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# The Evidence Base for Major Cancer Types: Nutritional and Lifestyle Factors Affecting Prevention

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**Abstract**
Cancer is characterized by the uncontrolled division of abnormal cells, forming tumors that can attack surrounding tissues and spread all over the body through the blood and lymphatic systems. Among the various types of cancer, the five major categories include carcinoma, sarcoma, melanoma, lymphoma and leukemia. Carcinomas, the most common, originate in the skin, lungs, breasts, pancreas, and other organs and glands. Lymphomas affect lymphocytes, while leukemia impacts blood cells. Melanoma typically begins in the skin and sarcomas arise in connective tissues like bone and muscle. Certain cancers, such as pancreatic cancer, mesothelioma, gall- bladder cancer, and cancer of esophagus are linked with higher death and poor rates of the survival. Key factors contributing to cancer risk include smoking, alcohol consumption, genetics, family history, socioeconomic status and environmental exposures. Preventive measures, such as, adhering to a Mediterranean diet, consuming foods rich in phytochemicals, like flavonoids and curcumin, limiting alcohol intake, quitting smoking, engaging in consistent physical activity, sustaining a healthy weight, and keeping away from excessive sun and obesity, are critical for reducing cancer risk. This review synthesizes current evidence on nutritional and lifestyles factors that influence the prevention of major cancer types, emphasizing the importance of integrated public health strategies in reducing cancer incidence globally.

**Key words**: Antioxidant, CAR T-cells, crucifers, curcumin, Hodgkin's, non-Hodgkin, regional disparity.

## 1. Introduction

Humans and livestock animals have had cancer for a long time as recorded in history. Dating back to 3000 BC [1]. Earlier signs of cancer have been reported in fossilized bone tumors and human mummies in Egypt [2]. The beginning of scientific oncology took place in the 19$^{th}$ century by using the contemporary microscope in studying the tissues with disease. This technology permitted an improved understanding of the destruction cancer had done and also assisted the growth of cancer surgery [2]. The progress made in the analysis and the cure of cancer came through the enthusiastic work of many researchers. Though, through the leadership of three surgeons, two pathologists, one physician-chemist and one physician-cytologist made outstanding contributions for which they deserve an everlasting place in the history of medicine and oncology [3].

The development of cancer, a complex disease, takes 10-50 years linking epigenetics. Eighty percent of all cancers are related to environmental factors impacting upon genetics and epigenetics [4]. Cancer disease is considered to be serious world-wide in terms of mortality and lack of effective treatment. By the year 2040 about 28.4 million new cancer cases and 10.1 million deaths are expected globally [5]. Chemotherapies used since 1930 are linked with pain, have side effects and a deficiency of targeting. Nanomedicines are a substitute where nanoparticles aims at cancer cells via active and passive processes [6]. The function of pathology in the management of patients has advanced with the passage of time from the backward-looking

review of cells, tissues, and disease to a probable anticipated point of view [7]. Nevertheless there is a insistent determination to progress disease treatments. Current struggles have concentrated to recognize less immunogenic anti-cancer agents that produce less serious adverse reactions [8]. Metastases or spread of cancerous cells from one part of the body to another is most common. It mainly involves bones, whereas bone is the third popular common spot for cancer spread after the lung and liver [9].

The aim of this review is to exhibit in simplified form latest advances in cancer research, type of major serious cancers, factors affecting these cancers and their nutritional and lifestyle preventive measures.

## 2. Most Common Types of Cancers

There are five main types of cancers briefly described [10].

**2.1. Carcinoma -** originate in the epithelial tissue of the skin and other organs affecting lungs, breast, pancreas and skin. A number of various subtypes include glandular carcinoma, cancer of squamous cells and urothelial carcinoma. The cancer of gallbladder is by nature insidious and stereotypically delayed manifestation place it amongst the most lethal neoplasm disease [11]. The cancer of the prostate is the second most prevalent cancer worldwide. Hereditary prostate cancer has the upmost heritability of an acute cancer in men [12].

**2.2. Leukemia -** a cancer of the white blood that originates in the blood-forming cells of the body for example the bone marrow and the lymphatic system and produces a high number of abnormal blood cells. It mostly affects people aged 55 or more and is also common in children less than 15. Leukemia is a clonal expansion of hematopoietic stem cells in the bone marrow. Leukemia survivors should be checked narrowly for secondary malignancies, cardiac problems, and endocrine disorders such as metabolic syndrome, hypogonadism and hypothyroidism. Five-year survival rates are prominent in younger patients and in patients with chronic myeloid leukemia or chronic lymphoid leukemia [13].

**2.3. Lymphomas** – cancer which begins in cells of the lymph system affecting lymphocytes and white blood cells [10]. Lymphomas amounts to about the third most frequent neoplasm in anterior cervical region. The malignant lymphomas are classified as malignant Hodgkin's lymphoma and non-Hodgkin's lymphoma [14]. Hodgkin's lymphoma can often be cured, but the non-Hodgkin's is a dangerous condition and its survival rate is normally 5 years. The presence of a type of abnormal cell known as Reed-Sternberg cell containing one nucleus is the characteristic feature of Hodgkin's lymphoma; if these cells are absent, the lymphoma is known as non-Hodgkin's.

**2.4. Melanoma** – originates in the melanocytes, but may also begin in a pigmented melanin, but could also begin in a pigmented mole also known as skin melanoma. More rarely, it can also begin in other pigmented tissues, e.g., in the eyes or intestines. Disparities exist in melanoma care in provider type, residence area, social economic background, race and ethnic group exist in the United States and somewhere else. These factors of disparities are linked with lessened access to dermatologists. People who are not insured or are publicly insured, more probably present with melanomas in later stages, resulting in severe outcome [15].

**2.5. Sarcomas** – Sarcomas are a malignant carcinoma growing from cells of mesenchymal origin such as cartilage, muscle, tendons and bones. Bone tumor is a most common sarcoma. Osteosarcoma (bone) and chondrosarcoma (cartilage) are some of the examples [10]. If identified before spreading, it can be treated, but it remains a serious ailment. Roughly 65% of adults treated for soft tissue sarcoma are alive 5 years after treatment. It is common to have DNA mutations in the soft tissue. Exposure to radiation or cancer causing chemicals are responsible for acquired mutations.

