

Review Article

Diet and Cancer Prevention : An Evolving Picture

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Cancer is a serious public health problem that affects people worldwide. The onset and the progression of cancer are influenced by several factors, viz internal/external environmental factors, as well as genetic factors, which can play a role in the emergence as well as the progression of many malignancies. Diet and Nutrition may play a role in the prevention or treatment of different types of Malignancies. A great number of studies have found that certain dietary patterns can help in preventing cancer and/or slowing the progression of tumors in patients. In addition to this, the literature suggests that a variety of dietary substances, including Curcumin, Green Tea, Folate, Selenium, and Soy Isoflavones, have anti-cancer potential. It has been demonstrated that these chemicals could be employed for cancer chemoprevention and therapy by targeting a series of cellular and molecular pathways. In this review, we have tried to summarise the impact of food patterns on cancer prevention.

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Key words : Cancer, Diet, Phytochemicals, Anti-cancer, Curcumin, Green Tea.

Cancer is regarded as one of the most serious public health issues that affect people all over the world¹. The identification of several elements involved in cancer pathogenesis has resulted from the evaluation of various dimensions of this disease. These discoveries may aid in the prevention and treatment of many cancers². To present, researchers who have a better grasp of the molecular/cellular pathways involved in various malignancies have been able to devise a variety of treatments and regimens for both before and after cancer. Lifestyle is one of the most important variables in the onset and progression of cancer. Human dietary habits may have a variety of effects on human health. Appropriate nutrition has a significant impact on human health³. It was discovered that adequate intake of different Vitamins and Lipids could have beneficial impacts on disorders including cancer^{4,5}. Several studies have suggested that a healthy diet and eating patterns can help prevent or possibly treat cancer⁶.

A plant-based diet with limited red meat consumption has been related to a lower risk of breast cancer⁷. Dietary chemicals are well-known therapeutic agents that can alter different kinds of cellular and molecular pathways^{8,9}. Consumption of diverse fruits and a diet rich in antioxidants may aid in cancer prevention. Various dietary ingredients, such as green

Editor's Comment :

- Processed meat, fried food, refined products, carbonated & alcoholic beverages and packaged food increases the risk of cancer.
- Dietary chemopreventive agents are long chain polyunsaturated fatty acids ,carotenoids ,curcumin ,green tea ,polyphenols, glucosinolates, vitamins (vitamin D, folate),minerals(calcium, selenium),etc.
- In nutrigenomics, we study the impact of dietary components on genetic variations as well as the effect of nutrients and bio active food ingredients in gene expression, individually.
- Life style is one of the most important variables in the onset and progression of cancer.

tea, carotenoids, selenium, curcumin and vitamins, have been shown in numerous studies to aid in cancer prevention and treatment. Inflammation is one of the most important contributors to the development of many malignancies^{5,7}. The use of appropriate dietary components, including antioxidants, may affect cancer development and prevention⁵. As a result, it appears that including them in one's diet could be beneficial for cancer prevention and treatment.

Foods that can make you more likely to get cancer "You are what you eat," as the cliché goes, is especially true when it comes to improving your health and adopting healthy eating habits. One will feel more energetic and fit if one eats healthily. Sluggishness and health problems are unavoidable if the food on your plate is high in trans fat and processed ingredients. Poor dietary choices and unhealthy eating habits can contribute to a variety of liver, renal and cardiac illnesses. While some can be treated if caught early enough, others, such as cancer, can be fatal. Cancer is one of the most common causes of mortality in the

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world, but it can be avoided by making appropriate lifestyle modifications. Cancerous cells proliferate in the body due to variety of causes, one of them is an unhealthy diet. Other factors that may play a role include a lack of physical activity, smoking, obesity, alcohol and UV-exposure. There is mounting evidence that eating habits might either increase or decrease cancer risk. So, to keep your health in tip-top shape, here are 5 items to stay away from¹⁰.

(A) Processed Meat :

Meat, poultry, fish and eggs are all good if cooked properly and eat them in moderation. Taking any animal-based goods that have been preserved by smoking and salting is unhealthy and can lead to a variety of health problems, including weight gain and cancer. Meat processing produces a chemical that is potentially carcinogenic, increasing the risk of colorectal and stomach cancer. Cook your meat instead of buying processed meat like hot dogs, salami and sausage¹¹.

