

Explainer: What is nutrigenomics?

March 7 2014, by Arnaud Deladeriere



Give me five of these any day. Credit: Nancy D. Regan, CC BY-NC

"Eat your five-a-day" is a health slogan that has been kicking around since the 1980s. The UK government made it an official campaign in 2003. But understanding the exact benefits (and harms) that our daily diet has on our health is only starting to become clear now.

The field of nutrigenomics studies how different foods have an impact on our genome and how this interaction can modify our biology to

promote healthiness or disease.

Genetic control

The food you eat has a direct impact on your nutrient metabolism – the nutrients that are extracted from the food we eat. Food not carefully chosen can lead to conditions such as obesity or type-2 diabetes.

Different nutrients such as vitamins, flavonoids, polyphenols and certain fatty acids affect the body in different ways: they can change the way your cells work and their regulation.

Proteins are key to every cell's operation. In recent years, scientists have shown that the generation of proteins is not only governed by genes, as was previously thought. It is also governed by modifications to the DNA molecule and the proteins bound to it; these modifications turn on and off the machinery of gene expression. The field studying this phenomenon is called epigenetics.

These discoveries have led to the realisation that many cancers and other disorders are due to a fault in these processes. In this context, scientists have therefore studied the regulation of the expression of genes (that is, the generation of proteins) but not their sequence and their potential mutations (a mutation in a gene can lead to malfunction of the [protein](#) and potentially cause diseases such as cancer). This means that epigenetic-related disorders are potentially reversible and can be prevented.

Scientific advances have helped understand how our genome (genetic code) and epigenome (attachments to the code) are ordered. This makes it possible to measure and understand how our environment can influence the functioning of our organs at the level of DNA.

Nutrigenomics could have a promising impact on society, at a medical but also an economic level.

Vital nutrients

Vitamin B9 (also called folate), contained in spinach, lentils or asparagus for example, is an important nutrient for women [during preconception and pregnancy](#). It [helps prevent](#) congenital malformation, especially malformation of a baby's nervous system early on in the pregnancy. But the way that vitamin B9 worked to prevent this was unknown until recently.

In mice, vitamin B9 is [required](#) for important epigenetic changes needed to keep the cell running. So if a pregnant woman's diet is too low in vitamin B9, the embryo may be affected. Surprisingly, it has also been shown in a recent paper published in [Nature Communications](#) that not only the egg is at risk during the preconception period, but also the sperm cells. This means future fathers should also enhance their diets with vitamin B9.

Normally, it would be expected that a lot of genes are involved when vitamins are taken. But it turns out, the genes affected by the intake of vitamin B9 are always the same, roughly 300 out of the total 30,000. This presents an opportunity to learn more about such specific interactions, in the hope of building treatments.

Nutrigenomics could also explain that having a healthy diet can protect from diseases such as cancer. It has been found that components such as sulforaphane, found in cabbage vegetables such as broccoli or Brussels sprouts, can naturally inhibit the molecular modification of histones, proteins bound to your DNA. This would prevent certain cancer-specific genes from being able to express themselves.

We are now entering a new era. We are able to understand and measure how our environment plays a role on our health. The exact reasons why our diet or everyday habits were classified as good or bad for our health

was long unclear.

It may soon be possible for your GP to take a blood sample and tell you if you are at risk of some diseases such as diabetes or different types of cancers. Different foods have the power to activate genes that affect susceptibility to certain diseases, it may be possible to advise an appropriate diet to slow down the progression of certain diseases. While we are largely limited to tackling diseases like cancer after they begin developing, [nutrigenomics](#) could provide a way of preventing these diseases developing in the first place.

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