## 3. Deadliest or Serious Cancers With poor Survival Rate [2, 16]

Several cancers are given with their survival rate of 5 years in parenthesis [2].

**3.1. Pancreatic cancer (11.5%)** – starts in the pancreatic tissues which supports digestion. Mostly cancers of pancreas are exocrine cancers, which means the cancer starts in the cells responsible for producing digestive enzymes. The

adenocarcinoma of the ducts of pancreas responsible for 90% of pancreatic cancer and frequently diagnosed at a later-stage. Poor 5-year survival rate of 15% is mainly due to late detection that significantly halt treatment options because pancreatic cancer is rare and screening of the adult population without apparent symptoms is not accessible with current modalities, screening in high-risk group of population is suggested [17].

**3.2. Mesothelioma** - a cancer of cells making thin layer of tissues that line outer surface of body cavities and wrap around the inner organs. Seventy five percent of the mesotheliomas grow in the mesothelium- a lining that encircles the lungs, and is named as the pleura. The kind of cancer is known as pleural mesothelioma. Mesothelioma is a perilous and rarely occurring form of cancer that usually manifest in the skinny layer of tissue that lines the lungs (pleura) or the abdominal lining called peritoneum [18]. Malignant pleural mesothelioma is a scarce and hostile neoplasm, which has been accredited to exposure to asbestos fibers (83% of cases); yet, despite many countries are observing ban on using asbestos, the prevalence of malignant pleural mesothelioma has ceases to minimize universally [18].

**3.3. Gallbladder Cancer** - this cancer begins in the tissues that lines the walls of the gall bladder. Cholelithiasis is the condition that defines the development of gallstones in the gallbladder and is the most prominent reason of developing gallbladder carcinoma, they are cholesterol and other materials deposits in the gall bladder. The shrouded nature and late diagnosis of gallbladder cancer make it the most deadly invasive neoplasms. The spread of gallbladder adenocarcinoma initially is by lymphatic or hematogenous metastasis thereby directly invading the liver. Patients approaching at later stages gets no success both surgically and non-surgically whereas early detection and treatment with surgery shows promising results. [11].

**3.4. Esophageal Cancer (20%)** - esophagus is the hollow fibromuscular tube that passes food and liquid from the pharynx into the stomach. Old age, male gender, smoking, alcohol consumption, and gastroesophageal acid reflux are some of the main risk factors. The occurrence and mortality propensity of esophageal cancer are changing remarkably across the world with substantial multifariousness between gender, anatomical types, tribal patterns and topographical distribution. Massive geographical difference is an epidemiological element of esophageal carcinoma, with the maximum incidence rates detected in East Asia and in South and East Africa and the minimum rates observed in West Africa. The discrepancy is to the disposition of more than 21 times between the lowest-prevalence and the highest-occurrence countries [19].

**3.5. Liver Cancer (20.8%)** - this cancer is the most commonly occurring cancer globally. The utmost significant risk factor is chronic hepatitis B or hepatitis C infections. Liver cell carcinoma is the most prevalent type of primary liver cancer in the US with seventy-five percent of primary and secondary liver cancer cases. The trend for both primary and secondary cases instances of demise is increasing analogous to the geographical concealing chronic liver disease or cirrhosis pathology. Hepatocellular cancer develops from chronic liver disease effectuate by multi-risk factors, like cirrhosis, inheritance and profuse alcohol intake [20].

**3.6. Lung and Bronchial Cancer (22.9%)** - this type of cancer is responsible for killing many people in the world and in the United States (US) every year. Major cause is the usage of tobacco-products and smoking. Lung cancer being the main reason for mortality in the United States (US), make up nearly a two-third of all cancer-related deaths. Differences exist as examined upon closer observation are: African American men were found to have a higher preponderance of developing lung cancer contrast to their Caucasian counterparts. A couple of plausible cause for higher occurrence rates in African American patients may be due to variance in smoking pattern, socio-economic variation, and metabolic capability of tobacco carcinogens. Ethnological and gender differences happen in all-cause demise in patients with metastatic lung and bronchial cancer in different regions of the world. Racial variations in different regions may be responsible for developing or being the cause of the prevalence of cancer and other related comorbidities. Attention should to be paid in these ethnicities be contingent on the territory [21].

**3.7. Pleural Cancer (22%) –** it happens in the pleural cavity. It is the region inside the thoracic cavity but outside the lungs, or in the outer lining of the lungs. Pleural malignant mesothelioma cancer is a rare neoplastic disease arising from mesothelium. It is often related with inhaling asbestos fibers. Malignant mesothelioma of the pleura is a pugnacious disease with stunted median rate of life, and extended concealment presents difficulty in prognostication, and cure. Despite substantial progress, mortality is still soaring either due to late diagnosis or resistance to treatment [22].

**3.8. Brain Cancer (32.5%) –** on rare occasions originates in the brain, but more frequently it reaches the brain from other regions. Brain cancers that are resulted in cancers which begun elsewhere in the body aren't incorporated in brain cancer survival statistics because cancers are classified on the basis of the site of their origin. The prevalence of brain tumors has been surging in all ages in present decades. The steepest incidence is in Africa and the maximum level is in northern Europe. In addition, the mortality rate of nervous system cancers is estimated at about 3.4 in 0.1 million globally. As the tendency of brain carcinoma in the globe is heightening, precautionary and defensive measures to lower the risk factors of such cancer are suggested to reduce the disease prevalence [23].

**3.9. Acute Myeloid Leukemia (30.5%) –**grows from blood-forming cells in the bone marrow, which separate into different blood-cell antecedent and in due course blood cells. Acute myeloid leukaemia (AML) occurs when blood cell growth is ended and the cells turn out to be cancerous. It is the commonly found leukemia amongst the grownup population and narrates to 80% of all cases. It is attributed by positive selection of immature "blast cells" in the peripheral blood and bone marrow causing ineffectual erythropoiesis and aplastic anemia [24].

**3.10. Melanoma –** is a skin cancer. About 90% will survive this melanoma after diagnosis and 85% people will survive for 10 years or more after being diagnosed with this disorder [10]. Differences in melanoma care in provider type, place of dwelling, socioeconomic status, race and ethnicity exist in the United States and elsewhere. These factors of inequalities are associated with reduced access to dermatologists. Persons who are not insured or are publicly insured more possibly present with later stage melanomas, resulting in inevitable consequences [15].

