



## Dietary Factors and Cancer

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**Abstract:** Epidemiologic research examines the distribution and determinants of diseases in populations and the application of this knowledge to control health problems. It is a crucial tool for understanding the causes and patterns of diseases and for developing effective strategies for the prevention and control of diseases. The review seeks to provide an overview of current scientific evidence concerning how diet affects cancer risk and identify areas requiring further research. It also explores how diets may be associated with several forms of malignancy and how diet may interact with other considerations, including lifestyle and genetics, to affect cancer risk. This paper provides an important foundation for subsequent studies into the complex relationship between malignancies and calories, looking at how different dietary behaviors can affect various types of cancer and how diet may interact with other factors to promote or reduce cancer risk. Our study aims to assess the connection between food and the emergence of cancer. Nutrition and an active way of life are believed to be useful in avoiding 30–40% of all cancer cases. The study seeks to understand the part of dietary and lifestyle factors in the etiology of cancer and how diet can be used to reduce cancer risk. Research suggests that a diet high in plant foods, with limited amounts of processed, red, and fatty meats, and low in sugar-sweetened beverages and highly processed foods, may lessen the chance of getting cancer. In addition, exercise and healthy habits such as limiting alcohol consumption, quitting smoking, and maintaining a healthy body weight may also lower the likelihood of cancer.

**Keywords:** Cancer, Diet, vitamins, soya, fibers and proinflammatory diet

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Received On 25 March, 2023

Revised On 4 April, 2023

Accepted On 13 April, 2023

Published On 21 April, 2023

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**Funding** This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

**Citation** Dr. Radhika Ketkar , Dietary Factors and Cancer.(2023).Int. J. Trends in OncoSci.1(2), 34-43

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Int. J. Trends in OncoSci., Volume I., No 2 (April) 2023, pp 34-43



## 1. INTRODUCTION

The relationship between nutrition and health is very close, and when malnutrition is present, it can seriously threaten one's health<sup>1</sup>. This can increase the likelihood of developing various illnesses, with cancers particularly noteworthy due to their status as the second most significant cause of premature death in adults worldwide, following cardiovascular disease<sup>2</sup>. Inadequate consumption of vital nutrients leads to malnutrition, weakening the immune system. Malnutrition can give rise to various health issues, such as anemia, vision impairment, stunted growth, and weakened bones<sup>3</sup>. It also increases the chances of developing chronic illnesses like heart disease and diabetes, in addition to particular cancers<sup>4</sup>. Consequently, malnutrition heightens vulnerability. The immune system reacts to illnesses like cancer and viruses<sup>5</sup>. Additionally, an inadequate diet, which results in a lack of critical vital nutrients, increases the chance of being sick. Additionally, malnutrition can stunt growth, which makes it a serious and widespread concern. The stimulation of mutant cells by growth factors and the transformation of normal cells by DNA-reactive, genotoxic carcinogens are key factors that contribute to cancer development. This slow process involves various stages, resulting in cancer from genetic factors and environmental exposures. Some environmental factors that could make malignancy more likely to occur include exposure to ionizing radiation, smoking, certain pathogens, and dietary factors<sup>6,7</sup>. These environmental factors affect the body, either directly or indirectly, by increasing the frequency of mutations in the DNA. The mutations, in turn, increase the risk of cancer by altering the normal functioning of cells and making them more prone to replication errors and unregulated growth. Furthermore, this contributes to higher cancer rates and other genetic diseases in certain populations. Changes in DNA due to environmental exposures can result in the formation of cancerous tumors. This process can take a long time, making cancer a slow-progressing disease<sup>8,9</sup>. Additionally, some individuals may be genetically susceptible to certain types of cancer, which increases their risk of developing the disease. Essentially a hereditary propensity is brought due to changes in DNA that can be passed through the generations of parents. Nonetheless, lifestyle factors, including smoking, can also significantly influence cancer, even in individuals without inheriting the chance of developing cancer. Consuming citrus and shellfish is considered to have a preventive effect on the development of cancers of the lungs. It is believed that leading an active life and eating a balanced diet can prevent up to 30–40% of all tumor forms. Malignancies incidence is often called the potential to prevent up to 30-40% of all tumors. The occurrence of carcinoma, also known as cancerogenesis, can be inhibited by certain substances such as retinoids, B vitamins (E, D, and C), polyphenols, fiber, calcium, soya, selenium, and polyunsaturated fatty acids like omega-3. On the other hand, some elements like proteins, lipids, sodium chloride, aflatoxins, nitrite, and nitrate; moreover, specific cooking methods, like salting, smoking, and broiling, tend to promote the growth of carcinoma.

