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Nutrition and Carcinogenesis: An Exploratory Analysis

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ABSTRACT

Background: Cancer cases around the world are increasing with every passing day. Cancers are caused by mutations in the four main groups of genes which are associated with the growth and development of cells. Chemical substances, physical agents and some microbes are associated with the causation of these mutations. Some diets contain such chemicals which could lead to the gene mutation resulting in the development of cancers. Awareness of such dietary factors among the community could be helpful in the prevention of cancers.

Material and Methods: Research papers were collected from the different databases by searching the key words such as cancers, malignant tumors, malignancies, diet, dietary patterns, dietary factors, carcinogenesis, food, edibles. Searched databases included PubMed, Google scholar, Scopus and Web of Science. After reviewing the titles and abstracts, a total of sixty-seven research articles were selected for this review paper.

Results: The collected research papers were reviewed by the nominated group of authors. A significant number of papers revealed that the certain diets are associated with some types of cancers. The important categories of cancer associated with the dietary factors include colorectal cancer, gastric carcinoma, esophageal cancers, malignant tumors of oral cavity, breast carcinoma, cancers of lung and pancreatic carcinoma. The diets associated with cancers include increased intake of processed meat, sulfur microbial diet, industrially processed food, pro-inflammatory diet and reduced intake of fiber, fruits & vegetables.

Conclusion: Many cancers have been associated with the unhealthy food. One of the important strategies for the reduction in the morbidity and mortality due to cancer is to find out the potential preventable risk factors of cancers. The adaption of healthy diet could be very vital in the reduction of cancer incidence.

Keywords: *Food; Dietary Patterns; Diet; Cancers; malignant tumors; Colorectal Cancer;*

1. INTRODUCTION

Malignant tumors are important cause of morbidity & mortality. Analysis of the cancer data from 185 countries revealed twenty million new cases in 2022 and cause of 9.7 million deaths [1]. The five most common sites of malignant tumors are lungs, female breast, colorectum, prostate and stomach. On the basis of demographic prediction, it is estimated that there will be 35 million cases of cancers in 2050 [1].

The cancers have a significant contribution to the burden on the economy and health of the people from all over the world, it would be imperative to find out the preventive measures and raise the awareness among the community about these preventable risk factors of malignant tumors. The approximate cost of treatment of cancer around the globe is 25227 billion US dollars from 2020 to 2050 [2).

For better economy, the prevention and control of diseases play a vital role. The adaption of preventable measures or the disease prevention has significant economic advantages. The reduction in the incidence of diseases by employing preventable measures reduces the healthcare expenditures and improves the productivity by increasing healthy population and workforce.

The important strategic techniques for the prevention of cancers include the following vaccinations programs such as vaccination against hepatitis B virus would reduce the risk of hepatocellular carcinoma and vaccination against human papilloma virus reduces thee changes of cervical cancers [3-4].

The policies against the cigarette smoking have led to reduction in the new cases of cancers. There are seventy-nine substances in the cigarette smoke which are linked with carcinogenesis [5].

The research studies revealed the increased risk of cancer among the human due to smoking and the commonly affected organs include lung, larynx, esophagus, oral cavity and pharynx, bladder, liver, uterine cervix, kidney, stomach, colorectum and pancreas (6-11).

Similarly control on the drinking of alcohol reduces the risk of the malignant tumors. Alcohol drinking is cause of about 4% of malignant tumors [12). The screening program could result in early detection of cancers which would result in better patient outcome with cost effectiveness.

Another very important preventive strategy is the promotion of heathy lifestyles by the encouragement of physical activities and use of the healthy diets.

The main objective of this review is to find out dietary factors that have association with the carcinogenesis.

2. MATERIALS AND METHODS

1. **Study design**: This is a narrative review. The qualitative evidence about the dietary factors which are associated with the cancers of various organs has been addressed.
2. **Research question**: does the diet has a role in the cancer development.
3. **Key words used**: The key words used for the literature search include cancers, malignant tumors, malignancies, diet, dietary patterns, dietary factors, carcinogenesis, food, edibles, lung carcinoma, colorectal cancer and gastrointestinal tumors.
4. **Research time period**: The search papers published from January 2000 and onwards
5. **Data sources**: Google scholar, Scopus, Web of science, PubMed

Inclusion criteria:

1. Publications from January 2020 and onwards
2. Research articles of peer reviewed journals
3. Publications in English

Exclusion criteria:

1. Publications before January 2020.
2. Publication in language other than English
3. Publications of non -peer reviewed journals

Data extraction

All research papers have been assessed on following parameters

- Year of publication
- Study design
- Setting of the study
- Dietary factors
- Types of cancer
- Results

Data analysis:

Among the retrieved research papers, the duplicated research articles have been removed, the data has been summarized for the important findings.

