
5. Environmental Factors Causing Cancer

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Abstract

All cancers occur as a result of changes that have risen in the DNA sequence of the cancer cells. Environmental exposures account for a huge proportion of cancer burden. According to present state of information, 80–90% of cancers are caused by external environmental factors called carcinogens. Environmental carcinogens include outdoor and indoor air pollutants, soil and drinking water contaminants etc. Epidemiological studies have showed that the chief factor accountable for the advances of cancers among humans are environmental factors occurs as a result of human behavior. It has been confirmed that the lifestyle factors such as nutrition, physical activity, tobacco and alcohol use, reproductive behavior etc. and naturally occurring exposures (ultraviolet light, infectious agents), pollution, workplace and household exposures are important for the development of cancer in the human population. Several factors influence the development of cancer in each individual, with the duration and amount of the exposure and the person's genetic background. Knowledge about the intricacy of cancer and its connection to environmental exposures continues to grow, but researchers face many challenges. This chapter focused on the systematization of knowledge concerning the risk factors of cancers and to move toward greater opportunities for prevention.

Keywords: *Cancers, Environmental carcinogens, Genetic background, Nutrition, Tobacco.*

5.1 Introduction:

According to World Health organization's report Cancer is the second leading cause of death globally, accounting for an estimated 9.6 million deaths, or one in six deaths. Lung, prostate, colorectal, stomach and liver cancer are the most common types of cancer in men, while breast, colorectal, lung, cervical and thyroid cancer are the most common among women.

India ranks third among nations in terms of highest number of cancers. Over 13 lakh people in India suffer from cancers every year, as per the National Cancer Registry Program report. The environmental contribution to cancer has been recognized for centuries.

In 1775, Dr. Percival Pott observed that the incidence of increased scrotal cancer among chimney sweeps, which was recognized that frequent contact to soot. Later, due to their occupational exposure a surge of skin cancers was reported in coal tar workers. In the 20th century, these annotations were experimentally confirmed by Yamagiwa and Ichikawa (Luch, 2005, Harvey, 2011).

Carcinogens are agents that cause cancer. Carcinogens can be divided into agents that are chemical, physical or biological in nature. About 60–90% of all cancers are currently assumed to be due to environmental factors. It is essential to mention that ‘environmental factors’ consist of both natural and human-made substances. Sedentary lifestyles, increase in urban pollution, in addition to rise in obesity, tobacco and alcohol consumption, are said to be the reasons behind the rise. Other factors include exposure to certain hormones, medical drugs, viruses, radiation, bacteria, and the chemicals that may be present in the water, air, food, and workplace. Diverse environmental exposures are connected to specific kinds of cancer. Contact to asbestos is mainly associated to lung cancer, although exposure a chemical found in certain dyes (benzidine), is linked with bladder cancer. Smoking is associated to cancers of the lung, mouth, throat, voice box, colon, kidney, bladder, oesophagus, liver, and pancreas.

This chapter addresses about the connection between the environment and cancer. It contains information about which type of environmental agent that can cause cancer and create awareness.

Substances in the Environment That Are Known To Cause Cancer in Humans:

The International Agency for Research on Cancer (IARC) upholds a registry of human carcinogens and suspected human carcinogens. This registry has been developed on the base of epidemiological studies on humans and other animal model studies. Further, the National Toxicology Program (NTP) conducts animal studies for long-term cancer studies of suspected chemicals. The number of compounds that are or possibly will be carcinogens is broad. Conversely, these chemicals can be divided into different classes, comprising heterocyclic amines or aromatic amines (HAs), polycyclic aromatic hydrocarbons (PAHs), mycotoxins, metals and fibres (notably asbestos), alkylating agents and other chemical mixtures such as tobacco smoke, certain anticancer drugs, warfare agents and oxidizing agents (Edward L Loechler, 2002) but all these broadly fall into one of the three categories according to the composition i) physical, ii) chemical and iii) biological agents.

