Nutrigenomic Counseling

Implications for Health Professionals

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A "one-size-fits-all" approach to nutrition advice is outdated, and evidence exists that a more personalised approach based on nutrigenomic testing can improve health outcomes far beyond what general dietary advice can offer. What is the state of the art of research supporting the use of nutrigenomic testing in clinical practice to improve the health of individuals as well as to enhance motivation and elicit long-term behaviour change?

For many years, health professionals have known that a "one-size-fits-all" approach does not address individual requirements. In clinical practice, we see that some patients see results and benefits from general nutrition dietary advice, with other patients not responding to these interventions at all. Varying responses to the same dietary intervention can be explained using the science of nutrigenomics and nutrigenetics.

These fields of nutrition focus on how genetic variations can affect how individuals respond to the foods, beverages and supplements they consume. Understanding these genetic variations helps practitioners understand their patient's individual nutritional requirements for optimal health outcomes. **Figure 1** shows how traditional nutrition research aims to link a specific nutrient or diet to a health outcome. However, this type of research can often yield contradicting results. Using the science of nutrigenomics and nutrigenetics we know that the various health responses and heterogeneity in the results can be explained by the genotype of the individual.

Nutrigenomic Testing

There are many examples of genes used in nutrigenomic testing that modify an individual's response to a nutrient and therefore alter their nutrition requirements.

Obesity

The FTO gene (Fat Mass and Obesity gene) is one of the most researched genes in the field of nutrigenomics and has many well-established gene-lifestyle interactions. One of the most common is the link between the FTO gene and protein with regard to weight loss. A high protein diet is blanket-prescribed to many as an efficient weight-loss strategy.

However, research into the link between the FTO gene and protein shows that only one in five people would have an enhanced response to a high protein diet for weight loss. This is because these individuals, who possess the AA genotype of the FTO gene, experience enhanced satiety from protein-rich foods. Research shows that over the course of two years, those with the AA genotype of the FTO gene experience a 220 percent greater reduction in fat mass on a high protein diet versus a low protein diet (**Fig. 2**), compared to those with the TT or TA genotype who don't have a significant difference in fat loss on a high or low protein diet (*Zhang 2012*).

Cardiometabolic Health

Similarly, personalised dietary recommendations for cardiometabolic health can also be determined using genotype. Take caffeine for example, where for many countries the public health guidelines for the safe daily limit is < 400 milligrams per day (approximately four cups of coffee per day if each cup is made with one espresso).

Unfortunately, these recommendations do not take into consideration an individual's response to caffeine, based on their genotype of the CYP1A2 gene (Cytochrome P450 gene). This gene codes for the CYP1A2 enzyme, which is responsible for most of the caffeine metabolism that occurs in the body. About 50 percent of individuals possess a ge-

netic variation in the CYP1A2 gene which causes them to be slow metabolisers of caffeine – meaning caffeine lingers in their system longer than the fast metabolisers. Research has shown that these slow metabolisers, who possess the AC or CC genotype of the CYP1A2 gene, have a two-fold increased risk of myocardial infarction and high blood pressure if they consume more than 200 milligrams per day of caffeine. While those fast metabolisers (AA genotype) can consume up to 400 milligrams per day and can even experience protective effects from caffeine on heart health *(Cornelis 2006).*

Implications

Interpretation of nutrigenomic test by a practitioner can empower an individual with the knowledge of the genetic variations that they carry. This information can then be used to personalise their diet to their own unique nutrient requirements to ensure that all recommendations are effective and safe for their body and needs. A one-size-fits-all approach is outdated, especially in this case where there is such a plethora of research showing that implementing a personalised approach in clinical practice can be much more beneficial to the health of the population.

Effects of Personalized Counseling on Motivation

Nutrigenomics has been shown in many well-designed scientific studies to produce superior results compared to general dietary advice. A study published in the British Medical Journal in 2020 aimed to investigate if genetic-based dietary advice for weight management would motivate individuals to stick to these dietary changes long-term compared to population-based advice.