3. RESULTS

Based on the selection criteria, sixty- seven research articles were included in the paper. Vast majority of the research papers revealed the positive association of certain diets with the development cancer such as colorectal carcinoma, gastric cancer, carcinoma of the oral cavity and esophageal cancers. The main foods that have a positive link with the carcinogenesis include increased consumption of processed meat, sulfur microbial diet, industrially processed food, pro-inflammatory diet and less intake of fiber, fruits & vegetables. The important findings of the studies are summarized in Table 1.

Table 1. The Association of Dietary Factors with The Cancers

Author	Diet	Cancer
Bradbury KE [13]	Red & processed meat	Increases Colorectal cancer (CRC) risk
	Fiber in diet	Reduced risk of CRC
Puzzono M [14]	Processed meat	Increased risk of CRC
Wang Y [15]	Sulfur microbial diet • Increased use of beverages, French fries, red meats & processed meats • Reduced intake of fruits, yellow vegetables, whole grains, legumes and leafy vegetables	Increased risk of CRC
Skulsky SL [16]	• Increased use of chocolate and confectionery, low-fiber bread; red and processed meats; • Less use of fruits, vegetables, and high-fiber cereals	Increased risk of CRC
Abebe Z [17]	The intake of diet that is high in fiber and unsaturated fatty acids	Reduced the risk of CRC.
Wang K [18]	• Increase intake of industrially processed food • Reduced unprocessed fiber-rich food intake	Increased risk of CRC
Su J [19]	The intake of diet which is low in • fiber • Milk • whole grains • calcium, Increased intake of processed meat	Increased risk of early-onset of CRC
Ronco AL [20]	Dietary acid load	Increased risk of Esophageal carcinoma (EC)
Niu C [21]	• Drinking well & surface water. • Intake of salty diet	• Increases the risk of low-grade & high-grade intraepithelial neoplasia / esophageal squamous cell

		carcinoma
	• Intake of poultry meat, fruits, vitamins & drinking of improved water	• Reduces the risk of esophageal tumor
Zang Z[22]	A food that is rich in poultry meat and poor in fruits & vegetables	Increases the risk of EC
Dong J 2023 [23]	The intake of pro-inflammatory diet	Increases the risk of EC
Li S [24]	• higher fat level	• Increased risk of esophageal squamous cell carcinoma (ESCC)
	• fiber and riboflavin	• Decreased risk of ESCC
Abeer Asif [25]	• Red meat • Excessive hot beverages,	Increases the risk of EC
Ren, X [26]	Sulfur microbial diet	Increases the risk of ESCC
Bora SK [27]	Increased use of fermented and preserved food with Kala Khar	Increases the risk of EC
Mujtaba Barekzai A [28]	Increased intake of • salty food • pepper, • red meat	Increased risk of EC
	Increased intake of • fruits • vegetables • fish • poultry	Decreased risk of EC
Boldo E, [29]	Red and processed meat	Increases the risk of gastric adenocarcinoma
Bulanda S [30]	Increased in the intake of red meat & thermally processed meat	oral cavity cancer risk is increased in these people
Xiaomin W [31]	Fast food	Increases the risk of gastric carcinoma (GC)
Collatuzzo, G [32]	dietary fiber intake	Reduces the risk of GC
Le, N.T [33]	Protein from animals, fish, and poultry	Reduces the risk of GC
Jin D [34]	• White bread	• Increases the risk of CRC