## 2. ENZYMES THAT THERAPEUTIC DIETARY INGREDIENTS TARGET

Many dietary ingredients may be crucial in triggering one or more carcinogenesis stages. There are reported studies that both necessary and optional dietary elements may affect this

process. In addition, DNA can affect how energetic nutrients in food are absorbed, metabolized, transported, or where they function, which can affect how the body reacts to a diet in general. For example, certain nutrients can act as antioxidants and reduce inflammation, while others can increase inflammation. This can directly affect the body's ability to protect itself from environmental toxins and carcinogens and repair damage caused by them. Additionally, some dietary components can act as hormones and influence the growth of cancer cells<sup>10</sup>. In short, the foods we consume play an important role in our overall health and well-being by affecting inflammation and hormone production levels. Additionally, bioactive dietary ingredients can change the genetic expression of various cellular processes that affect the course of cancer. About the skull and throat and particularly dental SCC, nutritional variables encouraging tumor formation include fiber, flavonoids (-carotene, tea, fresh fruits, and vegetables), fats from animals, burning or grilling proteins dishes, and supplements (vitamins C, E, and K, zinc, folate)<sup>11</sup>.

## 3. ANTIOXIDANTS AND FIBER

It is understood that damage caused by oxidation contributes to the etiology of carcinoma, which may result from poor dietary choices and unhealthy lifestyle choices. The procedure can potentially harm genetic material, which is an essential component in the development of malignancy.<sup>12</sup> The rates of DNA breakage caused by oxidized adenine were much reduced in dieters as opposed to people who do not consume in an analysis of reactive harm to DNA in 24 meat-eaters and 24 people who are not vegetarian. Regarding Italian circumstance-control research with 105 instances, the association between the frequency of intake of a particular set of foods and oral cancer risk was examined. In addition to a significant and robust direct association with various tobacco products, including cigars, opium, smokeless tobacco, and alcohol, the intake of fruits regularly, among those that are high in radicals and fiber, was reportedly linked to the highest defense against the occurrence of carcinoma of the mouth. Inducing malignancy by the searing or grilling of proteins and meals that produce heterocyclic amino acids can be prevented or reduced by radicals<sup>13</sup>. The aromatic polycyclic hydrocarbons and nicotine-specific nitrosamine, which may be significant malignancies influencers and one of the foremost significant etiologic factors in oral cancer, go through selective activation and detoxifying processes.<sup>14</sup> Enzymes like the quercetin in vegetables, genistein in soy, sulforaphane in broccoli, 3-methylindole, and isothiocyanates in foods that provide comparable protection regulate their reactivity. According to research, eating more grains, such as bread and cereal, lowers the incidence of oropharyngeal carcinoma<sup>15</sup>. This amount must be raised to 25–35 g daily for older people. The "fiber first diet," which lowers calorie and fat consumption by emphasizing the appropriate consumption of grains, particularly cereals, vegetables, and fruits, is one strategy for achieving this aim.

## 4. ENERGY EQUILIBRIUM AND A DIET HIGH IN FAT

The impact of numerous variables on overweight with the likelihood for malignancy was examined in epidemiological research that aimed to demonstrate a link among energy consumption, vigorous exercise, and malignancy<sup>16-18</sup>. Macronutrients, particularly lipids, which are important for

consuming calories, were mentioned as those considerations. Studies on the function of lipids found in food have shown a link between dietary fat consumption and cancer development. The ingestion of lipids, including their quantity and makeup, has been linked to the occurrence or avoidance of tumors, on the other hand. Vital fatty acids, which have a preventive impact towards malignancy and need to be integrated into the diet, include fish oil and vegetables high in n-3 polyunsaturated fatty acids. These fatty acids help reduce inflammation, which is thought to contribute to the development of certain cancers. They also help promote cell health and reduce oxidative stress, which can lead to cancer. As such, regular consumption of fatty acids can play a crucial role in maintaining good health and potentially reducing the risk of certain kinds of cancer.<sup>19,20</sup>

## 5. MICRONUTRIENTS

While diet and anemia have received a lot of focus in treating head and neck cancer patients, vitamins including vitamin C, E, -carotene, lycopene, folate, and zinc also play significant roles in cancer development<sup>21,22</sup>. In addition to these chemicals' protective capabilities, variations in the level of GST action, a detoxification peptide, and other metabolic genes might influence cancer risk. The circulatory system's vitamin amount also affects these activities. Regression of oral leukoplakia may also be caused by vitamin E and -carotene. This suggests that certain vitamins may be involved in detoxifying carcinogens and that this process may be accelerated by the presence of GST action, other metabolic genes, and other vitamins in the circulatory system. The evidence suggests that the activity of these vitamins may be important in preventing cancer and other diseases<sup>23</sup>. These vitamins promote overall health and well-being because they are antioxidants and can aid in the detoxification of carcinogens. For instance, it has been shown that vitamin C lowers the chance of colon cancer, and vitamin E lowers the risk of breast cancer due to its antioxidant properties and ability to support the detoxification of carcinogens. For instance, Vitamin C has been found to reduce the risk of developing colon cancer, while Vitamin E has been associated with a reduced risk of breast cancer.<sup>24</sup>