(B) Fried Food :

Excessive consumption of fried meals can also promote the growth of malignant cells in the body. A chemical called acrylamide is generated when foods like potatoes or meat are fried at high temperatures. According to studies, this chemical is carcinogenic and can even destroy DNA. Furthermore, fried foods can raise oxidative stress and inflammation in the body, both of which are associated with cancer cell proliferation. Look for alternate healthier cooking ways to replace frying¹².

(C) Refined Products :

Refined flour, sugar, and oil, for example, all have the potential to cause malignant cells to form. According to studies, eating a lot of highly processed sugar and carbohydrates raises the risk of oxidative stress and inflammation in the body, which can lead to cancer. Ovarian, breast and endometrial (uterine) cancers are more common in people who eat a diet heavy in refined goods. Make healthy substitutions to reduce your intake of processed items. Substitute jaggery or honey for sugar, whole grain for refined carbs, and refined oil for mustard oil and clarified butter¹⁰.

(D) Carbonated Beverages and Alcoholic Beverages :

Alcohol and carbonated beverages both include a lot of refined sugar and calories. Excessive intake of either fluid can lead to an increase in free radicals in the body, which can lead to inflammation. Alcohol also hinders your immune system's ability to recognize and

target precancerous and cancerous cells, making it more difficult for your body to detect and target them¹¹.

(E) Foods in Cans and Packages :

In India, the consumption of canned and packaged goods is continuously increasing. The market aisle is brimming with pre-packaged foods that can be cooked and severed in a matter of minutes. There are many different types of packaged foods to choose from, such as instant poha, noodles, idli, upma and spaghetti. Though it makes cooking more convenient, it also increases the risk of cancer. Bisphenol A (BPA, a plasticizer) is a chemical that is used to line most ready-to-cook food packages. When this molecule is dissolved in food, it can induce hormonal abnormalities, DNA changes and cancer¹³.

Eat less	Eat more
Saturated fats	Fruits and vegetables
Red meat	Food rich in Vitamin A, C and E
Processed meat	Whole grains
Food with preservatives	Green leafy vegetables
Alcoholic beverages	
Salt-cured and smoked food	

Table 1 shows list of food that reduces the risk of cancer. This table shows what food an individual should take more in amount and what should they have to eat less so that the risk of cancer will be reduced.

Different Types of Cancer and Associated Foods :

In Table 2 different types of cancer and foods as a risk factor, probable mechanism behind this, as well as food and nutrients which are responsible for minimizing/avoiding the cancer is shown. Cancer of the oral cavity and pharynx (nasopharyngeal cancer, oral and pharyngeal cancers), oesophageal cancer (squamous cell carcinoma and adenocarcinoma), stomach cancer, colorectal cancer, liver cancer, pancreatic cancer, lung cancer, breast cancer, and prostate cancer are dominant cancers, across the globe¹⁴. Obesity, overweight and alcohol consumption raise the chances of the several forms of cancer; these are just the most nutritional elements contributing to the global cancer burden¹⁴. Mutagen-containing foods can cause cancer, salted fish can cause nasopharyngeal cancer¹⁵ and aflatoxin-contaminated foods can cause liver cancer¹⁶.

According to the World Cancer Research Fund report-2018, neither fruits nor vegetables are convincingly or likely associated with the risk of any cancer¹⁴. Evidence suggests that it may protect against some cancers and the risk may increase at very low intakes. Specific elements of some fruits and

Table 2 — Different types of cancer and foods as a risk factor, probable mechanism behind this, as well as food and nutrients which are responsible for minimizing/avoiding the cancer

