Cancer Prevention through Lifestyle Intervention and Public Health Strategies

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Abstract

Cancer remains one of the leading causes of morbidity and mortality worldwide. Although therapeutic advances have significantly improved survival outcomes, a substantial proportion of cancers arise from preventable lifestyle and environmental factors. Evidence indicates that nearly 70% of cancers are associated with modifiable behaviours such as tobacco use, alcohol consumption, unhealthy dietary patterns, obesity, physical inactivity, infections, and environmental exposures. This review provides a comprehensive analysis of lifestyle related carcinogenic exposures, underlying biological mechanisms, epidemiological evidence, and public health interventions aimed at reducing cancer risk. The paper synthesizes findings from toxicological studies, epidemiological investigations, mechanistic research, and policy level strategies. Emphasis is placed on primary prevention through behavioural modification, population level interventions, and early life education. Strengthening lifestyle based prevention strategies represents one of the most effective, affordable, and scalable approaches for reducing global cancer burden.

Keywords: Cancer prevention, lifestyle intervention, tobacco, alcohol, obesity, diet, physical activity, ultraviolet radiation, public health, environmental exposure.

1. Introduction

Cancer is still one of the main reasons for illness and death worldwide, with millions of new cases occurring every year in different populations (Bray et al, 2024; Sung et al, 2021). The global cancer load is expected to keep rising due to a combination of factors such as population growth, increasing age, urbanization, and changing lifestyle habits (Bray et al, 2024; Sung et al, 2021). In the last few decades, there have been major improvements in the way cancer is treated, including surgery chemotherapy radiation therapy, targeted therapy, and immunotherapy. These advancements have led to better survival rates for many types of cancers; however, they have not made a major impact on the overall number of new cancer cases at the population level (Oluwajembola et al, 2025; Bray et al, 2024).

Most cancers are related to lifestyle and environmental factors that can be changed. Studies indicate that as much as seventy percent of cancers could be linked to preventable risk factors such as smoking, drinking alcohol, poor diet, obesity, and physical inactivity (Nandakumar et al, 2025; Islami et al, 2018; Schüz et al, 2015). This underscores the need for primary prevention measures besides therapeutic innovation. Tobacco is still the number one preventable cause of cancer worldwide and has a very strong link to lung cancer, head and neck cancer, bladder cancer, pancreas cancer, and a few other organs (Hecht et al, 2002;

Secretan et al, 2009). Drinking alcohol is also a major factor that leads to several types of cancers, especially those of the mouth esophagus liver, and breast (Larsson et al, 2020; Boffetta et al, 2006; Rehm et al, 2019).

Obesity and excess body weight are increasingly being pinpointed as important factors that could lead to cancer through mechanisms related to chronic inflammation, hormonal imbalance, and metabolic dysregulation (Friedenreich et al, 2021; Lauby-Secretan et al, 2016). Besides, dietary habits and lack of exercise may also affect cancer risk by changing insulin signaling, oxidative stress, and immune system function (Key et al, 2020; Friedenreich et al, 2021). Alongside these, UV radiation exposure and certain occupational or environmental exposures like radiofrequency electromagnetic fields have also been studied for their possible contribution to the development of cancer (Stang et al, 2001; Karipidis et al, 2007; Armstrong et al, 2001). Thus, a thorough understanding of cancer prevention by lifestyle changes necessitates the combination of epidemiological evidence, mechanistic understanding, and public health policies. Enhancing lifestyle based cancer prevention efforts is one of the most economical and largest potential ways to reduce the worldwide cancer burden (Nandakumar et al, 2025; Islami et al, 2018; Schüz et al, 2015).

2. Carcinogenic Lifestyle Exposures

2.1. Tobacco Exposure

Tobacco is the main cause of cancer that can be prevented, and the list of cancers that tobacco is strongly linked to includes lung, oral cavity, head and neck bladder pancreas kidney stomach, and colon (Hecht et al, 2002; Secretan et al, 2009; Islami et al, 2018). Tobacco smoke is a complex mixture of thousands of chemicals, many of which are carcinogens such as nitrosamines, polycyclic aromatic hydrocarbons, volatile organic compounds, and heavy metals (Li et al, 2022; Secretan et al, 2009). These substances directly interact with and damage DNA, create DNA adducts, and lead to mutations of major regulatory genes controlling cell division and DNA repair (Hecht et al, 2002; Li et al, 2022). Tobacco use also causes continuous inflammation, and production of free radicals (oxidative stress) contributes to progression of genetic instability (Caliri et al, 2021).

Extensive epidemiological research is consistent with significant causal relationships between smoking and various cancer types, such as lung bladder pancreatic, kidney, and gastrointestinal cancers (Secretan et al, 2009; Larsson et al, 2020). Based on ample human evidence, the International Agency for Research on Cancer classifies tobacco and tobacco smoke as Group 1 carcinogens (International Agency for Research on Cancer, 2012). At the population level, measures like taxation, advertising restrictions, smoking bans, and cessation programs are deeply involved in the efforts to significantly reduce the tobacco, related cancer burden (Nandakumar et al, 2025; Islami et al, 2018; Schüz et al, 2015).