**4. Most Common Type of Cancers –**
Breast and prostate cancers are considered to be the most common cancers.

**4.1. Breast Cancer -** deaths caused due to breast cancer have been repulsing; however, oncological results have not improved equally among all races and ethnicity. The chief factor affecting this outcome is lower means of approach to care which accords to declining rates of mammography screening on time [25].

**4.2. Prostate Cancer** - Prostate carcinoma is the second most common cancer after basal cell carcinoma in the world. The accurate pathogenesis of prostate cancer is not well recognized. Some of the perilous factors include advanced age, family history and obesity. African Americas are generally at higher risk than other Americans. Inherited prostate cancer has the uppermost inheritance ability of any major cancer in men [12]. A summary of various cancer types is given in Table 1.

**5. Factors Affecting Cancers and Preventive Measures**
**5.1. Ethnicity, Genetics and Race –** Residential location can have significant impact on cancer rate. Ten years before the diagnosis of colon cancer in Hispanics 32.6% lived in a single region or district for the entire period. The latter had significantly lower odds of being diagnosed with advanced-stage colon cancer. How a single ethnicity live in an enclave affects the diagnosis of colon cancer. Over the ten years precedent colon cancer diagnosis, 32% found to be living in an enclave for the whole period [26]. Past studies have associated short alleles of the PGC gene to risk for or protecting against gastric cancer based upon the origin of the ethnic population [27]. Inequalities have been found based on the ethnic origin on the rate of cancer. From 2018-2020, the highest cancer death rates were found in Black men followed by Whites and American Indian/Alaska natives, Native Hawaiian and Pacific Islanders Alliance and Latino. Among the women, highest cancer rates were in the Black women followed by native Hawaiian and pacific

islanders, American Indian and Alaska natives, White, Latino and Asians [28]. The peak death rates by age grouping was found among Native Hawaiian and Pacific Islanders persons aged 20-49, Black individuals 50-69; while the Asian group had the lowest cancer death rates across age groups [28].

Ethnicity also influences cancer frequency. There is an internationally increasing awareness of ethnic health inequalities. Ethnicity and immigration status significantly affect the cancer rates, e.g., stomach cancer was more prevalent in the East Asians, Latinos, central and South Americans, Africans, and the Caribbean group. Non-immigrant African males had the highest cancer incidence ratios whereas the non-immigrant South Asian females had the highest death rates [29]. Differences in melanoma care in provider type, place of residence, socioeconomic status, race and ethnicity exist in the United States and elsewhere, typically from decreased access to dermatologists. Uninsured and publicly insured

**Table 1. Various Types of Cancer**

**1. Most Common Types**

**1. Carcinoma -** originates in the epithelial tissue of the skin and many other organs. Prostate cancer is the second most popular worldwide and has uppermost heritability of any major cancer in men. **2. Leukemia -** a cancer of white blood cells affecting blood. It begins in the blood cells and produces a large number of abnormal cells. **3. Lymphomas** - it begins in the cells of the lymph system affecting lymphocytes and white blood cells. Hodgins lymphoma can often be cured, but non-Hodgins is a dangerous condition and the survival rate is normally 5 years. **4. Melanoma –** originates in the melanocytes, which make melanin, but could also begin in a mole. **5. Sarcomas -** a malignant cancer grows from connective tissues, such as cartilage, muscle and bones; tumor on the bone is the most common sarcoma.

**2. Deadliest or Serious Cancers**

**1. Pancreatic cancer -** it arises in the pancreatic tissues aiding in digestion and characterized by inflammation of the pancreas. The actual reason behind this cancer is not known. Mutations in the DNA of the cells of pancreas can result in the uncontrollable multiplication of the cells and is one of the causes for progression of this cancer. **2. Mesothelioma –** a cancer of the cells that line certain cavities of the body and surround the internal organs. It occurs when the DNA in the cells damaged. **3. Gallbladder Cancer –** this digestive system cancer begins in the gall bladder and is among the most delay invasive neoplasms. **4. Esophagus Cancer -** a huge geographical variation is an epidemiological characteristic of esophageal cancer, with the highest incidence rates found in Eastern Asia, east and South Africa with the lowest in Western Africa. **5. Liver Cancer –** world-wide cancer with chronic hepatitis B and c infections significant factors. Hepatocellular carcinoma develops from chronic liver disease. **6. Bronchial Cancer –** it kills many people world-wide, main cause being smoking and tobacco products usage. There are racial variations in different regions affecting its occurrence. **7. Pleural Cancer –** pleural mesothelioma cancer is a neoplastic disease arising from mesothelium usually linked with asbestos exposure. It is an aggressive disease and death rate is higher because of delayed diagnosis and cure struggles. **8. Brain Cancer –** it rarely begins in brain but more often spreads there from other cancers. Its lowest occurrence level is in Africa and highest in northern Europe. The incidence of this cancer is increasing world-wide. **9. Acute Myeloid Leukemia** – it arises from stem cells in the bone-marrow, which differentiates into various blood-cell, precursors and finally blood cells. It is the most popular leukemia amongst the grownup population and responsible for about 80% of all cases **10. Melanoma** - about 90% of the people with this skin cancer will survive after diagnosis and 85% persons with this illness will survive for 10 or more years after being diagnosed.

**3. Most Common Cancers**

**3.1. Breast Cancer –** it originates in the breast tissue and is caused due to changes or mutation in the DNA of breast cells causing them to grow abnormally and divide more rapidly than the healthy cells. Hormonal factors play an important role in breast cancer. **3.2. Prostate Cancer –** The exact cause of this cancer is not well understood. Some of the main factors affecting this cancer are advanced age, family history, obesity and African Americans generally are at higher risk. A prostate cell becomes cancerous due to a change in its gene.

individuals are more likely to present with late-stage melanomas, resulting in worst outcome [15].