The study compared one of the most effective public health weight management programs and nutrigenomic personalised dietary advice. Half the participants in the study followed a Gold Standard weight management program and the other half followed the Gold Standard weight management program in addition to personalised dietary advice given to them from nutrigenomic results. **Figure 3** shows the study found nutrigenomic dietary advice motivated individuals to adhere to dietary changes for longer periods than population-based advice.

Additionally, long term dietary adherence to total fat and saturated fat guidelines was also significantly greater in the personalised nutrition group *(Horne 2020).*

Conclusion

Nutrigenomics is a very powerful tool that can help healthcare professionals enhance their offering to their patients and help them see more efficient results in their health. Although nutrigenomics is not used routinely as of yet in any major public health system, there is an abundance of robust scientific evidence to show that it is time to make the shift from general advice to personalised recommendations.

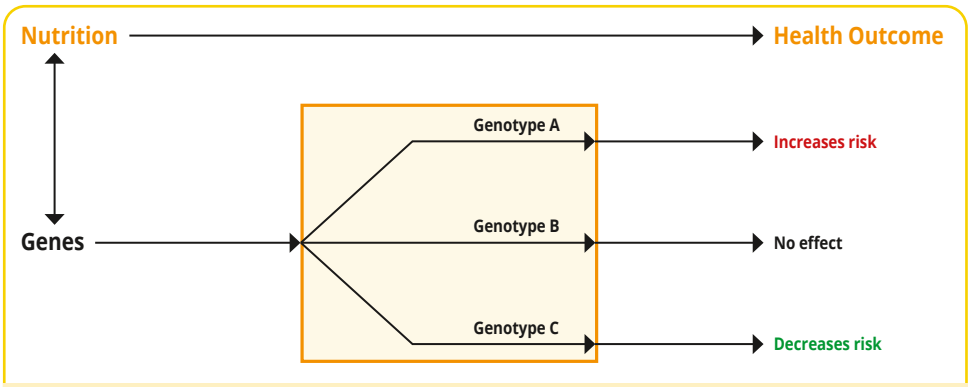


Figure 1: The importance of genetic variations with regards to links between nutrition and health outcomes. Individual response to diet is dependent on the genotype of specific modifier genes that play a role in the metabolism of nutrients.

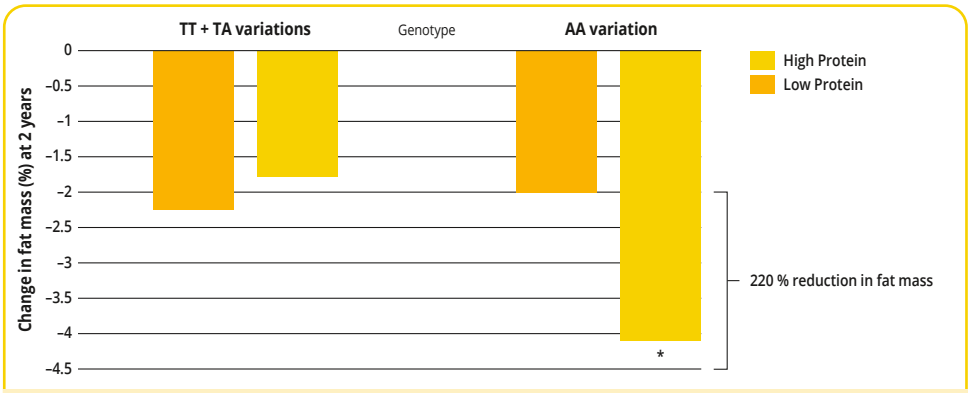


Figure 2: Change in fat mass percentage over a period of two years. AA genotype of the FTO gene had a significant reduction in fat mass on a high protein diet versus a low protein diet compared to those with the TT or TA genotype who don't have a significant difference in fat mass on a high or low protein diet (adapted from *Zhang 2012*).