2.2. Alcohol Consumption

One of the well, known factors that contribute to the development of cancer is the consumption of alcohol. It has been proven that consuming alcohol increases the chance of getting oral pharynx esophagus liver stomach, and breast cancers (Larsson et al, 2020;

Boffetta et al, 2006; Rehm et al, 2019). Researchers found that even small amounts of alcohol lead to increased risk of cancer when they looked at different populations (Larsson et al, 2020; Rehm et al, 2019). The main reason why alcohol causes cancer is because it is metabolized in the liver into acetaldehyde, which is a cancer, causing substance that causes DNA damage and inhibits the repair processes. Besides, alcohol helps increase the production of free radicals and changes hormone levels, especially estrogen, which could explain the link to the development of breast cancer (Boffetta et al, 2006; Rehm et al, 2019).

Drinking alcohol and smoking together can lead to a dramatic increase in the risk of developing cancers of head and neck because of the synergistic effect of two substances biologically (Secretan et al, 2009; Jethwa et al, 2017). Healthcare policies like imposing taxes on alcohol, limiting advertising, and running educational campaigns are some effective tactics that can be implemented to minimize the cancer cases caused by alcohol consumption on the large scale (Islami et al, 2018; Schüz et al, 2015).

2.3 Ultraviolet Radiation

UV radiation from sunlight is a significant environmental factor in the development of skin cancers, both melanoma and non, melanoma types, as is well documented in the literature (Armstrong et al, 2001). Further, continuous and repeated exposure to sunlight leads to cumulative DNA damage in skin cells. UV radiation causes DNA mutations directly and also produces a lot of reactive oxygen species, which besides damaging DNA also cause oxidative stress and can make the cells genomically unstable (Armstrong et al, 2001). So, these molecular changes, if they happen repeatedly, may lead to the cells becoming cancerous.

Epidemiological studies have been very consistent in showing that people who are overexposed to sun and do not take protective measures often develop skin cancer at a higher rate (Armstrong et al, 2001). Post, exposure protective measures and lifestyle alterations are: staying indoors during the middle of the day, covering oneself with appropriate clothing and consistently reapplying sunscreen. Sharing and increasing awareness through public education campaigns are always the backbone of any successful plan to aid people to understand the ultraviolet related cancer risks and prevention (Schüz et al, 2015).

2.4. Obesity and Metabolic Dysregulation

Research shows that UV exposure from the sun is a chief cause of skin cancer, including pigment, cancer and non, pigment, cancer types (Armstrong et al, 2001). DNA in skin cells becomes damaged by sun exposure. The longer and more frequent the exposure, the more damage is accumulated. Besides causing DNA mutations directly, UV radiation also causes the production of reactive oxygen species, which lead to oxidative stress and the damaging of genomic DNA (Armstrong et al, 2001). When subjected to these molecular changes for a long enough period, cells can become cancerous.

Most epidemiological research has found that the incidence of skin carcinoma is significantly higher among human groups that have excessive sunlight exposure and fail to adopt appropriate protective measures (Armstrong et al, 2001). The best form of defense is to

avoid exposure during the time of the highest sun intensity, wear protective clothing and use sun screen. Public health campaigns are very effective at promoting behaviors that reduce UV, related cancer risk (Schüz et al, 2015).

2.5. Diet and nutritional habits

Diet is one of the major factors responsible for cancer prevention. Consumption of processed meat, red meat, refined sugars, and saturated fats has been linked to an increased risk of colorectal and other cancers (Key et al, 2020; Bray et al, 2024). Such diets enhance inflammation, oxidative stress, and metabolic dysregulation. On the other hand, diets high in fruits vegetables whole grains, legumes, and fibers offer protective antioxidants and bioactive compounds capable of repairing DNA and boosting immune function (World Cancer Research Fund International, 2018; Key et al, 2020).

Besides, fiber is a key nutrient that can help lower colorectal cancer risk. At the population level, evidence indicates that healthy dietary patterns can reduce the overall cancer burden (Islami et al, 2018; World Cancer Research Fund International, 2018). Therefore, public health programs aimed at promoting healthy nutrition are a major part of prevention strategies. Table 1 shows examples of researches on tobacco exposure, radiofrequency electromagnetic fields, and ultraviolet radiation.

Table 1. Representative studies on carcinogenic exposures: tobacco, radiofrequency electromagnetic fields, and ultraviolet radiation.