Although deaths due to breast cancer have been falling; cancer related health consequences have not amended equally amongst all races and ethnic groups. The foremost factor affecting this outcome is lesser accessibility to care which leads to lesser rates of well-timed screening mammography [25]. The occurrence of breast cancer is ascribed to both genetic, representing gene mutations and non-genetic, e.g., race and ethnicity as important risk factors [30]. Genes associated with hereditary breast and ovarian cancer are noteworthy relevant etiological factors. About 5 to 10% of all cancers originate due to the congenital changes of group of genes predisposed to genetic factors [31]. Some of the vital factors for breast and ovarian cancer are family history, hereditary, age, and race. Hereditary prostate cancer has the peak heritability of any important form of cancer in men [12]. Prostate carcinoma is the second most common cancer world-wide. Factors that drive this cancer include age, family history and genetics. The major cancer therapies include radiation, bisphosphonate and palliative chemotherapy, however it often becomes metastatic requiring more aggressive treatment [32].

Socio-demographic differences, such as, race, insurance status, gender and age in accessing oncologic care exist along the variety of cancer care [33]. The effect of Asian ethnicity explicitly, environmental, sociocultural and genetic heterogeneity are the chief factors to consider in managing metastatic prostate cancer [34]. Similarly gastric cancer is thought to be caused due to factors such as genetics, epigenetics and environmental factors [35]. This cancer signifies an important disease burden globally. The most noteworthy source of this cancer is chronic inflammation, which is triggered by H. pylori infection. Recently organoid cultures developed from human and animal adult cells have enabled great developments in our understanding of gastric homeostasis [36]. There is a noteworthy prevalence for a family history of colorectal cancer in American countries and first degree relatives [37]. In other studies a positive family history was related to overall colorectal cancer patient's survival [38]. However, caution is required in interpreting these results due to different quality of the studies. The determinants associated with cancer occurrence and development include genetic make-up, life style, urbanization, obesity and diet. Colorectal cancer is the deadliest cancer in terms of mortality rate [39]. Genetics and dietary factors play a significant part in developing colorectal cancer. Though the primary mechanisms of the interaction between this cancer gene morphism and dietary fat are uncertain [40]. Likely, some polymorphisms of the ALOX and COX genes may have a principal role due to the dietary fat on this cancer.

**5.2. Vegetarian, Mediterranean Type Foods/Diets and Nutrients** – Certain food type intake appears to have positive effect on various cancer types. A study on the high uptake of cruciferous, chiefly broccoli and cabbage vegetables reduced the incidence of gastrointestinal and some other cancers. It did not have much effect on gallbladder cancer [41]. Foods containing beneficial phytochemicals such as green tea, cruciferous vegetables, omega-3 fatty acids and tomatoes have beneficial effects in preventing prostate cancer [42]. A notable decline in the possibility of the development of gastric cancer with an increased dietary intake of allium vegetables, particularly garlic has been reported [43]. An average and advanced levels of vegetable fat consumption may be related to decreased risk of cancer development or demise amongst patients with metastatic colorectal cancer [44].

Cruciferous sprouts and microgreens, derived from the Brassicaceae family, serve as a significant cause of bioactive compounds beneficial to human health, being abundant in vitamins, polyphenols, glucosinolates and carotenoids. Glucosinolates, which are sulfur-containing bioactive phytochemicals, exhibit anti-cancer properties [45]. A diet high in preserved vegetables, pickled vegetables, and salted meat is inversely correlated with mortality risk in patients with esophageal squamous cell carcinoma [46]. Research indicates that reducing the intake of preserved vegetables may be related to a reduced risk of early death from hemorrhagic stroke and

cancers of the digestive tract [47]. In North American, European, and Asian populations, vegetarian diets exhibited a negative correlation with the risk of gastrointestinal tumorigenesis in men, while no correlation was observed in women [48]. In conclusion, adherence to vegetarian diets typically decreases the risk of gastrointestinal tumorigenesis.

A vegetable-based dietetic design is linked with a reduced risk of digestive system cancers, including specific cancers of the gastrointestinal tract and accessory organs. Emphasizing the health benefits and quality of plant-based diets is crucial for the prevention of emerging cancers in the digestive system [49]. In a multiethnic population, increased adherence to plant-based diets abundant in healthy plant foods is related with a lower risk of hepatocellular carcinoma [50].

A thorough assessment of dietary patterns indicated that the anti-hypertensive DASH diet, characterized by its emphasis on minerals such as potassium, calcium, and magnesium through the consumption of vegetables, fruits, and whole grains, along with the Western dietary pattern and the identified dietary inflammation pattern, may be the most pertinent diets for colorectal cancer prevention [51]. A separate study indicates that compliance with a diet characterized by a high hPDI score may diminish lung cancer mortality [52]. hPDI quantifies adherence to a nutritious plant-based diet. The elevated hPDI correlates with a substantial consumption of fiber, plant proteins, whole grains, fruits, vegetables, and nuts, alongside a diminished intake of less nutritious animal proteins, refined grains, confections, eggs, dairy, and meats. This number signifies that nutritious plant-based foods received favorable ratings, whereas less healthful animal-derived foods received unfavorable ratings. Compliance with a nutritious plant-based diet among the United States population is associated with a reduced risk of pancreatic cancer, while adherence to a less healthful animal-based diet is linked to an increased risk. These results underscore the significance of evaluating the quality of plant-based foods to mitigate the risk of pancreatic cancer [53].

The Mediterranean diet has long been considered to have a protective role in diseases related to heart and cancer. This high quality diet with increased fruit and vegetable consumption has been found to be associated with decreased risk of some types of cancer in the ageing population [54]. It can improve quality of life in the elderly globally. A nutritional pattern highlighting eating fruits, vegetables, whole grains, pulses, nuts, seeds and low fat dairy products should be indorsed for all persons especially those at cancer risk [55]. Results of a study on Spanish Mediterranean type of diet rich in fruits, vegetables, pulses, oily fish benefits in preventing all breast cancer sub-types and chiefly triple-negative tumors [56]. Consumption of fruits containing bioactive protective substances include Mediterranean type of foods which are rich in phenols, organo- sulfur compounds, terpenes and sulforaphane, which are considered preventive measures of cancer.