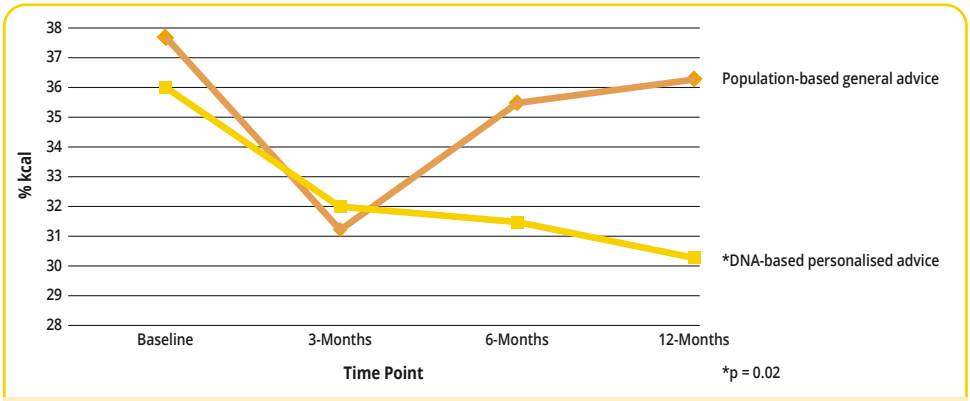


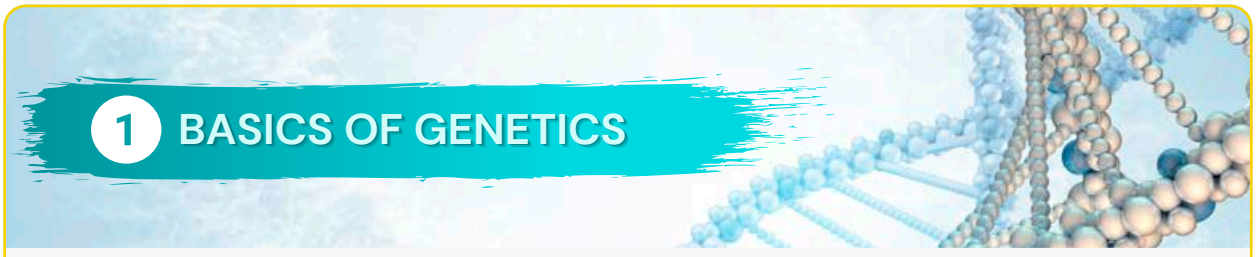
Figure 3: Change in percentage of calories from fat over a period of 12 months. DNA-based personalised advice significantly reduced total fat intake compared to the population-based general advice (adapted from *Horne 2020*).

Information for Health Professionals

As nutrigenomics are an unregulated field, understanding the different types of different genetic tests out there is essential. There are four critical concepts to master nutrigenomics:

- Basics of Nutrigenomics (**Fig. 4**)
- Epigenetics versus Nutrigenetics (**Fig. 5**)
- Types of Genetic Tests (**Fig. 6**)
- What to look out for when looking at a DNA Diet Test (**Fig. 7**)

For details see: https://thednadietitian.co.uk



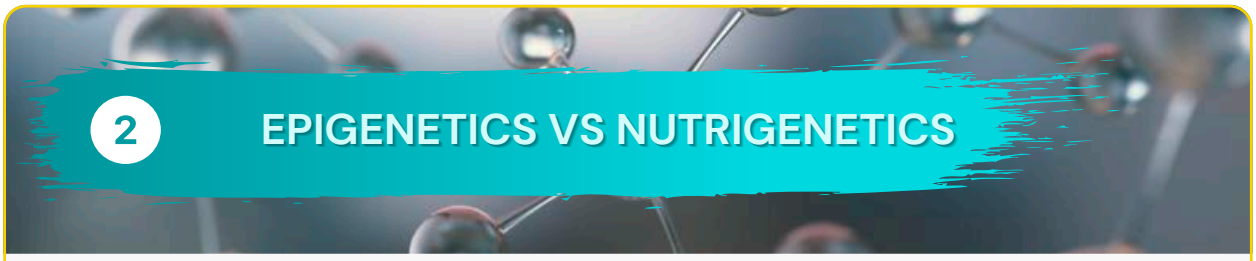
DNA: also known as deoxyribonucleic acid. DNA is a molecule that holds your full genetic code this is individual to you. This information is what makes you who you are, from your eye or hair colour, to how you metabolise different nutrient.

