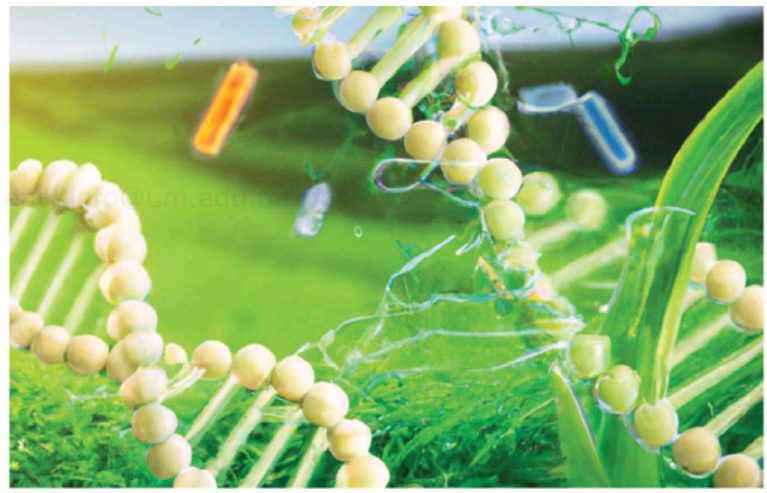
Lifestyle & Culture

Cancer, epigenetics and the environment


PROF. RENALD BLUNDELL


EMMA CAMILLERI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Everyone has heard of the word "cancer". Some of us may be familiar with the devastation and the possible sliver of hope that follows such a diagnosis. But do we truly understand what the word "cancer" means? What factors can predispose to such a dreadful disease?

By definition, cancer is a disease in which some of the body's cells start multiplying and dividing uncontrollably to form a mass of abnormal cells. This mass of cells forms a tumour, which can remain localised to the original region in the body where it had initially formed or else spread to other parts of the body. When a tumour is found in the area it actually formed, it is called a primary tumour while a secondary tumour is one that is located in a region of the body where the tumour was not originally formed. For instance, a primary tumour in the breast is likely due to breast cancer while a secondary tumour due to breast cancer found in the liver is a secondary tumour. Thus, secondary tumours are due to metastases, that is the spreading of tumours. Another important distinction to be made is between malignant and benign tumours.

Usually, benign tumours grow slowly and do not spread to other regions of the body while malignant tumours tend to grow faster, invade other organs and structures and spread throughout the body. Naturally, malignant tumours are more worrying and problematic. In addition, different tumours have different characteristics and thus vary in prognosis and management. Upon recognising a tumour, various tests are carried out including imaging (example CT scans, MRIs and so on) together with biopsies. Biopsies are important because they give medical professionals information on the cell type of the cancer and how it may behave to certain treatments. Thus, the cell type of one's cancer will be important in determining the management of the disease.

In addition, cancer location, together with its characteristics, can influence how it may present. For instance, in the case of an insulinoma, one may show symptoms of hypoglycaemia apart from the typical signs of pancreatic cancer like painless jaundice and back pain. An insulinoma is a malignant neuroendocrine tumour of the pancreas that releases insulin which acts to lower blood glucose levels. On the other hand, tumours can also be ones that do not release hormones and may not show any specific signs until it has grown and started causing more evident problems.

Many factors including genetics, the food we eat and the environment may have a role, whether small or not, in the risk one may have of developing cancer. In other words, cancer and epigenetics are linked to each other. Epigenetics is "the study of how our behaviours and environment can cause changes that affect the way our genes work". In simpler words, our actions and behaviours can influence gene activity. While epigenetic changes are reversible unlike genetic mutations and do not affect our DNA sequence, they do impact the way a cell reads a DNA sequence and thus gene expression too.

All human cancers show epigenetic changes which are known to cooperate with genetic alterations driving towards the cancer phenotype. Such changes include DNA methylation, histone modifiers and readers, chromatin remodelers, microRNAs and other components of chromatin. Luckily, by understanding these processes, epigenetic therapies have become a possibility. But how do epigenetics truly affect health?

Epigenetics can influence our health in various ways through our genome. For instance, let us say person X is infected with Mycobacterium tuberculosis – the culprit for tuberculosis. These pathogens can lead to some changes within the immune cells, for example, the histones become altered. This may then result in the "turning off" of the IL-12B gene which would weaken the immune system and promote the survival of this pathogen.

Similarly, just as some genetic mutations make us prone to cancer development, so do certain epigenetic changes. For example, having a BRCA1 gene mutation which prevents it from normal functioning, increases the risk for breast cancer. Likewise, enhanced DNA methylation resulting in reduced BRCA1 expression raises the risk for breast cancer too. One must note, that although cancer cells have increased DNA methylation at certain genes, the overall DNA methylation levels are lower than in normal cells.