## 6. ALCOHOL-NUTRIENT INTERACTIONS IN THE ETIOLOGY OF MOUTH CANCER

Plenty of strong scientific proof linking beverages and food to laryngeal, pharyngeal, and oral cancer. Qualitative research indicates that as the number of calories from alcoholic beverages increases, the daily allowance of protein, carbohydrates, fiber, and numerous micronutrients gradually but significantly declines<sup>25</sup>. It remains not likely that a quantitative relationship and a biological process of communication be identical among all carcinomas. Carcinomas are classified by their distinct histological and molecular characteristics, and the biological processes involved in their development differ from one type to another. As a result, it is unlikely that the same quantitative relationship and communication process between cells would be found across all carcinomas. Thus, the quantitative relationships and biological communication processes vary amongst different carcinomas, highlighting the need to develop tailored approaches to each type of cancer.<sup>26</sup>

## 7. THE ROLE OF NUTRITION IN CANCER PREVENTION

For cancer, a diet high in animal fats raises the incidence of breast cancer. It is shown that obesity is a condition that predisposes the development of cancerous neoplasia. The high intake of animal fats increases the level of cholesterol, which is a risk factor for developing breast cancer.<sup>27</sup> Obesity, in turn, is associated with an increase in hormone levels, such as estrogen, which is known to influence the development of cancerous cells. Therefore, it is important to maintain a healthy weight and avoid a high-fat diet to reduce the risk of developing breast cancer. An excessive, inordinate unhealthy diet is one underlying the key determinants of oncogenic risk. Retinal pigments and micronutrients lower the incidence of breast cancer in women with a body mass index (BMI) > 25 Kg/mq;<sup>28</sup> they also have a preventative effect on hepatocarcinoma brought on by hepatitis B and C and malignancies of the stomach triggered by *Campylobacter pylori*. *Campylobacter pylori* is a bacterium that can cause gastric cancer. It is typically found in food not properly cooked or in contaminated water. Retinal pigments and micronutrients can help to lower the incidence of gastric cancer caused by *Campylobacter pylori*. These micronutrients help reduce the oxidative stress caused by free radicals and inflammation, two major risk factors for certain types of cancer. By decreasing inflammation and oxidative stress, these nutrients are thought to help reduce the risk of certain types of cancer. Furthermore, they may even help in the prevention of cancer and other diseases caused by oxidative stress and inflammation.<sup>29</sup>

### 7.1. Soya

The body of evidence linking soybean meal intake to a reduced likelihood of developing certain cancer types is growing. For example, the lower incidence of bladder cancer incidences among severely mixed lacking in immunity (SCID) mice was demonstrated by an observational investigation. For 5000 years, that region's principal diet comprised plants of Asian origins. The chemicals found in those plants appeared to have a protective effect against bladder cancer, and the SCID mice had a lower bladder cancer rate than other mice. This indicates that the chemicals in the plants that the mice were eating had a protective effect against bladder cancer<sup>30</sup>. This suggests that the same protective effect may be present in humans with plant-based diets of Asian origins. Soya is high in carbohydrates (42%) and fatty acids, glycosides, acids, molecules, antioxidants, and micronutrients. Carbohydrates provide energy to the body, while fatty acids help to regulate cholesterol levels and improve heart health. Glycosides, acids, molecules, and antioxidants help to protect cells from damage, and micronutrients like potassium and magnesium are essential for overall health. Additionally, soya is a good dietary fiber source, which helps improve digestion and reduce the risk of chronic diseases<sup>31</sup>. According to Japanese research, bloodstream concentrations of chemotherapy drugs such as IFN-gamma, TNF-alfa, and cytokines are greater in cuisine-restricted mice than in control animals. According to research from the United States, a regular soy-based diet helps prevent lung melanoma metastases. This finding highlights the crucial role that antioxidants derived play in this process.

### 7.2. Probiotics

Antioxidants improve the absorbent of minerals and help halt the onset of food triggers and intolerance. Increased fiber

consumption promotes the development of gut microbes. The persons with the lowest risk of colon cancer are related to the *Lactobacillus* species that create lactic acid. Antioxidants protect the cells from oxidative damage and help to reduce inflammation. Fibre is prebiotic that helps feed the beneficial microbes in the gut, which helps create a balanced gut microbiome and boost the immune system. *Lactobacillus* species are beneficial bacteria that produce lactic acid and help to reduce the number of harmful bacteria in the gut, thereby reducing the risk of colon cancer. The *Lactobacillus* species help reduce the gut's pH and keep the environment hostile to pathogenic bacteria<sup>32</sup>. They also help to break down complex carbohydrates, produce vitamins, and stimulate the production of antibodies. Furthermore, the *Lactobacillus* species also synthesize amino acids and natural antimicrobial compounds to help defend against potentially harmful bacteria growth.