Nucleotide bases: are the bases that make up the DNA molecule. The 4 different bases are called: Adenine (A), Guanine (G), Cytosine (C), and Thymine (T). These bases make up the entire genetic code as well as your genotype of different genes.

Genes: active sections of DNA that code for a specific protein. All processes in our body are carried out by proteins like enzymes, transporter molecules, receptor etc.

Genetic variations: are mutations that occur in the genetic sequence, causing difference in how you utilise, metabolise, transport and excrete different nutrients. These genetic variations are also called Single Nucleotide Polymorphisms (SNPs) as they usually occur in one base pair where it has been incorrectly replaced with another (i.e. A>T)

Figure 4: Basics of Genetics

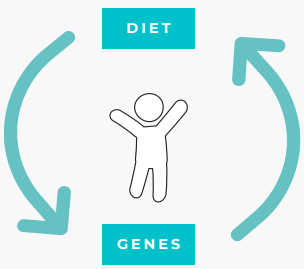


EPIGENETICS

Diet & lifestyle affects gene expression

Gene expression and silencing occurs at the promoter region of the gene, which is responsible for activating the process of gene expression. Methyl groups can attach to the promoter region and down regulate the expression of the gene. The less methyl groups attached to the promoter region (also known as the TATA box), the more the gene will be expressed.

This is an emerging field however we currently don't test epigenetic changes in clinical practice.



NUTRIGENETICS

Genetic variations (SNPs) affect our response to diet

Nutrigenetics studies variations in modifier genes, which are genes that modify our response to diet. These genes are usually implicated in a metabolic process in which we know a weaker protein can lead to issues with metabolism.

Nutrigenomic research aims to find associations between specific genetic variations in genes of interest and clinical outcomes based on dietary intervention. Actionable advice to be used to personalise dietary advice in clinical practice based on these differences in sequences.