Many fruits contain phytochemicals which are a good source of anticancer properties. Quercetin, a flavonoid found in a number of fruits exhibit antioxidant and anticancer effects by inhibiting cell proliferation and inducing apoptosis [57]. Dates found mainly in the Middle East and North Africa possess health benefit to inhibit free radicals, and have been said to be anti-inflammatory and cytotoxic on cancer cell lines [58]. Fruits, such as, Pine apple, citrus fruits, papaya, mango and Cape gooseberry have anti-inflammatory and chemo-preventive properties and promote antitumor mechanisms, chiefly in colorectal cancer prevention by regulating cell signaling and or proliferation path-ways [59]. Plums belonging to genus Prunus, consumed as food have several medicinal effects as these are potential sources of polyphenolic and bioactive compounds, carotenoids and a number of organic acids. Consequently plum consumption is

effective in the treatment of some lung and oral cancers [60].

Relationship between the consumption of different plant foods and diminished cancer has been well recognized in several epidemiological research. Amongst these, turmeric (*curcumin longa*) or the golden spice is a well-known constituent within the Indo-Pak sub-continent cooking and Ayurveda holistic medicine approach. The bioactive type of turmeric known as curcumin has been studied widely in vitro and in vivo using a wide range of cancer types [61]. Nano-formulations are also evolving as an effective method strengthening the use of curcumin within cancer environment.

**5.3. Obesity** – is a metabolic disorder that has become despairingly widespread globally. It is now considered a pandemic and has been gradually increasing in the western countries. Excess body fat has been related to cancer progression, which is an avoidable factor for cancer-specific survival related to poor prognosis in cancer patients. Fatness affects the response to cancer treatments such as, immunotherapy and chemo-therapy [62]. Obesity is linked to an increased risk of postoperative difficulties particularly in wound healing complications and infection following ovarian cancer surgery [63]. Active lifestyle and diet-related interferences enhance the overall quality of life and minimize adverse effects after breast cancer treatments [64]. Obesity encourages the frequency and progression of other cancers including breast cancer. It promotes low-grade inflammation, primarily in white adipose tissue, which cause immunological dysfunction characterized by elevated pro-inflammatory cytokine production and diminished T-cell activity [65].

Obesity association's studies have been well known for at least 11 cancer types. Recently Mendelian randomization has provided matching information to traditional approaches, but the validity requires that the genetic instrumental variables be casually related to cancers only mediated by exposure [66]. Obesity is an everyday cause of illness and mortality. A growing body of evidence suggests its role in the beginning and development of various cancers, such as, renal cancer carcinoma. Since tumors require energy for their uncontrolled growth, it seems reasonable that their initiation and progression is related to the dysregulation of cell metabolism. Thus the intake of excessive energy and nutrients may favor various cancer developments [67]. Obese women who develop breast cancer have a deteriorated prognosis with diminished survival rates and increased rate of metastasis with decreased response to endocrine and chemotherapeutic treatments [68].

Obesity is associated with an elevated risk of several cancers. Hyperinsulinemia is posited as a connection between fat and cancer proliferation. There is evidence suggesting a correlation between obesity, diabetes, and proliferative problems associated with thyroid cancer [69]. Fucoxanthin, a dietary carotenoid prevalent in seaweeds and diatoms, exhibits anti-obesity properties by modulating UCP1 levels and lipid metabolism [70]. Given that obesity elevates the risk of cancer, early detection of non-alcoholic fatty liver disease is crucial to impede disease progression and avert serious complications. An inconsistent correlation exists between obesity, as quantified by body mass index (BMI), and several malignancies, including non-small-cell lung cancer. Consequently, the utilization of BMI for assessing adiposity ought to be supplanted by a procedure capable of distinguishing abdominal obesity [72]. The present meta-analysis indicates that elevated BMI in gastric cancer patients correlates with prolonged operational duration and an increased incidence of overall post-operative problems. Gastrectomy is regarded as a secure intervention for this group of patients [73].

In a group study in Korea, metabolic syndrome (a group of risk factors specific for cardiovascular disease) was found to be associated

to an increased risk of gastric cancer in the Korean population. It suggests that it may possibly be an adjustable factor for gastric cancer [74].

**5.4. Smoking** – cigarette smoking and alcohol consumption have been identified as common cause for head and neck cancers. Cessation of cigarette smoking is most common to reduce the risk of head and neck cancers. Noteworthy association was found between awareness on head and neck cancers and some of the socio-demographic characteristics of those who responded to a survey [75]. Passive smoking poses a major burden on population's health and the national economy. This is true for countries with high occurrence of smoking like Jordan where water pipe smoking is common [76]. The risk of death due to lung cancer rises with pack years and reduces with quit - years among Chinese adults. These results suggest that the dose response relative risk of lung cancer deaths related to smoking should be assessed separately [77]. Using opium in addition to smoking cigarettes accounts for a large quantity of cancers in Iran. In order to lessen the cancer threat, prevention policies should aim to diminish the use of both substances through community awareness programs and interventional efforts [78].

Cigarette smoking is the leading cause of mortal cancers, however according to meta-analyses it has a significant inverse association with prostate cancer. It is suggested that this lower risk for smokers might be ascribed to low prostate cancer risk among smokers. Though smokers who develop the disease do have a significantly poor diagnosis [79]. Because of high morbidity and death of patients with bladder, prostate and kidney cancers, these cause a high economic and health care cost. The incidence of these cancers declined in those who stopped smoking and reduced consumption of arsenic free water [80]. Smoking also increases all-cause and cancer death risks in gastric and colorectal cancer patients [81]. Smoking is responsible for poor survival at all stages of kidney cancer. Advance research is warranted to determine the role of various types of stopping tobacco use on kidney cancer survival [82]. Long time tobacco use results in 90% of all lung cancers, which is often diagnosed too late for major risk reduction. Cancer survivors will benefit from tailored smoking stoppage education provided by oncology staff to help stop smoking after the diagnosis of cancer [83]. The percentage of lung cancer is rising among Asian women. The GWAS (genome-wide association study) derived PRS-21 (polygenic risk score) significantly improves the risk stratification and prediction accuracy in never-smoking Asian women [84].

There is a 20% decrease in lung cancer death resulting from screening with a further reduction in mortality from stopping smoking. Those with high nicotine dependence showed most benefits from dual pharmacological therapy [85]. Lung cancer deaths disproportionately affect self-identified Black or African American people chiefly because of their low self-reporting smoking intensity rates [86]. In a study using Arabic frankincense, chewing gum exhibited pro-apoptotic and anti-proliferative actions against cancer-damaged cells [87]. A substantial amount of data indicates that stopping smoking at any time could improve the patient's outcome. Further, smoking cessation is recommended after cancer diagnosis [88]. The problem caused by smoking can be lessened by changing lifestyle and implementing strict laws on smoking by governments and policy makers [89].