### 7.3. The Metabolism of Glucose

According to the glycemic index (GI), a living thing's capacity to absorb sugar from the diet is measured<sup>33,34</sup>. This is similar to a sponge's ability to soak up water - the more absorbent it is, the more quickly it takes in the liquid. With the GI, the higher the number, the quicker the body absorbs sugar. The Glycemic Index (GI) is a system that ranks carbohydrates based on how quickly and how much they raise blood sugar levels after eating. Foods with a higher GI are broken down and absorbed quickly, while those with a lower GI are broken down and absorbed more slowly. Insulin-dependent individuals are three times more likely to develop colon and rectal cancer. Subsequently is clear that a metabolic imbalance brought on by hyperglycemia is a factor in the growth of carcinoma. The glycemic index measures the rate

at which carbohydrates are broken down and absorbed into the bloodstream. When carbohydrates are broken down quickly, it can cause a rapid spike in blood sugar levels, leading to insulin resistance and metabolic imbalances. These metabolic imbalances can increase cancer risk, particularly in insulin-dependent individuals. Consequently, it is evident that elevated blood sugar levels, as measured by the glycemic index, can be a contributing factor to carcinoma growth by creating an unfavorable metabolic imbalance.

### 7.4. Red Meat

The significant link between red meat and colon-rectal cancer has been demonstrated by Bingham et al.<sup>35</sup> The heterocyclic amino acids generated by cooked meat are also linked to breast cancer. Because they bind to meat's myoglobin and prevent the generation of botulinic exotoxin, nitrates, and nitrites are utilized in food processing. Botulinic exotoxin is a poisonous substance produced by the bacterium *Clostridium botulinum*, which can cause foodborne illness. Nitrates and nitrites bind to the myoglobin of the cooked meat, preventing the generation of botulinic exotoxin and thus making the food safer to eat. Food cooked over charcoal or smoke-cured produces hazardous carbon-based compounds such as pyrolysates and peptides with a severe cancer-causing impact. These compounds can bind to the cells in the body, which can cause mutations in the DNA and lead to the development of cancer. When these compounds are present in the body, it increases the risk of breast cancer, particularly in women who have already been exposed to other cancer-causing agents. Therefore, limiting exposure to these hazardous compounds is important by choosing grilled or smoked foods less often or finding alternative cooking methods.

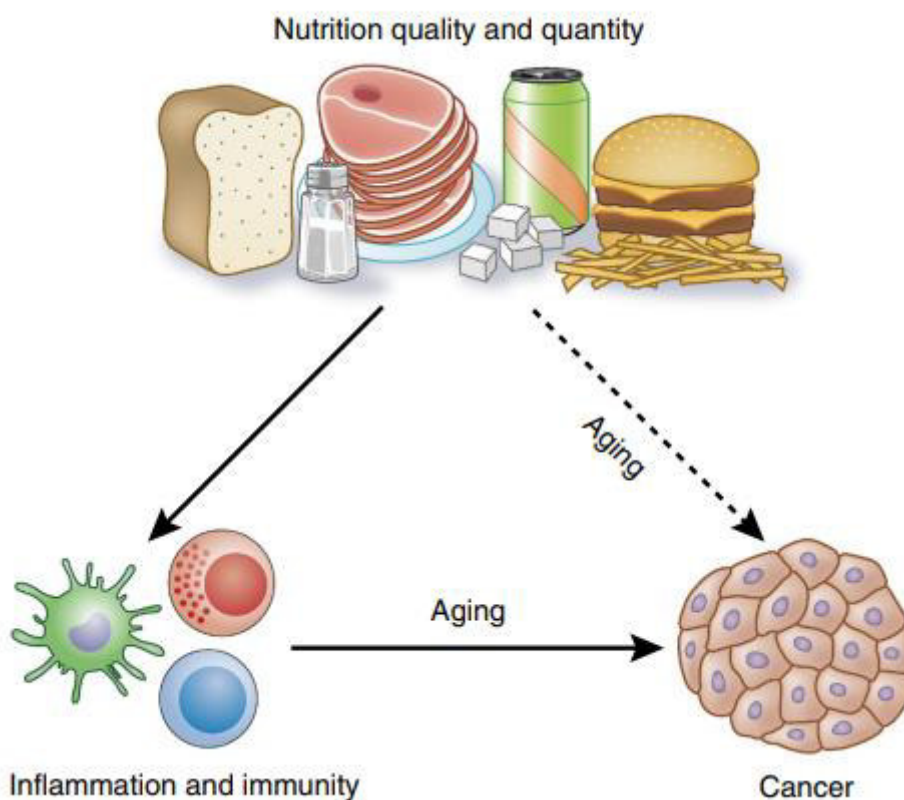


Fig :I Interactions among carcinoma, immunology, and irritation.<sup>36</sup>

## **8. FOOD PHYSIO-PATHOLOGICAL EVALUATION**

### **8.1. *Keep a correct body weight.***

The higher death risk for several malignancies, including breast, uterine, colon, gall bladder, and genital cancers, has been linked to an inaccurate calorie estimate. People tend to underestimate their calorie intake, leading to weight gain and increased cancer risk.<sup>37,38</sup> Obesity has been linked to an increased risk of certain types of cancer, so that this inaccurate calorie estimate could contribute to the higher death risk for these malignancies. To make matters worse, even when people try to maintain a healthy diet, this inaccurate calorie estimate can prevent them from achieving their desired result.