Figure 5: Epigenetics versus Nutrigenetics

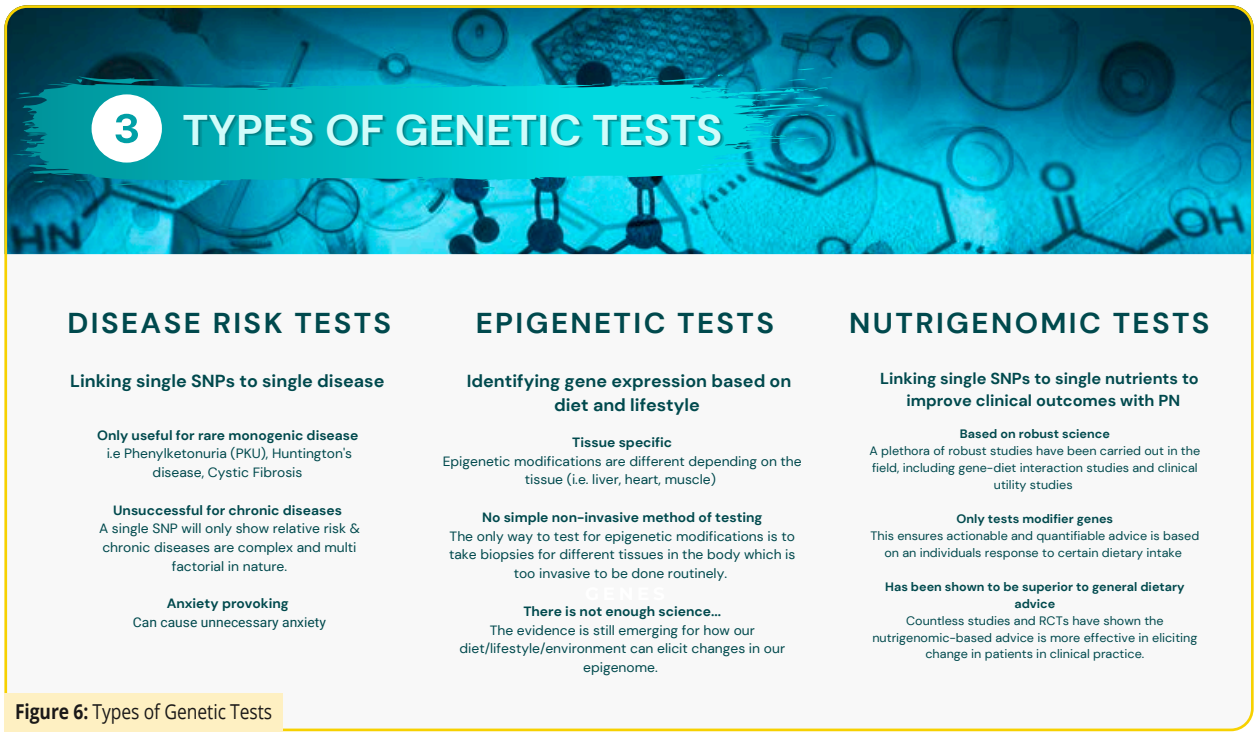


Figure 6: Types of Genetic Tests

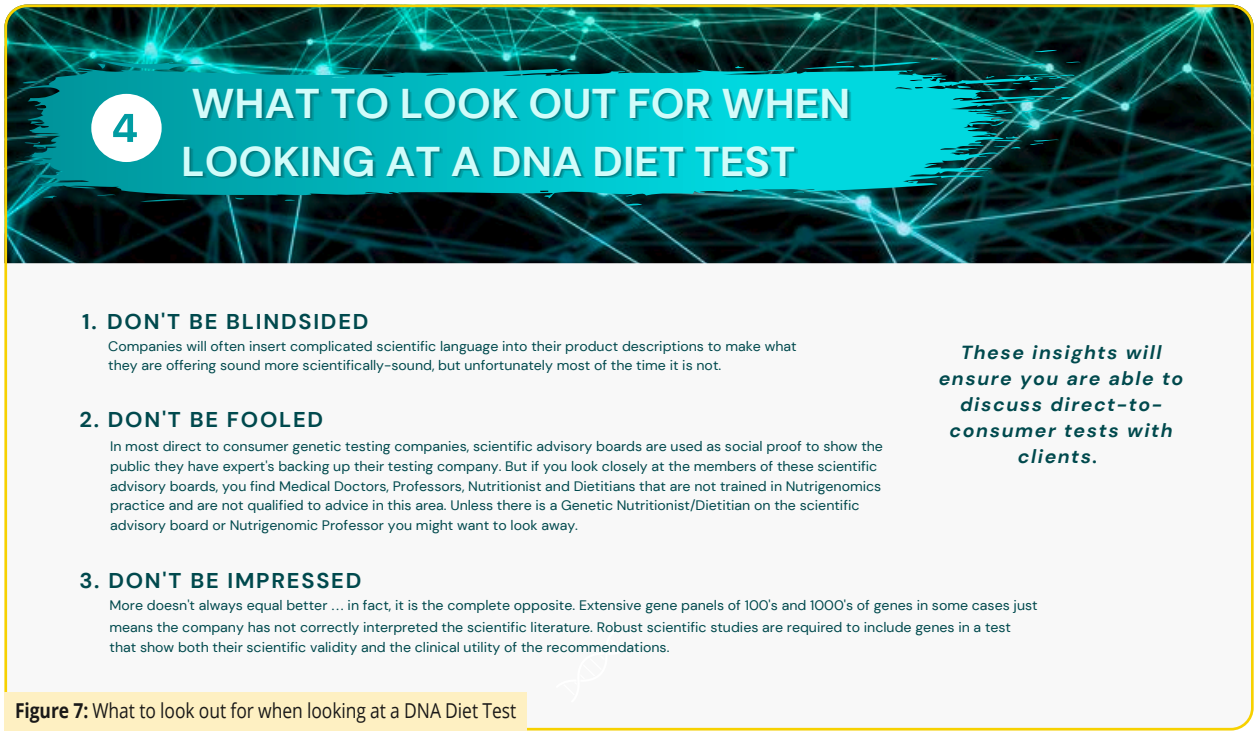


Figure 7: What to look out for when looking at a DNA Diet Test

Literature

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The author

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