Author, Year	Design and sample	Exposure Type	Main Findings
Li and Hecht, 2022	Comprehensive toxicological review	Tobacco smoke constituents	Identified more than seventy-nine carcinogens in tobacco; mechanistic evidence linking nitrosamines, PAHs, VOCs, cadmium to multiple cancers
Larsson et al., 2020	Mendelian randomization study	Smoking, alcohol	Strong causal association with lung, bladder, kidney, gastrointestinal, pancreatic, liver cancers
Secretan et al., 2009	Systematic review	Tobacco, environmental exposures	Classified tobacco and tobacco smoke as Group 1 carcinogens

Wei et al., 2009	In vitro study	Tobacco specific carcinogen NNK	Increased colon cancer cell migration; mechanistic evidence for metastasis
Hecht, 2002	Mechanistic review with human biomarker evidence	Tobacco derived carcinogens	Demonstrated metabolic activation of PAHs in breast tissue
Jethwa and Khariwala, 2017	Clinical epidemiology review	Tobacco alone or with alcohol	Significant proportion of head and neck cancers attributable to tobacco and alcohol
Caliri et al., 2021	Mechanistic review	Tobacco induced oxidative stress	Reactive oxygen species driven macromolecular damage central to carcinogenesis
Stang et al., 2001	Case control study	Occupational RF exposure	Increased risk of uveal melanoma in exposed workers
Karipidis et al., 2007	Case control study	Occupational RF exposure	Possible increase in glioma risk among exposed individuals

3. Public Health and Preventive Strategies

3.1 Tobacco control

Smoking remains the most spectacular cancer risk factor that the elimination of smoking would be the major point in a strategy to reduce the cancer deaths effectively. There is a number of effective measures implemented in the tobacco control which, when combined together, contribute to a considerable reduction in cigarette consumption at the population level (Nandakumar et al, 2025; Islami et al, 2018; Schüz et al, 2015).

Helping smokers quit is beyond doubt the best prevention as quitting not only prevents the smokers from getting new cancer but also lowers the risk of death from cancer in the already diagnosed. Experts recommend combining behavioral therapy along with medications as vidence shows these are the most effective methods in helping smokers quit (Nandakumar et al, 2025; Islami et al, 2018). The combination of the entire set of tobacco control policies including legislative actions, public awareness programs and healthcare based interventions are proven to be the most logically and effectively able to reduce the incidence of tobacco related cancers permanently (Islami et al, 2018; Schüz et al, 2015).

3.2 Alcohol Regulations

Policy changes are necessary to alter patterns of alcohol consumption at the population level, which then risk todevelop several types of cancers attributable to alcohol such as the aforementioned oral cavity, esophagus, and liver. Measures that can be implemented include raising excise duty, curtailing advertisement, restricting availability, and strict imposition of minimum drinking age laws which consideration of different country by country may affect the level of alcohol consumption and the subsequent risk of cancer (Larsson et al, 2020; Schüz et al, 2015; Rehm et al, 2019).

3.3 Promotion of Healthy Diet

Promoting healthy eating habits is a key aspect of cancer prevention. Initiatives aimed at the public health level that focus on increasing the consumption of fruits vegetables whole grains, and fiber, while decreasing the intake of processed foods and red meat, are linked with a lowered risk of cancer (World Cancer Research Fund International, 2018; Key et al, 2020; Bray et al, 2024). Dietary guidance programs, effective food labeling systems, and the control of processed food advertising would enable individuals to choose their diet wisely (World Cancer Research Fund International, 2018; Schüz et al, 2015). Changes in the diet at the level of the community decrease inflammation, enhance metabolic health, and lead to an overall decrease in cancers related to lifestyle (Islami et al, 2018; Key et al, 2020).

3.4 Encouraging Physical Activity

Engaging in physical activity on a regular basis helps lower the risk of developing cancer, especially breast and colorectal cancers. Studies at the community level demonstrate that physical activity is increased, obesity is decreased, insulin sensitivity is improved, and inflammation is lowered, all of which are factors that aid in cancer prevention (Friedenreich et al, 2021; Lauby-Secretan et al, 2016). Public health measures such as city designs that make it easier for people to walk and cycle, programs promoting health in the workplace, and physical education in schools are examples of how to encourage active ways of living (Friedenreich et al, 2021; Schüz et al, 2015). Persistent promotion of moderate physical activity among all age groups is a step towards the long, term reduction of the cancer burden related to lifestyle (Islami et al, 2018; Friedenreich et al, 2021).

4. Conclusion

Changing lifestyle to prevent cancer is still among the most efficient ways to lower the load of cancer worldwide. Nearly half of all cancers can be traced back to those same actions that are modifiable behaviors, such as tobacco use, alcohol drinking, bad diet, being overweight, lack of exercise, and exposure to the environment (Nandakumar et al, 2025; Islami et al, 2018; Schüz et al, 2015).

Research shows that these lifestyle choices affect the body in several ways that can lead to cancer including chronic inflammation, production of harmful free radicals, hormonal changes, and disrupted metabolism (Hecht et al, 2002; Friedenreich et al, 2021; Lauby-Secretan et al, 2016). Preventing these through lifestyle changes not only reduces cancer risk but also helps in overall health maintenance. Effective public health regulations,

education from a young age, vaccination programs, and availability of health prevention services are necessary for lasting effects (Nandakumar et al, 2025; Schüz et al, 2015). Although modern therapies have significantly increased survival rates, preventing cancer is the healthiest, most cost, effective, and fair strategy for cancer control in the long run (Islami et al, 2018; Bray et al, 2024).

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