### **8.2. *Vary your diet***

Eating a diversified diet in moderation is the greatest chance of reducing cancer risk. In addition, exercise regularly and avoid smoking and excessive alcohol consumption. Additionally, it is important to stay current with recommended cancer screenings. These habits can reduce the risk of developing certain types of cancer and other diseases. For example, regular exercise has been shown to reduce inflammation and help the body to regulate hormones, while avoiding smoking and drinking can reduce the chances of certain cancers due to the carcinogenic nature of these activities. Additionally, screenings can help to detect cancer early when it is more treatable.

### **8.3. *Include fruit and vegetables in your daily diet.***

Vitamins and minerals are abundant in fruits and vegetables. They are a source of phytochemicals, chemicals obtained from plants that are physiologically metabolized despite having little nutritional value. They involve antioxidants derived (plant estrogens) in soya, indoles in cabbages, sulfur compounds in garlic and leeks, and pigments in several crops.<sup>39</sup> These antioxidants help to protect against cell damage. In contrast, plant estrogens, indoles, sulfur compounds, and pigments help boost the body's natural immune system and reduce the risk of certain diseases. Consumption of foods high in fiber, such as cereals, whole wheat flour, and legumes, helps prevent colon cancer in two different ways. First, bran and whole wheat bread contain a lot of insoluble fibers, which absorb liquids and cause swollen feces and an increase in fecal bulk. As a result, there are less dangerous bile acids and other potentially carcinogenic chemicals in feces. Soluble fibers are present in many vegetables, bran, and oats. Instead of increasing fecal bulk, this type of fiber creates a gelatinous matrix that aids in

removing bile acids and other substances that might be toxic to the colon.

### **8.4. *Reduce total consumption of fats.***

A large intake of fatty animals and linoleic oils, such as rapeseed or maize oil, may hasten the occurrence of intestine and malignancies in women, in contrast to limited use of lipids. For instance, drinking a lot of maize oil may increase bile acid manufacturing, which could eventually boost the risk of getting malignancy in the colon. However, different effects may result from other kinds of lipids. For example, omega-3 fatty acids, present in oils from seafood and some veggies, may reduce the incidence of breast and colon cancer. On the other hand, high quantities of omega-6 fatty acids found in maize oil have been associated with elevated bile acid levels. These bile acids can raise cancer risk and are suspected to be carcinogenic and the risk or the chance of getting carcinoma of the colon. Fatty acids called omega-3, by contrast, are especially present in seafood oils and greens like kale and spinach and are known to be cancer-preventive because they reduce agitation and control cell proliferation.

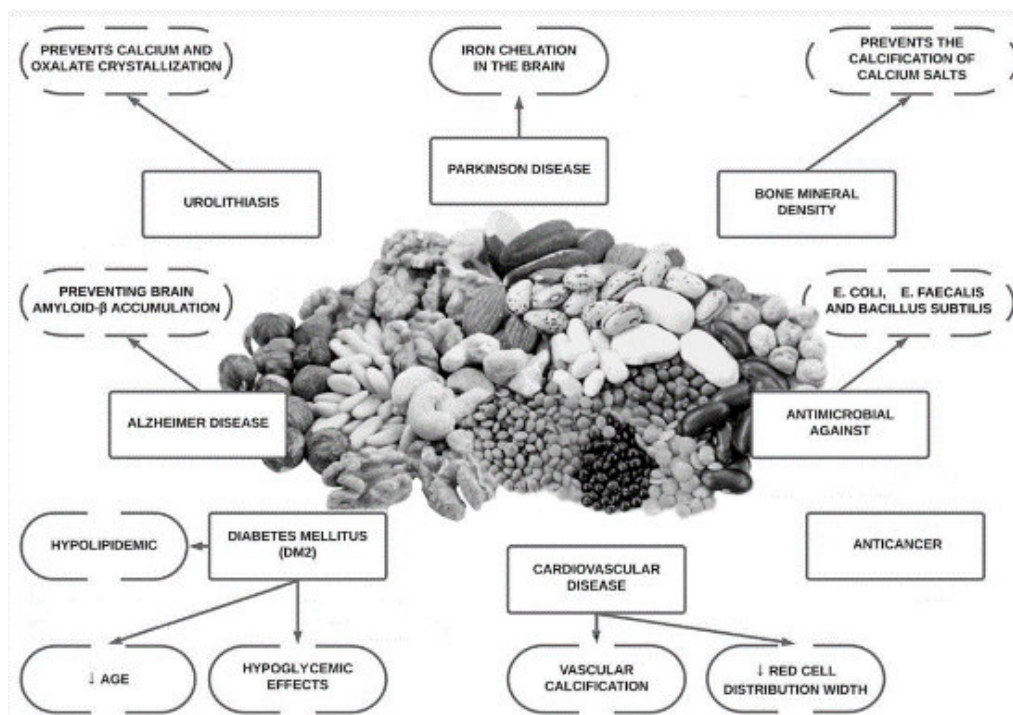
### **8.5. *Limit the consumption of alcohol.***