**5.5. Environment** - Environmental carcinogens include a variety of factors, such as, indoor and outdoor pollutants including contamination in drinking water and soil. An increased risk of mesothelioma has been noticed among those who are exposed to asbestos. There is strong indication of increased chance of bladder, skin and lung cancers in those consuming water with high arsenic content. Despite the small risk of cancer following exposure to environmental chemicals, the number of those developing cancer is rather high due to the high prevalence of exposure [90].

Besides smoking, radon gas is considered to be a chief cause of lung cancer. Indoor environments, where radon, a naturally occurring decay product of uranium, can accumulate and reach high concentrations are of particular concern for lung cancer formation [91].

Outdoor air pollution significantly contributes to the global disease burden, including cancer. It is estimated that hundreds of thousands of annual lung cancer fatalities are linked to particulate matter (PM) air pollution. Epidemiological evidence regarding outdoor air pollution and its association with other cancer forms, such as bladder or breast cancer, is more constrained [92]. The findings from a meta-analysis indicated that particulate matter (PM) less than 2.5 mm was the prevalent exposure pollutant in 55.5% of cases, whereas lung cancer was the most often examined malignancy in 59% of cases. This data could aid in public cancer prevention and assist stakeholders and policymakers in decision-making [93].

An exceptional nationwide study examined the correlation between cancer mortality, socio-economic issues, and environmental contamination sources in Italy using an artificial intelligence methodology. Cancer mortality exhibits a non-random and non-spatial distribution, exceeding the national norm primarily in areas with elevated environmental pollution, despite the presence of healthy lifestyle practices. The air quality was the most significant factor influencing the average cancer mortality rate, followed by sites designated for reclamation, urban regions, and motor vehicle density [94]. The emerging evidence indicates that exposure to air pollution increases the chance of liver cancer development. Research undertaken in the United States, Taiwan, and Europe demonstrated reliable associations between ambient exposure to air pollutants, particularly PM < 2.5 mm and nitrogen dioxide (NO2), and the risk of liver cancer [95]. The proliferation of organic contaminants, including brominated flame retardants, has intensified the challenges faced by scientific communities. The risk of cancer progression is associated with oxidative stress in the endoplasmic reticulum. A malfunction of antioxidant systems enhances cancer through many pathways, including DNA damage, inflammation, and angiogenesis [96].

Hypoxia has been shown to promote microenvironmental alterations in breast cancer and other solid tumors. Hypoxia-surviving tumor cells are characterized by acquiring more aggressive traits via a cascade of activated signaling pathways. The expression levels of the Rab 11 gene were diminished in breast cancer patients' metastatic axillary lymph nodes relative to the source tumor site [97]. Hypoxia, characterized by low oxygen tension, is a primary factor contributing to tumor aggressiveness, resulting in therapy resistance and metastasis in solid malignancies, including breast cancer, the foremost cause of cancer-related mortality among women [98]. The tumor microenvironment is characterized by low pH, elevated reactive oxygen species, and hypoxia, creating a conducive environment for cancer proliferation. Hypoxia not only enhances tumor angiogenesis and metastasis but also contributes to the development of treatment resistance, which increasingly poses a significant barrier to cancer therapy [99].

Exposure to several factors in adolescents as well as in adults could be linked to the development of testicular cancer. Most likely exposures to environmental and occupational exposures are related to increase or decrease in the testicular cancer risk [100]. Exposure to light at night, for example, has been associated with thyroid cancer. Studies conducted in North China showed positive impact of night light as an air pollutant. The location of the prefecture-level city influenced the spatial pattern of the number of thyroid cancer occurring cases [101]. There is some degree of suggestion that the consumption of antibiotics may essentially alter the human microbiome and thus generate a pre-cancerous

environment promoting the development and growth of cancer [102].

**5.6. Non-Vegetarian foods** - Most non-vegetarian foods have an adverse effect on a variety of cancers. A large amount of colorectal cancers (CRC) can be attributed to a diet low in whole grain and high in processed meat, tobacco use and other factors. Only a small number of cases are caused by inherited genetic characteristics [103]. The CRC has one of the highest rates of recurrence in terms of frequency and death. Inherited, as well as environmental factors are associated with its pathogenesis. Males are associated with a high risk of polyps; alcohol and red and processed meat consumption increases polyps risk [104]. The Western diet with high intake of meat and low fibre is strongly related to CRC. Mycoprotein produced from *Fusarium venanatum* could be a useful alternative to meat in relation to gut health and CRC prevention [105].

Available data shows that the consumption of ultra-processed foods is associated to higher chances of CRC [106]. A study comparing the food intake by medical and non-medical students showed an increased risk developing CRC by students of non-medical universities due to a lack of knowledge of the risk factors [107]. The high consumption of red and processed meat is associated with CRC and overall global deaths. Novel microbiota metabolites are recognized as red meat intake possible biomarkers, suggesting a harmful effect [108]. The International Agency for Research on Cancer has shown, that processed meat plays a vital role in the human diet, but remains a carcinogen. It can significantly change the microbial activity by blocking the body's metabolic pathways [109]. In order to decrease the risk of developing CRC, consumption of unhealthy foods mentioned-above should be avoided.

Diets high in sodium, such as meat products which contain large amount of sodium chloride increase the occurrence of gastric and kidney cancer and other diseases. The focus of industries and researchers should be to decrease the sodium content in foods [110]. Likewise another study suggested to expand research, and assign more commitment and the will to reduce the sodium intake through processed foods and meat by all concerned [111]. Due to the high antioxidant of turkey products enriched with vitamin complex, they should be included in the diet of cancer patients [112]. According to the International Public Opinion Survey on Cancer 2020, about 1 in 3 persons in high income countries did not follow practices to reduce risk factors. On the other hand only 1 in 4 reported being familiar with the fact that consumption of red and processed meat was a cancer causing factor [113]. The undesirable foods intake with less than ideal nutrition leads to breast, ovarian and endometrial cancers and other diseases in women [114]. Based on a meta-analysis, a positive association was found between processed red meat and an increased risk of pancreatic cancer [115].