Sl No	Types of Cancer	Food raises risk of cancer	Probable mechanism	Food lowers/minimizes cancer	References
1	Oral cavity and pharynx	Preserved food with salt	Nitrosamine formation or reactivation of the Epstein-Barr virus.	Eating more fruits, vegetables, and related micronutrients such as vitamin-C and folate.	15
2	Oesophageal cancer- Squamous cell carcinoma, Adenocarcinoma	Scalding hot tea and mate	Obesity, Alcohol	Protective role of fruit and vegetables	15, 27-29
3	Stomach cancer	Large amount of salted foods, such as salt preserved fish, large amounts of pickled Vegetables	Salt itself or by carcinogens derived from the nitrites in many preserved foods <i>Helicobacter pylori</i> infection. Production of N-nitroso compounds by mould or fungi, which are sometimes present in these foods.	Diets rich in fruit and vegetables and for people with high plasma concentrations of vitamin C	15, 30
4	Colorectal cancer	Processed and unprocessed red meat	The preservative (nitrates & nitrites) of processed meat, might increase exposure of the gut to mutagenic N-nitroso compounds Both processed and unprocessed red meat also contain haem iron, which might have a cytotoxic effect in the gut and increase formation of N-nitroso compounds. Cooking meat at high temperatures can generate mutagenic heterocyclic amines and polycyclic aromatic hydrocarbons.	Dairy products, dietary fibre (cereal fibre and wholegrain cereals), calcium, Vitamin D	31, 32
5	Liver cancer	Aflatoxin, a mutagenic compound produced by the fungus <i>Aspergillus</i> in foods such as grains, nuts, and dried fruit when stored in hot and humid conditions.	Alcohol is the main diet related risk factor, probably through the development of cirrhosis and alcoholic hepatitis. Overweight and obesity, chronic infection with hepatitis B or C viruses.	Coffee might have a true protective effect because it contains many bioactive compounds.	12, 15
6	Lung cancer	Smoking, eating red meat, processed meat and drinking alcohol.	There is no conclusive evidence that any single food causes lung cancer.	Diet higher in fruits and vegetables are associated with a slightly lower risk of lung cancer in smokers, but not in never smokers.	33, 34
7	Breast cancer	Alcohol increases risk by about 10% for each drink consumed daily.	Obesity raises the risk of breast cancer in postmenopausal women, most likely by increasing circulating oestrogens produced by aromatase in adipose tissue.	Isoflavones from soya	35, 36
8	Prostate cancer	Obesity is likely to increase the risk of developing more aggressive forms of prostate cancer.	Age, family history, black ethnicity, and genetic factors are the only well-established risk factors.	Lycopene (from tomatoes), micronutrients including β carotene, vitamin D, vitamin E, and selenium, isoflavones (from soya foods).	37, 38

vegetables may have antioxidant properties. Other than this, vegetarians do not consume meat or fish and typically consume more fruits and vegetables than non-vegetarians. Vegetarians and vegans may have a slightly lower risk of all cancer sites combined than non-vegetarians, however and observations for individual cancers are unclear. Hence, maintaining a healthy body weight and blood sugar levels by eating a varied diet high in fruits and vegetables and minimize the intake of red and processed meats and processed

sugar is beneficial¹⁷. It is advised that try to get your nutrients and vitamins from your diet rather than supplements.

Cancer Chemoprevention and Dietary Chemicals:

Cancer chemoprevention is defined as a method of reducing or suppressing the development and progression of cancer using natural or synthetic substances^{9,18}. The use of dietary components is appealing because of their unique qualities, such as minimal toxicity as compared to conventional

medications. It has been demonstrated that dietary chemicals can be used as a cancer chemoprevention treatment agent. Multiple lines of evidence suggested that a wide range of dietary chemo-preventive agents, including long-chain polyunsaturated fatty acids, carotenoids, curcumin, green tea polyphenols (ie, catechins)¹⁹, glucosinolates/isothiocyanates, vitamins (ie vitamin D and folate), and minerals (ie, calcium and selenium), could be introduced into clinical application for cancer therapy⁸.

Curcumin is a fascinating phytochemical with a variety of anti-cancer activities¹⁹. Curcumin exerts its therapeutic benefits by targeting various cellular and molecular pathways, and may also alter several cellular and molecular targets, including microRNAs (miRNAs), COX-2, NF- κ B, MMPs, AP-1, cyclin D1, EGFR, Akt, -catenin, adhesion molecules and TNF^{4,19}.

Green tea is another natural component that has been linked to a variety of medicinal benefits²⁰. Green tea is thought to have anti-cancer qualities via inhibiting tumor growth by targeting cellular and molecular factors involved in cell proliferation and angiogenesis. One of the main targets that this component may influence is VEGFs²⁰. Proteins (including enzymes), carbohydrates, lipids, amino acids, vitamins (B, C, E), and minerals (ie, Ca, Mg, Cr, Fe, Zn, F, K) have all been found to be abundant in this plant²¹. The presence of polyphenols, particularly flavonoids, has been linked to the medicinal effects of green tea in several studies. Catechins (flavan-3-ols) are flavonoids found in green tea leaves, including epicatechin (EC), epicatechin-3-gallate (ECG), gallic acid (GC), epigallocatechin (EGC), and predominant epigallocatechin-3-gallate (EGCG)⁹.