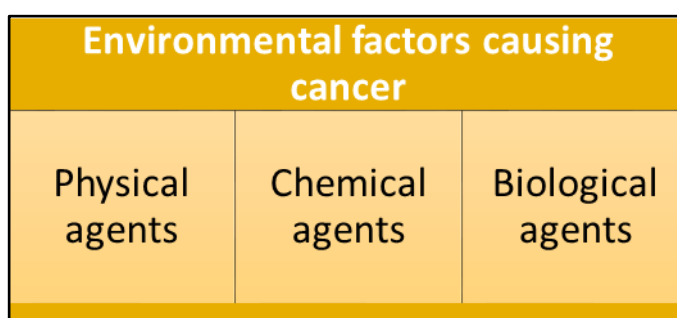


Figure 5.1: Environmental Factors Causing Cancer

5.2 Physical Carcinogens:

The term physical carcinogen includes several types of radiation (e.g., ultraviolet and ionizing radiation).

5.2.1 Ionizing Radiation:

Ionizing radiation is undetectable and they are high-frequency radiation that can damage the DNA and cause mutations. In certain medical procedures people are exposed to some radiations that may cause cancer later or they are increased risk of getting cancer. For example, persons who have treated with radioactivity in childhood to treat acne and other conditions have been revealed to be at greater risk for thyroid cancer and other tumours of the head and neck (Little, 2000).

5.2.2 UV Radiations:

The occurrence of skin cancers such as basal-cell carcinoma, melanoma and squamous-cell carcinoma has increased dramatically in recent years. Most skin cancers rise because of contact to solar radiation. UV radiation cause an adverse reaction in skin. UV radiation in the range 100- to 400-nm seems to be causative. UV radiation in three regions of wavelength UVA (315 to 400 nm), UVB (280 to 315 nm) and UVC (100 to 280 nm) exposure can cause cancer therefore excess contact to any of the UV radiation is considered unsafe (de Laat et al., 1996; Anderson and Parrish, 1981)

5.3 Chemical Carcinogens:

Most of the carcinogens can be categorized as chemical carcinogens. As examples, hormones, heavy metals, organic combustion products, toxins, tobacco, pesticides and fibers etc., are considered to be chemical carcinogens.

5.3.1 Tobacco:

Tobacco use remains the topmost important and preventable factor responsible for cancer risk. Smoking is predicted to contribute to around 30% of all cancer deaths. Cigarette, chewing tobacco, cigar, snuff, pipe smoking and exposure to environmental tobacco smoke (ETS or second-hand smoke) are altogether associated to increased cancer risks (Hecht, 2011). Smoking have been linked with cancers of the mouth, throat, lung, nasal cavity, bladder, liver, colon, kidney, stomach, cervix, and with leukemia. Second-hand smoke has been associated with lung cancer.

5.3.2 Diet:

The effects of food on cancer threat have been attributed together to dietetic chemical constituents and to total energy consumption. Nearly 14% to 30% of cancer deaths have been attributed to physical inactivity, diet and obesity. Several studies illustrated that heavy intake of red, preserved and processed meats, salt-preserved foods, alcoholic, carbonated beverages and salt probably surge the risk of stomach cancers.

Physical inactivity and obese seems to be one of the most significant changeable causes of cancer. Raised steroid hormone synthesis in adipose tissue is the basis for obesity-induced endometrial and breast cancers (Hursting et al, 2012).

5.3.3 Polycyclic Aromatic Hydrocarbons:

Polycyclic aromatic hydrocarbons (PAHs) are a various group of intensively studied organic compounds containing benzo[a]pyrene. PAHs are formed during incineration of organic matter like coal and mineral oil. PAH exposure happens in the form of coal tar, automobile exhaust, soot, charred food products and cigarette smoke. PAH contact is associated in humans with skin, lung, and types of cancers (Rubin, 2001).

5.3.4 Pesticides:

Most of these pesticides are carcinogens. Amitrole, ethylene oxide, chlorophenoxy herbicides, DDT, hexachlorobenzene, dimethylhydrazine, chlordecone, lead acetate, lindane, nitrofen, and toxaphene are some of the known pesticides act as carcinogens. Several studies revealed that people with high exposures to pesticides, for example farmers, crop duster pilots, pesticide applicators, and manufacturers have found high rates of lung, brain, blood and lymphatic system cancers.

