



## What is the Impact of Lifestyle on the Incidence of Cancer?

AR Carmichael<sup>1\*</sup>, Kefah Mokbel<sup>2</sup> and Zartasht Sami Carmichael<sup>3</sup>

<sup>1</sup>Consultant Breast Surgeon, The London Breast Institute, The Princess Grace Hospital, London

<sup>2</sup>Lead Breast Surgeon at The London Breast Institute of The Princess Grace Hospital, Reader in Breast Surgery London, UK

<sup>3</sup>University of Birmingham, Edgbaston, Birmingham

In the year 2012, more than 14 million people were diagnosed with cancer and 8.2 million people died of cancer worldwide [1]. With the number of cancer cases increasing worldwide; it is important to decipher the role that lifestyle plays in the development of this disease. It has been estimated that around 42% of cancer cases each year in the UK are linked to 14 major lifestyle habits and other factors [2]. There are multiple internal and external factors related to lifestyle that can lead to cancer including tobacco smoke, UV and ionising radiation, occupational exposure to harmful chemical and biological substances, alcohol, obesity and lack of physical activity.

Tobacco smoke accounts for over a quarter of all cancer related deaths in the UK accounting for 23% of cancers in men and 16% of cancer in women and it can also be linked to at least 14 different types of cancer [3]. Cigarette smoking alone caused nearly 9 out of 10 lung cancer cases reported in the US [4]. Tobacco smoke that is generated by smoking has been reported to contain more than 60 carcinogens [5]. The commonly found carcinogens in tobacco smoke include well-known agents such as benzene, polonium-210, benzo(a)pyrene and nitrosamines; these compounds induce DNA damage ultimately leading to cancer. In addition, each cigarette contains compounds that can enhance the carcinogenic effects of tobacco smoke such as the metal Chromium. Chromium causes benzo(a) pyrene to stick more readily to DNA thus increasing the likelihood of DNA damage; Arsenic gas contained within the tobacco smoke can damage the DNA repair system; Benzene which is well known to cause leukaemia based cancers where the average smoker inhales about 10 times more Benzene than a non-smoker [6]. Studies have shown that benzo(a)pyrene can cause G to T base transversion mutations within the p53 gene that ultimately contributes to the development of lung Cancer [7]. It has been reported that benzo(a)pyrene alone increases the risk of G to T transversions within the 248 and 273 codons by 18%! [8]. This transversion mutation turns off the tumour suppressor gene allowing cells to grow and divide uncontrollably - leading to malignant transformation.

It is important to recognise that tobacco smoke does not only predispose to lung cancer but also to cancers of the larynx, oesophagus, oral cavity and pharynx, bladder, kidney, pancreas, liver, stomach, bowel, cervix and ovaries. Tobacco smoke contains many harmful toxins that prevent effective cleaning of the body surfaces and cavities. For example, formaldehyde and acrolein kill cilia cells preventing the removal of waste and other toxic products from the airways. This leads to accumulation of toxic waste in the airways exposing the lining of the airways to both carcinogens and toxins contained within tobacco smoke. Polonium-210 can deposit in the airways of smokers emitting alpha-radiation, this exposes the cells to a higher amount of radiation than normal potentially resulting in DNA damage [9].

It has been shown that after 10 years of quitting smoking, the risk of developing lung cancer falls dramatically by 50% compared to a smoker [10]. In summary, smoking is the most important single lifestyle factor for cancer development.

By the International Agency for Research on Cancer, alcohol has been classed as a Group A carcinogen increasing the incidence of

different types of cancer predominantly of the liver, mouth and breast [11]. Alcohol consumption has been estimated to account for 5% of all cancer deaths worldwide. The alcohol-attributable fractions of incident cancer cases are 30.4% [12].

Consuming alcohol increases the risk of developing cancer in multiple ways. Alcohol acts as a solvent increasing the absorption of carcinogens within the mouth and throat, alcohol is metabolised into the potential toxin acetaldehyde by the enzyme alcohol dehydrogenase which can damage DNA impairing the DNA repair systems. Alcohol can also increase levels of oestrogen within the body where uncharacteristically high levels can predispose to breast cancer. Chronic alcohol consumption can result in liver damage and *cirrhosis* predisposing the individual to liver cancer. In pregnant women, drinking alcohol has been linked to an increased risk of their childhood Leukaemia [13].

Evidence has suggested that over 20 different types of cancer could be linked to diets that are low in fruit and vegetables [14]. Some food types such as red meat have been linked with colorectal cancer, and soya and milk-based products with breast cancer. It is reported that diet may represent 30-35% of the risk factors that contribute to the onset of cancer [15].