Nutrigenomics or Nutritional Genomics : Role in Nutrition and Medical Science

Nutrigenomics investigate the effect of food on our genes and the reaction of specific genes to nutrients absorbed via different foods²². It is linked to the molecular interaction between genes and nutrients in the body (nutrigenetics) and these factors that influence the transcript profiles (transcriptomics), metabolites (metabolomics) and proteomics²². Nutrigenetics and transcriptomics, in conjunction with “omic” technologies such as metabolomics and proteomics, are accountable for the great variation in cancer prevention as well as risk among persons²²⁻²⁴. Nutrigenomics is defined as the impact of dietary components on genetic variations as well as the effect of nutrients and bioactive food ingredients on gene expression individually^{23,24}. The principles of nutritional genomics includes- metabolomics, transcriptomics,

proteomics and epigenetics²².

In cancer chemoprevention, epigenetic mechanisms are significant pathways that can be influenced by dietary components²⁴⁻²⁶. DNA methylation, histone changes, chromatin remodelling, miRNAs are some of the processes that serve as epigenetic regulators. Dietary chemicals have been suggested to affect cancer prevention by targeting epigenetic pathways^{25,26}. Bioactive phytochemicals have been shown in numerous studies to be able to alter the expression of a range of oncogenes and tumor suppressor genes by targeting epigenetic pathways involved in Cancer start and development^{25,26}. Furthermore, the use of bioactive phytochemicals, either alone or in conjunction with other natural or synthetic medicines, may be linked to considerable anti-cancer effects²⁶. Omega-3 fatty acids (found in fatty and greasy fish, and flaxseed oil), dietary polyphenols or polyhydroxy phenols [epigallocatechin (green tea), turmeric acid (cinnamon), resveratrol (grape, wine, blueberries and mulberries) and curcumin (spices turmeric and curry)], apigenin, a plant flavone [present in many fruits and vegetables, parsley, celery and dried chamomile flowers], genistein is isoflavones [soyabeans], and have role in cancer prevention.

Eatwell Plate : Essential Food for One and All

The Eatwell Guide outlines the guidelines for eating a healthy and well balanced diet⁴⁴. The guide outlines the various foods and beverages you should consume and in what proportions on a daily or weekly basis. The Eatwell Guide categorises the foods and beverages we consume into five major groups :

- **Vegetables and fruits** — The majority of us are still not eating enough fruits and vegetables. They should account for more than a third of the food we consume each day. They are good source of vitamins, minerals and fibre.
- **Bread, potatoes, rice, pasta and other starchy carbohydrates** — These are good source of energy as well as chief source of different kinds of nutrients.
- **Legumes, pulses, fish, eggs, meat and other protein sources** — These foods are high in protein, vitamins and minerals. Pulses, such as beans, peas, and lentils, are excellent meat substitutes because they are lower in fat and greater in fibre and protein. Select lean cuts of meat and mince and consume less red and processed meats such as bacon and sausages.
- **Dairy and other fluids** — The guidelines suggest 6-8 glasses of water per day. Water, low-fat milks, and low-sugar or sugar-free beverages, such as

tea and coffee, all comes in this category.

- **Oils and spreads** — Unsaturated fats, which include vegetable, rapeseed, olive, and sunflower oils, are healthier fats. Remember that all types of fat are high in energy and should be consumed in moderation.

These recommendations implement to the vast majority of people, regardless of their weight, ethnic origin, dietary restrictions or preferences. If one have special dietary or medical requirements, consult a registered dietician about how to best adapt this guide to one's need.

CONCLUSION

Dietary habits are one of the most important risk factors for a variety of malignancies. A high intake of meat (red meat, processed meat, fish, and processed fish) or a sugary diet has been linked to an increased risk of cancer. Curcumin, green tea components, carotenoids, minerals and vitamins, among other dietary chemicals, may affect several cellular and molecular targets involved in cancer genesis and progression. As a result, it appears that incorporating them into varied dietary patterns could be beneficial for cancer prevention and treatment. Furthermore, several lines of evidence suggest that plant-based diets contain many antioxidant and anti-inflammatory components, such as vitamin E, that may be useful in the prevention or treatment of certain malignancies. The impact of diverse dietary patterns on the prevention or treatment of certain cancers is still unknown. As a result, additional research is needed to show whether they play a helpful or harmful function in cancer prevention.

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