Based on studies in Asian countries a close positive relationship with cancer was found between processed meat and fish in men and women, and milk, soymilk drinks in men. However, there was no evidence between use of ultra-processed food intake and all cause cancer mortality [116]. Dietary factors are important, as positive relationship has been reported between high intakes of red meat or excessive indulgence in alcohol intake and pancreatic cancer [117]. Somewhat similar results have been found in Brazil where positive association has been found between high consumption of red and processed meat consumption and CRC risk [118]. Another important risk factor is dietary acid load. The average western diet is heavily meat based, which translates into acid burden from the diet. It is due to the high intake of methionine, an acidifying amino acid found in large quantities in animal-based foods [119].

Besides being genetically predisposed, cancer can be modulated by reducing risk factors including eating diversified foods, regular physical activity, avoiding excessive alcohol, processed food consumption and obesity [120]. In spite of the overwhelming reports on the inverse relationship of red meat and processed food, a 6 year meta study is controversial as it reports that intake of these foods has no relationship to pancreatic cancer risk [121].

**5.7. Milk and Food Products Derived from Dairy** - Some dairy products prepared from milk have preventive role in different cancers. Fermented milk has numerous benefits due to the lactic acid bacteria which stops the growth of cancerous cells. Milk curd has been found to lessen the risk of colon cancer [122]. A prospective analyses of associations showed inverse lung cancer risk due to the fermented diary use in a United States population [123]. Fermented milk products from donkey has been used mainly in central Asian as well as in other countries due to its high nutritional properties. The presence of alpha-lactalbumin, a type of protein in the fermented beverages from donkey milk has been reported to be anticancerous [124]. Furthermore, dairy products contain probiotics, which are useful bacteria. Fermented dairy foods have been found to lessen the chance of cancer [125]. In another study, consumption of fermented dairy products was related to diminished cancer relapse and death in breast cancer survivors [126].

A Meta analyses showed that dairy foods such as whey proteins (beta-lactoglobulin, alpha-lactalbumin, serum albumin and lactoferrin), have a protective role in lessening the probability of CRC. Whey proteins have been shown to activate apoptosis and also protect the onset and development of CRC [127]. The large high iron and calcium content in plasma, due to high use of dairy products, is a risk factor for prostate cancer [128]. Consumption of dairy products in combination with fruits and soy products could assist in decreasing the gastric cancer risk [129]. Results from a prospective cohort study showed that milk and/or dairy products consumption more than 5 times a week plus 10 minute duration of meal eating could play a protective role against thyroid cancer [130].

It is important to consider the food source of calcium. In a study calcium intake was not related to high lung cancer risk, but milk due to its high calcium content was found to be a lung cancer risk factor [131]. There is a strong evidence that the relationship between high intake of calcium and cancer was variable. However, it has been found protective against CRC but offered limited protection against breast cancer. With limited available evidence it has been reported that dairy products and high calcium containing foods increase prostate cancer risk [132]. Higher intake of low fat dairy foods pre- and post-diagnosis were related to all cause lower death risk in persons with stage 1 to 3 CRC and also to diminished recurrence risk [133]. A higher intake of low fat dairy products has also been shown to prevent lung cancer [134]. A summary of possible factors affecting cancer occurrence and its preventive measures is given in Table 2.

**Table 2. Factors Affecting Cancer and Preventive Measures**

| Factors Affecting Cancer | Preventive Measures |
|---|---|
| **Ethnicity** – Groups living isolated in an enclave are affected with colon cancer. Race has a significant effect as Black men have higher cancer rates than people of other races. Cultural, sociodemographic, and genetic heterogeneity among the Asians is important in managing metastatic cancer. | For lower socioeconomic groups, there should be availability of housing in areas with better outdoor environment, and various levels of governments should provide improved economic, hospital and financial needs of these people. |
| **Mediterranean (Med)/Veggie diets** - Consumption of such | Med diets prevent cancer because of their anti-oxidant and anti- |

| | |
|---|---|
| diets have mostly positive influence in preventing cancer. Less healthy plant and animal derived foods, processed foods score negatively in preventing cancers. | inflammatory properties. Because of high content of polyphenols, carotenoids, glucosinolates, sulforaphane, and curcumin in these diets exhibit anti-cancer effects by inhibiting proliferation and inducing apoptosis. |
| **Obesity** – Metabolic disorder caused due to obesity, encourages low-grade-inflammation and progression of a variety of cancers. Tumors require energy, for their uncontrollable growth related to dysregulation of cell metabolism, easily available in obese people. | Obesity is an avoidable factor. Active lifestyle and diet related interferences enhance the overall quality of life and minimize the adverse effects of cancer. Controlling or eliminating obesity decreases the risk of diabetes, hyperinsulinemia, and cancer growth. |
| **Smoking** - Cigarette, water pipe smoking, and opium use are common risk factors for head and neck cancers, in countries where people inhale these products on a large scale. Long-term tobacco use results in lung cancer, a leading cause of cancer world-wide. High morbidity and death in long term smokers is responsible for prostate, bladder and kidney cancers resulting in large economic and health care costs. | In order to reduce the cancer burden, prevention policies should be directed to diminish or eliminate the use of tobacco and smoking through community awareness campaign and interventional efforts. It can also be reduced by altering the lifestyle and applying strict laws on smoking by governments and policy makers. |
| **Environmen**t – Pollutants and contaminants are the chief causes of cancer, such as lung cancer. Increased risk of bladder, skin and lung cancer in those drinking high arsenic containing water. Radon gas and < 2.5 mm particulate matter are of concern for lung cancer. Hypoxia (low oxygen, pH and high reactive oxygen) leads to breast and solid tumors. Exposure to night light has been found to be associated with thyroid cancer. | Breathing indoor and outdoor pollutants, contaminants from filthy air and impure water and exposure to night light should be avoided. Various level of governments and society should take strict measures to inform the public about the environmental cancer risk factors. |
| **Non-veggie Foods** – CRC can be attributed to red meat and ultra-foods intake. Consuming high meat diets, which contain large amount of sodium increase gastric and kidney cancers. Diets high in acidifying amino acid methionine which is very high in meats translates in acid burden a cause of numerous of disorders. | Processed and red meat intake should be substantially reduced and substituted with small amount of lean meat. Notably, public should be familiarized with carcinogenic foods which should be avoided and/or greatly reduced. |
| **Meat and Foods Derived from dairy** – Consuming dairy foods generally does not cause cancer. Foods containing high amount of calcium do have some negative role. With limited available information, dairy products intake with high calcium does increase prostate and lung cancer risk. | Fermented milk due to its lactic acid bacteria inhibits cancer cells growth. Milk curd reduces colon cancer risk. Fermented products intake from donkey's milk, due to its alpha-lacatlbumin content, is reported to be anti-cancerous and associated with weakened cancer relapse and death in breast cancer survivors. |