5.3.5 Solvents:

Several solvents used in paint, paint thinners and grease removers are known or assumed of being cancer-causing. These include carbon tetrachloride, benzene, chloroform, dichloromethane, tetra and trichloroethylene.

Benzene has a widespread use as solvent in the chemical and drug industry and it is identified to cause leukaemia in humans. Inhaling polluted air is the chief method of exposure (McHale et al., 2012).

5.3.6 Dioxins:

Dioxins are undesirable by-products of biochemical processes that comprise chlorine and hydrocarbons. They are the widespread environmental pollutant. There are not less than 100 different types of dioxins are available.

They are manufactured by bleaching of paper and pulp; incineration of municipal solid waste, toxic, and hospital wastes. They are also found as a pollutant in some herbicides, insecticides, pesticides and wood preservatives. They can enter in or body easily and accumulate in fats and degrade slowly. A particular dioxin that is likely to link with cervical cancer in women because of the presence of dioxin in sanitary napkins.

5.3.7 Asbestos:

Exposure to asbestos, which is found most often in the construction and shipbuilding industries, has been linked to lung cancer and mesothelioma. Asbestos fibers are released into the environment from roofing, electrical and thermal insulation; cement pipe and sheet; plastics, flooring, textile and paper products.

5.3.8 Medical Drugs:

The drugs that are used as immunosuppressant's, such as cyclosporine and azathioprine are related with increased cancer risks, Estrogens used to treat symptoms of certain gynaecological conditions and menopause shown to rise the occurrence of endometrial cancer and breast cancer. In addition, Progesterone along with estragon increased the risks of breast cancer and blood clots (Dunn et al., 2005; Parnes et al., 2005). Diethylstilbestrol (DES) during prenatal period may have a higher possibility for developing breast cancer and DES before birth have a greater chance of developing an unusual kind of cervical and vaginal cancer.

5.3.9 Aflatoxin:

Aflatoxin is the most potent liver carcinogen produced by fungi. Several types of aflatoxins are produced by *Aspergillus* mold species, such as *Aspergillus flavus* and *Aspergillus parasiticus*. Exposure to aflatoxins arises via ingestion of contaminated nuts and grain (Groopman and Wogan, 2011).

5.3.10 Cadmium:

Cadmium is a heavy metal present in water, soil and air. Occupational contacts to cadmium occur through the manufacture of pigments, nickel-cadmium batteries, plastic stabilizers, electroplating processes, electronic waste recycling, metal smelting, and also cigarette smoking. Cadmium exposure has been associated to human lung cancer (Joseph, 2009).

5.4 Biological Carcinogens:

A biological carcinogen is a term used to designate any biological substance that is directly or indirectly involved in the development of cancer. About 20% of human cancers are associated with infectious agents including bacteria, parasites, and viruses. According to the IARC Monograph, 11 biological agents are considered to be carcinogenic to humans. These biological agents include seven viruses, three worms, and one bacterium (European Agency for Safety and Health at work, 2003). In 2012, 15.4% of cancers (2.2 million) are caused by viruses (9.97%), bacteria (5.5%), and helminths (0.06%). The major contributing infectious agents are *Helicobacter pylori* (770,000 cases), human papillomavirus (HPV) (640,000), hepatitis B virus (HBV) (420,000), hepatitis C virus (HCV) (170,000), and Epstein Barr virus (EBV) (120,000) (Parkin, 2006). Other important infectious agents are Kaposi sarcoma herpesvirus (KSHV), human T-cell lymphotropic virus type-1 (HTLV-1), human immunodeficiency virus-1 (HIV-1), *Opisthorchis viverrini*, *Clonorchis sinensis*, and *Schistosoma haematobium* (Das et al., 2020).

5.5 Conclusion:

Cancer is a multifarious genetic illness as a consequence of environmental contacts which serve as the chief force in the beginning of tumours development and progression. The carcinogens play a major role in either establishing or promoting the phases of carcinogenesis.

Numerous components influence whether a person contacted to a carcinogen will develop cancer, comprising the amount and length of the exposure and the person's genetic background. Understanding the carcinogens and their mode of action are very important for the prevention and treatment. The best way to escape from getting cancer is to implement a healthy lifestyle and decrease exposure to harmful environmental factors which are known to cause cancer as much as possible.

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