Hard drinkers are more likely to acquire oesophageal, laryngeal, and carcinomas of the mouth, among other malignancies. In addition, heavy alcohol consumption leads to an increased risk of cancer due to the carcinogens in alcohol. These carcinogens damage the DNA of the cells and increase the risk of cancer. A further risk contributor to malignant tumors is tobacco. Therefore, those with heavy alcohol consumption and smoking are at a greater risk of developing serious cancers.

### **8.6. *Limit the consumption of salt or foods preserved with nitrite.***

In nations where their usage is widespread, they can raise the risk of oesophageal and gastrointestinal cancers. Oesophageal cancer is a type of cancer that develops in the lining of the esophagus, the tube that carries food from the mouth to the stomach. It is one of the most common types of cancer worldwide and is often caused by prolonged exposure to environmental carcinogens, such as tobacco and alcohol. This is because tobacco smoke contains carcinogens, which are chemicals that damage the DNA in cells and can lead to the development of cancer. Thus smoking has been linked to an increased risk of various types of cancer due to its carcinogenic properties.





**Fig:2 Overview of potential health benefits of phytate.<sup>40</sup>**

### 8.7. Diet and custom

Recently, a lot of people have followed vegetarian diets. It is a behavior that values life, the lives of others, and the natural world on a cultural, ethical, economic, and ecological level. Its followers follow a lifestyle focusing on maintaining a healthy body weight and regular physical activity. They do not consume alcohol, smoke, or use drugs. The diet allows for fruit, vegetables, grains, legumes, seeds, and nuts but forbids meat and fish. Some vegans consume milk, dairy products, eggs, and other foods. Vegans also avoid using products derived from animals, such as fur, leather, and wool. They also strive to reduce their consumption of animal-based products and focus on sustainable and ethical consumption. They often advocate for animal rights and strive to reduce their environmental footprint. The purpose of the vegan diet is to minimize the exploitation of animals and their products while providing a nutritious and balanced diet. Vegans believe that animals should not be used for food or clothing and that all animal exploitation should be minimized. They strive to reduce their consumption of animal products as much as possible while still consuming a balanced and nutritious diet.<sup>41</sup>

### 8.8. Elemental sulfur

The herb garlic and other veggies with comparable properties (onion, leek, chive, etc.) contain diallyl trisulfide, which has hypolipidemic and hypoglycemic action and is effective against cardiovascular and metabolic illnesses. Diallyl trisulfide increases metabolic pathways for carcinogen detoxification and cell death induction, but it also inhibits oncogene development and angiogenesis.<sup>42</sup> The exact way behind this compound's ability to combat cancer is not fully understood. One proposed explanation is that diallyl trisulfide can act as an antioxidant by reducing oxidative stress, which has been linked to cancer.<sup>43</sup> Additionally, the compound has been shown to activate certain enzymes that activate detoxification pathways and inhibit the growth of certain types of cancer cells. It is also thought that the compound can stimulate apoptosis, or programmed cell

death, which helps to reduce the spread of cancerous cells. Diallyl trisulfide could significantly impact cancer prevention and treatment by targeting these processes.

### 8.9. Vitamins and minerals

Selenium, vitamins E, C, and D, and antioxidants are all combated by their common essential antioxidant qualities. Selenium is an essential trace element with antioxidant and anti-inflammatory properties and is involved in many important metabolic processes in the body. It can protect cells from oxidative damage and reduce the risk of certain chronic diseases. Oxidative stress can hurt our bodies and cause carcinogenesis. Nevertheless, antioxidant damage is a healthy mechanism with benefits, including enhancing the immune system's response. Epidemiology results are inconsistent despite certain epidemiological research finding a benefit of high fruit and vegetable diet on therapy for certain kinds of tumors such as cervix uteri or head and neck cancer. Results for vitamins D and folic acid in malignancy of the pancreas, vitamins E, C, and selenium in prostatic and gastrointestinal cancers,<sup>44-46</sup> and group B vitamins in prostate cancer are all ambiguous. This is likely due to the complexity of the human body and the interactions between different nutrients, as well as the difficulty in controlling for the many other factors that can influence cancer risk. More consistent results can be expected as more research is conducted on nutrition's role in cancer. As such, it is important to continue investigating nutrition science to understand how nutrients can affect cancer risk.