## 6. Cancer Prevention Measures

**6.1. Natural Dietary Preventive Measures** - Curcumin exhibits significant anti-inflammatory and anti-cancer properties by modulating DNA methylation, histone modification, and associated signaling pathways [35]. Consumption of vegetables, unprocessed grains, fish products, and

fermented foods is linked to a reduced chance of cancer. Conversely, both raw and processed red meats, as well as refined meals, are associated with an elevated risk of cancer. The use of fermented foods may diminish cancer risk and enhance health status in conjunction with other factors, including genetics and a healthy lifestyle [39]. Nine functional components i.e. carotenoids, indole-3-carbinol, Vitamin E, squalene, glucoraphanin, sterols, ferulic acid, flavonoids and phospholipids exhibit therapeutic qualities, including anti-cancer effects, either in their native forms or as derivatives [135]. Recent investigations demonstrate that the acetone-water extract of the Neem (*Azadirachta indica*) plant inhibits the cyto-adherence of cancer cells during metastasis and obstructs HIV from infiltrating bigger T lymphocytes [136]. Proper nutrition is essential for the growth and development of children and adolescents. For the latter, an effective preventive measure for a nutritious meal is to allocate half of the plate to fruits and vegetables, while the other half should comprise whole grain cereals, lean meats, and fat-free or low-fat dairy products [137]. This is referred to as the MyPlate diet, which emphasizes the consumption of fruits and vegetables and represents the five dietary groups. 1. Fruits 2. Vegetables 3. Low-fat dairy 4. Whole grains 5. Lean meats. Legumes, nuts, eggs, and tofu are also recommended in a balanced diet according to a guidance released by the United States Department of Agriculture's Center for Nutrition Policy and Promotion. The ingestion of soy products or fruits is associated with a reduced risk of stomach cancer. A balanced consumption of these meals may mitigate its risk [129].

**6.2. Treatment Measures Using Drugs, Surgery, Chemo, and Radiation Therapy** [138] Surgery, chemotherapy and radiation therapy have been used to treat cancer patients for many decades. Drugs like imatinib (Gleevec) and tarstuzumab (Herceptin), which emerged in the 2000s are used to kill cancer cells and have become standard treatment for many cancers. These have been followed by immunotherapy over the past decade; such therapies reinforce the immune system to attack tumors by shrinking and eradicating them. Immune checkpoint inhibitors known as drugs are now in use to treat melanoma, lung, kidney, bladder and lymphoma. Most recently, since 2017 CAR (Chimeric antigen receptors) T-cell therapy has been approved, which has the ability to eradicate leukemias and lymphomas. In this therapy, T-cells are extracted from the patient's blood and modified in the laboratory by including a gene for a receptor known as CAR. It facilitates the binding of T cells to a specific cancer cell antigen, leading to the destruction of cancer cells, after which the CAR cells are reintroduced to the patient. The immune system requires appropriate receptors to bind to antigens and eliminate cancer cells [138].

## SUMMARY OF RECOMMENDATIONS

A vegetarian diet may result in increased consumption of some vitamins and minerals; nevertheless, it can also cause deficiencies in iron, calcium, and total proteins, thereby impacting genomic stability and inducing oxidative stress [139]. To implement the proposed integrated nutrition and exercise therapy into standard care, it is essential to ensure countrywide access to multidisciplinary nutrition teams and tailored exercise therapy programs for cancer patients [140]. Recent advancements in immune control have revolutionized cancer treatment through the development of T-cell-targeted immune checkpoint inhibitors, enabling T cells to eliminate cancer cells. This immunotherapy has provided a more comprehensive understanding of cancer, focusing not only on the cancer cells to be targeted and eradicated but also on the immune microenvironment around these cells [141]. A substantial consumption of soy, dairy products, or fruits correlates with a diminished risk of stomach cancer. Factors strongly associated with an elevated risk of many malignancies include overnutrition, obesity, alcohol consumption, salt intake, and the consumption of red and processed

meats. However, characteristics strongly associated with a reduced risk include veggies, whole grain meals, fiber, dairy, calcium, and coffee [142]. A recent study published in 2024 indicated that the decreasing incidence of lung, colorectal, and prostate cancers is attributable to the efficacy of early detection programs and screening initiatives. Lung cancer rates are anticipated to persist as the most often diagnosed and prevalent cause of mortality. Nonetheless, the rates are decreasing as a result of tobacco regulation, earlier diagnosis, and enhanced therapies [143].

## CONCLUSIONS

The interplay between nutritional and lifestyle factors in cancer prevention is both complex and significant. The evidence compiled in this manuscript underscores the critical role of diet, physical activity, and avoidance of known carcinogens, such as, tobacco and excessive alcohol in reducing the risk of major cancer types. Adopting a Mediterranean or plant-based diet, rich in anti-oxidants, fibre, and healthy fats, has been consistently linked to a lower risk to a lower incidence of various cancers. Conversely obesity, sedentary behavior, and consumption of processed and red meats remain substantial risk factors. Furthermore, socioeconomic disparities and access to healthcare play crucial roles in the early detection and prevention of cancers, emphasizing the need for public health initiatives that target at-risk populations. Ultimately, a holistic approach that integrates dietary modifications, lifestyle changes, and equitable healthcare access is essential in mitigating the global burden of cancer. Continued research and public health efforts are vital to further refine these strategies and improve outcomes for populations world-wide.

## List of Abbreviations

DNA – deoxyribonucleic acid
BMI – body mass index
CRC – colorectal cancer
PM – particulate matter
CAR – chimeric antigen receptors

**Conflict of Interest** -None

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