Different cancers that may seem similar have different DNA methylation patterns. In saying this, epigenetics can aid determine the type of cancer present or detect cancers that are hard to identify earlier. However, despite this, epigenetics alone is not enough to diagnose cancer and thus screening tests are vital. For instance, colorectal cancers show abnormal methylations at DNA regions near specific genes that affect their expression. Now, certain colorectal cancer screening tests use stool samples to look for abnormal DNA methylation levels at one or more of these DNA regions. In addition, should this test reveal a positive or abnormal result, a colonoscopy would be needed to further investigate and complete the screening process.

Through our understanding of epigenetics and the human genome, epigenetic therapy is one way of managing cancer. This is only viable since as previously mentioned, epigenetic changes are reversible. Thus, epigenetic therapy aims to reverse the casual epigenetic changes that occur in cancer, leading to the restoration of a "normal epigenome". In the last few years, many epigenetic drugs have been made that can effectively reverse DNA methylation and histone modifications seen in cancer. Although some concerns regarding these drugs being incorporated into the DNA may be worrying due to their potential toxic effect on normal healthy cells, these drugs are believed to specifically act on the rapidly dividing tumour cells. This has been supported by various studies.

Apart from these epigenetic factors, hereditary cancer syndromes account for about 5 to 10% of all cancer diagnoses. Hereditary cancer syndrome, genetic syndrome or family cancer syndrome all refer to the same thing. It means that a genetic change that significantly increases the risk of developing cancer runs in the family. However, this does not necessarily mean that one relative will definitely get cancer if the other relative had cancer. It is vital to understand that not every cancer that seems to run in a family is caused by a family cancer syndrome and it is not uncommon to have many cancers in a family. Cancer might be more common in certain families because family members share certain behaviours (example smoking 10 packets of cigarettes a week). When we refer to inherited cancer it is not the cancer that is being inherited but the mutated gene that can lead to cancer development. In truthfulness, only 5 to 10% of all cancers are known to be greatly connected to gene mutations inherited from a parent.

So, how does one recognise the potential of a family cancer syndrome being present?

- While is it encouraged to always seek medical advice, certain things and patterns may be pointing towards family cancer syndrome, such as:
- Many cases of the same cancer, particularly if it is an uncommon or rare type of cancer
- Cancers occurring at younger ages than normal (example colon cancer in a 20-year-old)
- More than one type of cancer in a single person (example a woman having both breast and ovarian cancer)
- Cancers occurring in both paired organs (example both eyes/kidneys/breasts)
- Cancer occurring in many generations
- Cancer occurring in the unusual sex (example breast cancer in males)

Furthermore, apart from the factors mentioned above, other environmental factors like radiation, smoking and pollution can increase cancer risk too. Both infrared radiation (example from laptops and heaters) and ultraviolet radiation (example from the sun) have the potential to damage skin cells and thus negatively affect our cells' DNA leading to the potential of skin cancers.

In addition, when one smokes a cigarette over 5,000 chemicals, most of which are harmful, are released into the body. About 70 of those 5,000 chemicals are known to cause cancer. Once these chemicals enter your lungs, they find their way into the circulatory system and thus all over the body. These chemicals not only damage the cells' DNA and makes it harder for the cells to repair any abnormal DNA but they also weaken the body's immune system making it harder to fight off any cancer cells that may form. Thus, if person X smokes a full packet of cigarettes today which is equivalent to 20 cigarettes, they have just introduced 100,000 potentially harmful chemicals in the body, out of which 1,400 are most definitely known to increase cancer risk.

Despite all the above, what can one do to reduce their risk of getting cancer?

Although changing one's lifestyle and habits is not easy, it is the first step to adopting a healthier one to reduce cancer risk. Such adaptations involve avoiding tobacco products, especially individuals who drink alcoholic beverages since the cancer risk of tobacco and alcohol combined is greater than their respective individual risk. Eating healthier foods that come from plant sources is better than consuming fried, overcooked and/or processed foods that may be full of preservatives, carcinogens and other harmful chemicals like N-nitroso compounds and heterocyclic amines. In addition, avoiding overexposure to UV and infrared radiation as well as being physically active and maintaining a healthy weight will help too.

Finally attending screening programmes against certain cancers is important as well as speaking to a medical practitioner when one notices something abnormal. Locally, three cancer screening programmes are offered:

- Breast cancer screening for all women between 50 and 69 years of age every two-and-a-half years
- Cervical cancer screening for women between 25 and 41 years of age. After one's first cervical screen, one will receive invitations every three years. When one reaches the age of 50, they will be invited every five years.
- Colorectal cancer screening for all individuals between 57 and 73 years of age. Persons in this age group are also automatically invited to do a home-testing kit FIT (faecal immunochemical test) every two years.

Renald Blundell is a biochemist and biotechnologist with a special interest in Natural and Alternative Medicine. He is a professor at the Faculty of Medicine and Surgery, University of Malta.

Emma Camilleri is currently a medical student at the University of Malta.