### 8.10. Fiber

Additionally, there is a dose-reaction association; regardless of geography, cultural background, or menopause state, each 10 g/day rise in dietary fiber is linked to a 7% decreased risk<sup>47,48</sup>. A link between fiber consumption and colorectal cancer has been hypothesized, considering eating habits and certain factors like grain shells, manufacturing of food levels, systemic immune impacts, or colon microbiota makeup. This

suggests that dietary fiber may be protective against colorectal cancer as it helps to bind and eliminate toxins from the body and can help to reduce systemic inflammation. Fibre can also help to regulate the digestive system and promote the growth of healthy gut bacteria. Furthermore, dietary fiber may act as a prebiotic, providing a nutrient source for beneficial bacteria in the gut, which can help to strengthen the gut wall and provide protection from outside pathogens.

### 8.11. Pro-Inflammatory Diet

The prolonged swelling brought on by a pro-inflammatory diet encourages the growth of some types of cancer, including oral cancer. To define criteria for analyzing dietary patterns and the risk of various diets, the dietary inflammatory index (DII) was established. According to recent studies, the DII links diet and blood C-reactive protein levels to the severity of irritation. Insufficient DII concentrations suggest antibacterial diets, decreasing the chance of developing oral cancer, whereas high DII values might suggest pro-inflammatory diets. High iron consumption is one of the harmful variables linked to oral squamous cell carcinoma (OSCC) and lung, prostate, and breast cancer tumors. This might be accounted for because iron is involved in essential cellular processes such as cell metabolism, development, and proliferation, which can result in the synthesis of nitrogen compounds and catalyze the generation of free radicals that can harm cells. Natural red meat also includes ammonia and phosphates, which can aid in the growth of mouth cancer and iron. In addition, cooking results in the development of additional oncogenic processes, such as heterocyclic amines and polycyclic hydrocarbons. Nitrates' ability to cause cancer derives from their transformation into the nitrite that makes methemoglobin<sup>49</sup>. Because it cannot attach nitrogen, this methemoglobin might result in a lack of oxygen. Vegetables, for example, typically have low nitrite concentrations. At the same time, they are stored fresh, but nitrite concentrations may rise depending on the storage circumstances due to bacterial contamination or indigenous nitrate reducer activity<sup>50</sup>. The nitrate reductase enzyme is deactivated when food is kept in the fridge. Certain microbes and plants produce a naturally occurring coloring called lycopene. Lycopene may be extracted from ripe tomatoes and fruits like watermelons and grapefruits. This substance has excellent antioxidant capabilities and is being investigated for the therapy and avoidance of persistent illnesses such as heart diseases, bone abnormalities, and chronic illnesses<sup>51</sup>. Due to the management of lipid peroxidation and reduced glutathione (GSH), it may thus be helpful in the therapy of possibly cancerous oral disorders and function as a preventative measure against mouth cancer. The consumption of greasy meals has been strongly connected to colon, rectal, and stomach cancer. Research has been done to see if this also applies to oral cancer. It has been concluded that males who consume a lot of fried food have a slightly higher chance of developing oropharyngeal carcinoma. Garlic includes many organosulfur and flavonoid components, which give it flavor, but it also possesses non-sulfur elements, which work together to have positive benefits. According to studies looking into the anti-cancerous effects of garlic, certain compounds may boost enzyme performance by eliminating carcinogens. According to some scholars, there is solid evidence linking eating garlic with esophageal, prostate, larynx, colon, ovarian, kidney, and oral cancer<sup>52</sup>.

### 8.12. Folate

Vegetables, beans, grains, etc., all contain folic acid, sometimes folate or vitamin B9. Additionally, it can be obtained as folic acid pills and naturally occurring folate found in plant and animal sources. It is a crucial component in DNA methylation and has been associated with various tumors, including breast, ovarian, cervix, lung, and colon cancer<sup>53</sup>. It is a crucial component in DNA methylation and has been connected to several tumors, including those of the breast, ovary, cervix, lung, and colon. There is evidence that smoking or alcohol lowers the regulation of folate levels. Folate is crucial for DNA synthesis, methylation, and cell cycle repair. Because the mouth epithelium is constantly regenerating and growing, it can reduce the risk of oral cancer<sup>54</sup>. Folate is a key vitamin needed for the development and growth of cells, and it helps to keep the DNA methylation process in check. When folate levels are low, it can lead to unregulated DNA methylation and cause cells to divide and grow too quickly, leading to the development of tumors. The use of smoke or alcohol can further reduce folate levels and increase the risk of developing cancer.<sup>55</sup>