	• Dietary fiber, calcium, magnesium, phosphorus, and manganese	• Reduced risk of CRC
Tayyem R [35]	The Mediterranean dietary pattern	Reduces the risk of GC
Takasu A [36]	Increased intake of sodium & reduced soluble dietary fiber	Increases the risk of GC
Sassano M [37]	Vitamin C	Reduces the risk of GC
Ferro A [38]	Increased intake of processed & red meat	Increases the risk of GC
Nguyen TG [39]	Increase in calcium intake	Reduces the risk of GC
Sengngam K [40]	Trans-Lycopene & β-Cryptoxanthin intake	Decrease the risk of GC
Le NT [41]	Less than normal daily intake of selenium	Increases risk of cancer of stomach, colon, rectum
Dalmartello M [42]	allium vegetables	Deceases the risk of GC
Le NT [43]	• Decreased intake of vitamin B_{12}	Increases the risk of esophageal, lung, and breast cancer
	• High intakes of vitamin B_{12}	Increases the risk of GC
Ferro A [44]	Increase use of fruits	Risk of GC is reduced
Collatuzzo G [45]	dietary iron intake	Risk of GC is reduced
Loeb S [46]	Higher plant-based diet index	Reduces the risk of advanced prostate cancer
Martínez CF [47]	Healthful pro-vegetarian pattern	GIT cancers' risk is reduced
Di Maso M [48]	Cholesterol-lowering diet	Reduces the risk of prostatic cancer
Arafat HM [49]	Dairy consumption	Breast carcinoma (BC) risk is reduced
Wajszczyk B [50]	Milk	Reduces the risk of BC
Kaluza J [51]	High long-term consumption of milk	Increases the risk of ER+/PR+ BC
	High long-term consumption of fermented dairy products	Decreases the risk of ER-/PR- BC.
Aguilera-Buenosvinos I [52]	low-fat dairy product consumption	Decreases the risk of BC.
Reis MG [53]	Increased intake of fruits, vegetables, and tea	Decreases the risk of OSCC
	Salty meats, dairy, coffee, sausages and fried & spicy foods.	Increases the risk of OSCC
Esposito G [54]	Diabetes risk reduction diet in prevention.	Reduces the risk of endometrial cancer
Markellos C [55]	Highest olive oil consumption	Reduces the risk of cancers of breast, GIT, upper aerodigestive tract and

		urinary tract
Rodríguez-García C [56]	high-fat diet	CRC risk increases
Di Maso M [57]	Plant-based cholesterol-lowering diet	Reduces the risk of pancreatic carcinoma

4. DISCUSSION

A significant number of studies suggests that some dietary patterns and certain edibles are associated with the development of cancers. To prevent the cancer development, it is very important to find out the preventable risk factors of the malignant tumors. The identification of unhealthy dietary factors would be helpful in the reduction of occurrence and cancers and it would have a significant contribution in the control of morbidity and mortality due to malignancies.

Unhealthy diet is a risk factor for malignancies [58]. There is a significant role diet in carcinogenesis. The carcinogenic agents cause mutations in the DNA which leads to the development of cancer. The important genes which have been mutated in malignant tumors include protooncogenes, tumor suppressor genes and genes that regulate apoptosis. The carcinogenic agents that are associated with the genetic mutation leading to cancers are chemicals, physical and microbial agents. An important cause of DNA mutations is the free radicles. The free radicles can cause DNA damage and if it could not be repaired and it is a non-lethal then the cells may lose control over the cell cycle [59]. The free radicles have unpaired electrons. These reactive species are produced in the body through different endogenous processes. The free radicals play an important role in some physiological processes but their production causes oxidative stress and this oxidative stress is an important cause of DNA damage [60].

The important free radicles include reactive oxygen species such as superoxide, hydrogen peroxide and hydroxyl radical while reactive nitrogen species include nitric oxide, peroxynitrite and nitrogen dioxide [61]. The overproduction of free radicles particularly after the high consumption of fat increases the morbidity and mortality due to various types of malignant tumors and the use of curcumin in foods reduces the risk of oxidative stress and plays a role in the prevention of cancer [62].

A study conducted by Li S et al narrated the diet with proinflammatory nutrients such as high fat increases the risk of esophageal squamous cell carcinoma while diet with anti-inflammatory nutrients such as fiber and riboflavin reduce the risk of esophageal cancer [63].

The diet low in fiber content is associated with the colorectal carcinoma. The dietary fibers yield butyrate after the action of microbial flora of the gut on the fibers and the butyrate has antiproliferative effects leading to reduced risk of cancers [64]. The fiber from grain reduces the risk of colorectal cancer [65]. The fiber intake of 25-29 grams per day is sufficient but fifty grams per day is beneficial in the prevention of colorectal cancer and the risk of cancer may be reduced by 15 – 16% [66].

The ultra-processed foods increase the risk of cancers. A ten percent increase of ultra-processed food in the diet increases the risk of malignant tumors of colorectum, breast & pancreas [67].

Conclusion: The adaption of healthy food is an important preventable measure for many diseases including the cancers. The processed foods including red meat and unhealthy fat play a role in the causation of oxidative stress which could contribute in the DNA mutation leading to the development of malignant tumors. Some food may also contain carcinogenic compounds. The appropriate utilization of fruits, vegetables, whole grains, legumes, healthy fat such as olive oil, vitamins and minerals could be of vital importance in the prevention of cancer development.

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