grade tumors. The effect of COX-2 inhibitors such as rofecoxib and celecoxib upon the risk of colon polyps have been studied in familial adenomatous polyposis patients and in the general population. In both groups, there were significant reductions in colon polyp incidence, but this came at the price of increased cardiovascular toxicity.

Genetic testing

Genetic testing for high-risk individuals is already available for certain cancer-related genetic mutations. Carriers of genetic mutations that increase risk for cancer incidence can undergo enhanced surveillance, chemoprevention, or risk-reducing surgery. Early identification of inherited genetic risk for cancer, along with cancer-preventing interventions such as surgery or enhanced surveillance, can be lifesaving for high-risk individuals.

Gene	Cancer types	Availability
BRCA1, BRCA2	Breast, ovarian, pancreatic	Commercially available for clinical specimens
MLH1, MSH2, MSH6,	Colon, uterine, small bowel,	Commercially available for

PMS1, PMS2	stomach, urinary tract	clinical specimens
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Vaccination

Considerable research effort is now devoted to the development of vaccines to prevent infection by oncogenic infectious agents, as well as to mount an immune response against cancer-specific epitopes) and to potential venues for gene therapy for individuals with genetic mutations or polymorphisms that put them at high risk of cancer.

As reported above, a preventive human papillomavirus vaccine exists that targets certain sexually transmitted strains of human papillomavirus that are associated with the development of cervical cancer and genital warts. The only two HPV vaccines currently on the market are Gardasil and Cervarix.

Screening

Cancer screening is an attempt to detect unsuspected cancers in an asymptomatic population. Screening tests suitable for large numbers of healthy people must be relatively affordable, safe, noninvasive procedures with acceptably low rates of false positive results. If signs of cancer are detected, more definitive and invasive follow up tests are performed to confirm the diagnosis.

Screening for cancer can lead to earlier diagnosis in specific cases. Early diagnosis may lead to extended life, but may also falsely prolong the lead time to death through lead time bias or length time bias.

A number of different screening tests have been developed for different malignancies. Breast cancer screening can be done by breast self-examination, though this approach was discredited by a 2005 study in over 300,000 Chinese women. Screening for breast cancer with mammograms has been shown to reduce the average stage of diagnosis of breast cancer in a population. Stage of diagnosis in a country has been shown to decrease within ten years of introduction of mammographic screening programs. Colorectal cancer can be detected through fecal occult blood testing and colonoscopy, which reduces both colon cancer incidence and mortality, presumably through the detection and removal of pre-malignant polyps. Similarly, cervical cytology testing (using the Pap smear) leads to the identification and excision of precancerous lesions. Over time, such testing has been followed by a dramatic reduction of cervical cancer incidence and mortality. Testicular self-examination is recommended for men beginning at the age of 15 years to detect testicular cancer. Prostate cancer can be screened using a digital rectal exam along with prostate specific antigen (PSA) blood testing, though some authorities (such as the US Preventive Services Task Force) recommend against routinely screening all men.