### 8.13. Selenium

A popular selenium mineral may be found in walnuts, poultry, beef, and game (bush meat). As it affects the methylation of DNMT and histone deacetylase (HDAC), selenium has pro-apoptotic qualities in addition to its reactive and DNA repair effects<sup>56</sup>. DNMT stands for DNA methyltransferase, an enzyme that adds a methyl group to DNA molecules. This process is known as DNA methylation and is important for gene regulation. Selenium affects the ability of DNMT to methylate DNA and has been linked to the prevention of certain types of cancer. Selenium is known to play a role in regulating gene expression and DNA repair. It does this by affecting the methylation of DNMT (DNA methyltransferase) and HDAC (histone deacetylase)<sup>57</sup>. These are proteins that are involved in gene expression and the regulation of apoptosis. By doing so, selenium helps to promote apoptosis and repair damaged DNA. Selenium also helps to prevent DNA damage by increasing the expression of protective genes, such as those involved in antioxidative activities and DNA repair.<sup>58</sup>

### 8.14. Zinc and Copper

In addition to nuts, grains, legumes, and yeast, zinc is mostly in animal proteins (beef, pig, and sheep). Several physiological processes, including removing free radicals through the enzyme system, include interactions between copper and zinc. Zinc is important for many biological processes, including the production of DNA and proteins. It also plays an important role in the immune system, as it helps the body fight off infections and helps the body heal faster from wounds. Additionally, zinc helps regulate hormones, including testosterone and estrogen, which are important for reproduction<sup>59</sup>. Zinc also plays a role in the metabolism of carbohydrates and fats, aiding in efficient energy production. Furthermore, zinc can help with cognitive development, including memory and learning.

### 8.15. Turmeric

A biological source of the Zingiberaceae family from Southeast Asia is curcumin (*Curcuma longa* L.). An orange

flavoring and food coloring ingredient is turmeric resin. A phenolic molecule called curcumin is used to flavor and color various foods. It has been extensively utilized in traditional medicine (Chinese, Hindu, and Ayurvedic) to treat digestive issues. It has long been known to have powerful therapeutic properties and anti-inflammatory, antioxidant, antiangiogenic, and anticancer properties. Three curcuminoids, curcumin, demethoxycurcumin, and bisdemethoxycurcumin, all of which have antioxidant effects, are present in turmeric. According to research, curcumin reduces metalloproteinases (MMP-2 and MMP-9) in target organs, inhibiting cancer invasiveness. Curcumin also increases the expression of apoptotic genes, which stimulates the body's immune system. It has been shown to reduce the growth of certain cancer cells by inducing apoptosis, which is programmed cell death. In addition, curcumin has been shown to reduce inflammation and oxidative stress, which are often associated with cancer development. Additionally, curcumin has even been found to have therapeutic potential in various other diseases due to its antioxidant and anti-inflammatory properties.

### 8.16. Green Tea

High levels of catechins and flavins may be seen in saliva an hour after consuming green tea, which speeds up their slow release into the salivary glands<sup>60</sup>. As a result, it may be successful in reducing periodontal disorders and cavity formation. On the other hand, it has been observed that drinking tea, particularly green tea, has a negative correlation with mouth cancer. The antioxidant Epigallocatechin gallate (EGCG), found in green tea, reduces the development and invasion of tumor cells and promotes the death of tumor cells in oral cancer, among other ways. This is because the antioxidants found in tea, such as EGCG, help to reduce inflammation, which is one of the key causes of cancer. Additionally, the polyphenols found in green tea help block the activity of carcinogens, which are known to contribute to cancer development. Furthermore, green tea has been

shown to improve health in several other ways, such as reducing the risk of type 2 diabetes, improving cholesterol levels, and potentially even promoting weight loss. EGCG (epigallocatechin-3-gallate) is a type of catechin and antioxidant found in green tea. It is thought to be the most powerful of all the catechins and is believed to be the main reason green tea has powerful anti-cancer properties<sup>61,62</sup>.

## 9. CONCLUSION

Several epidemiological studies relate food to reducing the risk of cancer. Different diets impact bodily cells through epigenetic processes that change their genetic makeup. The same pathways might influence or change cancer cells, making them less likely to develop cancer and more responsive to therapy. Different micronutrients, including The health advantages of a diet rich in fruit and veggie intake, are assumed to be influenced by polyphenols, lycopene, catechins, flavins, curcuminoid, slowly digesting starches, minerals (selenium, zinc, and copper), carotenes, vitamins (A, B, C, and E), folate, and omega 3 fatty acids. Some, nevertheless, are also present in fish and other animal-based foods. These compounds' having many mechanisms of action may combine to provide synergistic antioxidant, anti-inflammatory, anti-angiogenic, and antiproliferative effects. These substances may have synergistic antioxidant, anti-inflammatory, anti-angiogenic, and anti-proliferative effects since they each have distinct modes of action. There is little study on mouth cancer. Most published research makes no distinction between the oropharyngeal or upper aerodigestive tract and mouth cancer. Surprisingly few high-quality studies show a connection between food and mouth cancer. More research is required to determine the precise connection between food and mouth cancer.

## 10. CONFLICT OF INTEREST

Conflict of interest declared none.

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