Around 20% of all cancers can be caused by being overweight [16]. Nearly half a million people worldwide develop cancer due to obesity [17]. More than one in 20 cancers in the UK can be linked to being overweight or obese. As a nation, we are getting larger and at present nearly 25% of all adults are obese [18]. A study published in the *Lancet* in 2011 showed that if current trends continue, by 2030 around 4 in 10 people in the UK will be obese [19]. Obesity has been directly linked to higher incidences of two of the most common types of cancer – breast and bowel (breast cancer in postmenopausal women along with three of the hardest to treat – pancreatic, oesophageal and gallbladder cancers [20].

Physiologically, those with excess body weight will have metabolic hormonal alterations, including sex steroids, insulin and insulin-like growth factors. These alterations lead to an imbalance between the processes which cells undergo in order to proliferate and differentiate predisposing the cell to malignant transformation. It has been shown that cells in obese individuals are resistant to the effect of insulin

**\*Corresponding author:** AR Carmichael, Consultant Breast Surgeon, The Princess Grace Hospital, London, UK, Tel: 004420720908202040; E-mail: [amtulcarmichael@googlemail.com](mailto:amtulcarmichael@googlemail.com)

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increasing the levels circulating in the blood thus contributing to cancer development as high levels of Insulin are considered mutagenic.

Obesity increases the amount of lipids in the blood circulation, along with the levels of reactive oxygen species and certain adipocytokines which may promote a mutagenic environment. Obesity can promote low grade inflammation that creates a microenvironment where malignant cells might flourish, through hypoxia induced angiogenesis.

Lack of physical activity contributes to the development of cancer. Little physical exercise can lead to obesity. In America, one third of cancer related deaths can be linked to poor diet and physical inactivity [21]. Increasing physical activity by becoming more active will help reduce the risk of cancer - the Centres of Disease and Control recommend doing moderate intensity of exercise 5 days a week [22].

About 13,600 new cancer cases are reported in the UK each year due to risks related to different occupational jobs [23]. Occupation is an extremely important factor contributing to the risk of cancer - in males this is the third largest risk for cancer [24]. Occupation related cancer accounts for 4% of the overall UK cancer burden (6% men and 2 % women). More than half (56%) of cancers attributable to occupation are seen in men in the construction industry. It is also reported that women working a shift system have an increased incidence of breast cancer [25]. A job which involves repeated exposure to radiation increases the risk to cancer [26].

Examples include the nuclear industry, healthcare industry, mine-workers, construction/ industry workers as well as air hostesses. Exposure to asbestos greatly increase the risk of developing a particular type of lung cancer referred to as mesothelioma. [27].

To decrease the incidence of occupational cancer, appropriate actions are needed. Workers are now trained to take extra caution to protect them from ionising radiation. Those in professions that may come into contact with asbestos are now fully trained in preventive measures.

Other lifestyle factors that can increase our risk of getting cancer include tanning, viruses and the use of hormones. Exposure to UV light is the primary cause of skin cancers; melanoma and non-melanoma. UVA and UVB rays can penetrate the skin from the outermost layers damaging the DNA within the cells [28]. If this damage is not repaired it can lead to skin cancer. Fairer skin types are more prone to damage from UV rays than darker skin types due to the lower amount of melanin which can absorb these harmful UV rays. In order to avoid excessive sun exposure, public awareness campaigns have been and continue to be used to highlight the risks for the public. These include minimising direct exposure to sunlight, using sunscreen and covering up. A layer of clothing will minimise the absorption of UV light by skin and prevent the development of skin cancer.

Viruses can cause cancer such as the Human Papilloma Virus (HPV) where over 13 cancer causing strains exist. HPV spreads through sexual contact where it can persist in the body for many years penetrating into the deep layers of the cervix, causing these cells to proliferate and potentially turn cancerous [29]. The government has introduced vaccinations since 2008 to school girls aged 12-13 within the UK - it has proved very useful in immunity to HPV 16 and 18 which together cause 70% of cervical cancer in the UK [30]. High hormone levels of sex hormones can increase the risk breast, ovarian and endometrial cancers [31].

Overall, there are many environmental factors that can affect the incidence of cancer. As a result it is important to maintain a healthy lifestyle by avoiding smoking, minimise alcohol consumption, eat in

moderation, take regular exercise and avoid environmental exposure. Implementation of such advice universally could result in a significant reduction in cancer incidence.

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