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Causes of Cancer – Part 5: Genetics

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Previous articles in this series (1 - 5) have discussed preventing 37,000 Australian cancer cases a year by addressing six lifestyle factors (6). In doing so we've covered three of the four causes of cancer proposed by Professor Ian Frazer of the University of Queensland (7):

- 30 % of cancer is caused by what we do to ourselves;
- 30 % of cancer is caused by what we've done to the environment;
- 30 % of cancer is caused by what you catch; and
- Only 5 – 10 % of cancers are genetic.

In this article we will look at the 5 – 10 % of cancers caused by your genes.

Before we begin, I am indebted to Paul Kern for his article "Know your genes, know your health challenges" published in the April – June 2017 issue of Healthy Living (8). That Paul did such a good job discussing which genes are implicated in cancer means I don't have to and can take this article in the direction I really wanted to go. So please view this article and Paul's as a set to be read together.

The first thing we need to discuss is Professor Frazer's 5 – 10 % estimate may be true for cancer-causing genes you inherited from your parents. But it isn't telling the whole story: Genetics plays a profound role in the development of cancer, far more than what Professor Frazer's 5 – 10 % estimate suggests. To understand the distinction we need to know why and we need to know how.

I can't help it: I've got the gene

Regularly we hear popular press reports about how scientists have found the genes responsible for some medical condition or behaviour, as though having the gene alone explained everything and sealed your fate. Such thinking is naïve and flawed. You are not a slave to your genes.

Your DNA, collectively called the genome, contains roughly 25,000 genes. A gene is a set of instructions to make a protein. Around 25,000 genes means around 25,000 proteins. What these proteins do and when they are expressed keeps you alive, makes you function and sets certain physical characteristics, like your eye and hair colour and how tall you are. They can also determine how susceptible you may be to particular diseases or medical conditions, as Paul Kern discussed in his "Know your genes, know your health challenges" article (8).

For the purposes of this discussion it will be useful to think of the genome as a recipe book and each gene as an individual recipe. If you're having friends over for dinner you don't start at the first recipe in the book and make every one, you go through the book and craft the meal by picking recipes that complement one another: A nice pumpkin soup recipe for starters; a hearty curry for main course and a soufflé for dessert.

Some recipes you'll make often; some occasionally; some on special occasions; some just once and some you'll never make. Likewise, which recipes you make will change over time. You'll stop using recipes from the children's section as your children grow and use different recipes as your tastes change. It is exactly the same with your genes. Some genes are expressed all the time, some occasionally; some only once; some only on special occasions or for a short period while some will never be expressed.

The critical thing is this: If you can prevent a damaged gene from being expressed, then it can't hurt you. So the important thing is not if you have the gene, it is whether it is expressed, under what circumstances and what other factors may be acting on it.

So what determines if a gene is turned on or off and when? While the answer depends on the particular gene, we now know the environment has a profound effect on gene expression. Indeed Epigenetic evidence suggests the environment has more profound effects on the genes than the genes do on the environment, potentially turning genes on or off permanently in ways that may be inherited by your children. There is considerable interest in Epigenetics as both a contributing factor in cancer and as a therapeutic strategy against a range of diseases, including cancer - and with good reason (9).

While a fascinating and important subject, we won't be discussing it here. I will however make particular mention state of mind and meditation have been found to regulate the expression of beneficial genes (10).

It has been said "Your genetics loads the gun but the environment pulls the trigger." While this is a very apt description, to fully appreciate its significance we need to discuss how the gun gets loaded in the first place.

The instructions in the roughly 25,000 genes of your DNA are written in genetic words and letters. Around 3 billion letters. This is around the same number of letters contained in a stack of books 75 metres high. Think about this for a minute: All the information in a stack of books 75 metres high packed into every cell in your body, something so small you can't see without the aid of a powerful microscope.

When a cell reproduces, this information has to be copied – Perfectly. Unfortunately, the process isn't quite perfect. Every time a cell reproduces and copies the 3 billion genetic letters, it makes about 175 errors (11). That means each and every one of the roughly 30 trillion cells in your body has, on average, at least 175 errors in the genetic blueprint. It also means the more copies you make the more errors accumulate: 175 errors in the first copy; 350 in the second; 525 in the third and so on...

An error in the cell's genetic blueprint is called a mutation. Despite what the comic books may say, mutations won't make you one of the X-Men. A mutation is a fault; it's damage, it's something you don't want.

Fortunately, the cell has ways of dealing with some mutations so they don't alter the information a gene contains, while others can be repaired. This isn't true for them all however and mutations will accumulate and harmful mutations are the starting point for cancer. But how do you get from a mutation to cancer?

The multi-stage model of Carcinogenesis

Carcinogenesis – the genesis or beginning of cancer - is a multi-stage process (12, 13):

- Initiation;
- Promotion; and
- Progression.

The first stage is called Initiation and involves DNA damage – mutations. It doesn't matter whether your genes were damaged because you were born that way; through errors made when your DNA was copied; or through your lifestyle choices like smoking or excessive exposure to ultraviolet light. What is important is any DNA damage has the potential to be the starting point for cancer.

As we've already discussed, damaged genes can only hurt you if they are expressed, which brings us to the second phase: Promotion. This is where something like a chemical, environmental or epigenetic factor either causes the abnormal expression of normal genes or the expression of damaged ones.

Here we need to make a small but very important diversion.

If damaged cells are the starting point of cancer and every one of the roughly 30 trillion cells in your body can't be trusted because they each have at least 175 errors, what are the odds some of these cells will have all the mutations they need to become a cancer? The answer is chilling: It's 100%. Let's spend a few minutes on this so the significance sinks in: On the day you were born you had potentially cancerous cells in your body. There are potentially cancerous cells in your body right now, as you read this sentence.

And on the day you die, there will still be potentially cancerous cells in your body. It means you don't "get" cancer because it's already there...

If we all have potentially cancerous cells in our bodies from the day we were born, then why doesn't everyone get cancer? Knowing no cell can be trusted, your body sets up Command and Control systems so no cell is ever completely in charge of its own destiny. By exercising collective control potentially cancerous cells are stopped from growing by the signals they receive from around the body and by the influence of their neighbours. Promotion is a process where this collective control breaks down, giving the potentially cancerous cell a chance to make a break for it. And they do, turning into early cancers.

These early cancers are the Enemies of the State we discussed in the previous article, the ones your immune system is constantly looking to seek and destroy (5).

The final stage is Progression, where the early cancer slips through your defences (14), gets a foothold and grows large enough to be a visible cancer. This is when the Doctors finally know it's there but by then it may have been growing for between 2 and 9 years. We've already discussed what giving your opponent a 780 metre head start in an 800 metre race means (5).

If your body contains potential cancers all the time, then the secret to avoiding cancer is to manage your risk and keep it under control so it doesn't take control of you. That means avoiding things that cause mutations like smoking, ultraviolet light and alcohol. It also means avoiding things (like environmental pollutants and epigenetic factors), which may cause abnormal gene expression, potentially damaged genes from being expressed, or beneficial genes from being silenced. And finally making sure to do everything you can to keep your greatest ally – your immune system – at the absolute top of its game.

Your body is set up by nature to protect you from cancer – provided you respect it. Whether you are supporting or interfering with that process is determined by the decisions you make every day. And that brings us back to the six lifestyle factors we started with.

You have more control over your health than any Doctor ever will. I hope these articles help you use that control wisely.

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