DNA Core

Practical application

Virginia Wood – MSc RNT
Clinical Support Team Manager

Nordic Laboratories

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Hej, Hello, Bonjour, Aloha, Guten Tag, Konnichiwa, Olá, Assalamu alaikum, Marhaba, Ciao, Namaste, Γεια σου, Nǐ hǎo, Sawubona, Hallå, Shalom, Hei, Kia Ora, Annyeong, Xin chào, Hujambo, Привет, Jó napot

Key to personalised Healthcare



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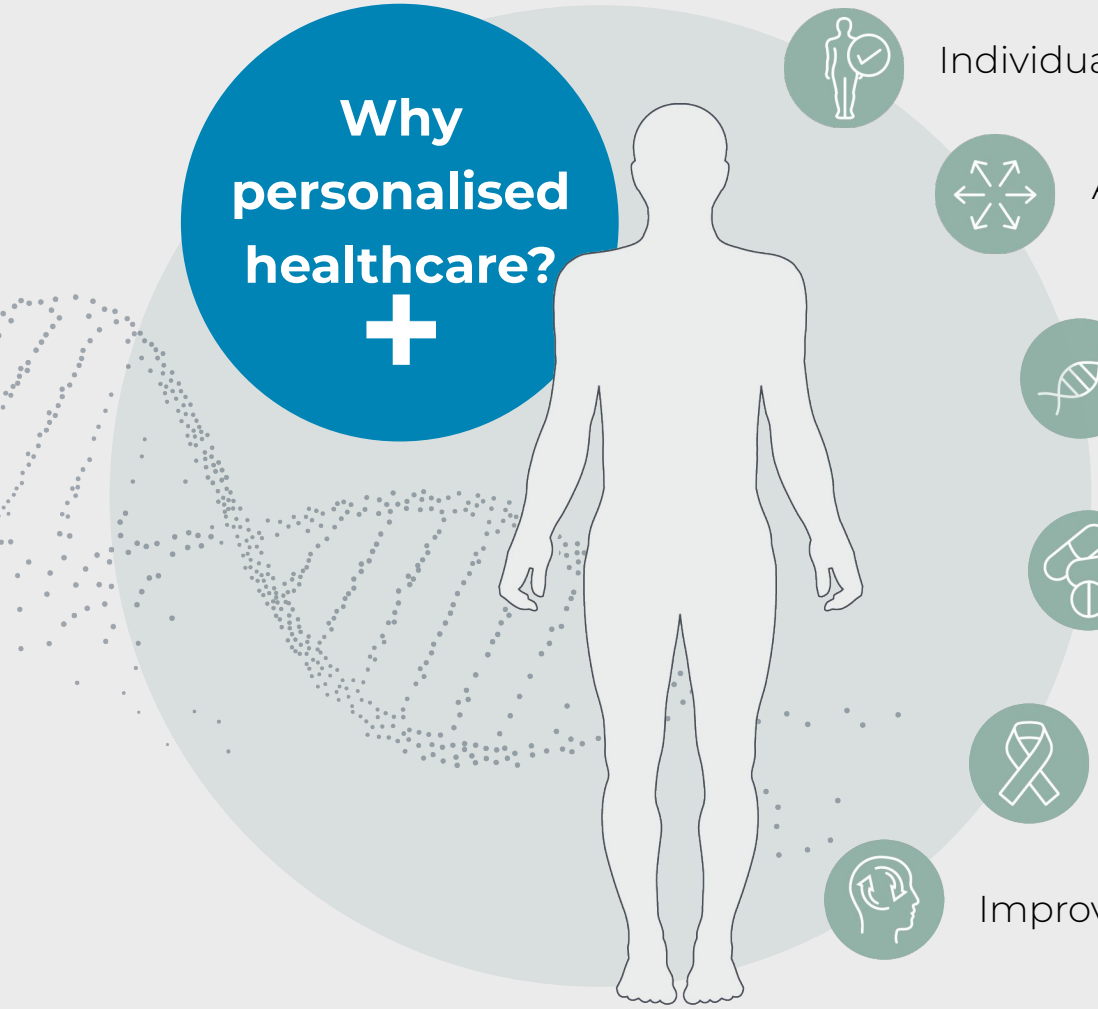
Why DNA? An arm of personalised healthcare



- Individualised responsiveness
- A different approach for each individual
- Guide recommendations based on unique genetic code (blueprint)
- Avoid trial and error of prescription medications (unnecessary side-effects, inefficacy etc.)
- Understand and target key pathways: the drivers of disease development
- Improves behaviour change and compliance

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High/full penetrance: Genetic mutation

- High/full Penetrance (cause-effect relationship): Genotype = Phenotype
- A mutation is a change in the genomic sequence of an organism that causes a discernible change in the characteristics of an organism
- Convey high probability that the effect will be expressed and “visible”
- Can be a single base-pair, entire gene, large segment of a chromosome or an entire chromosome

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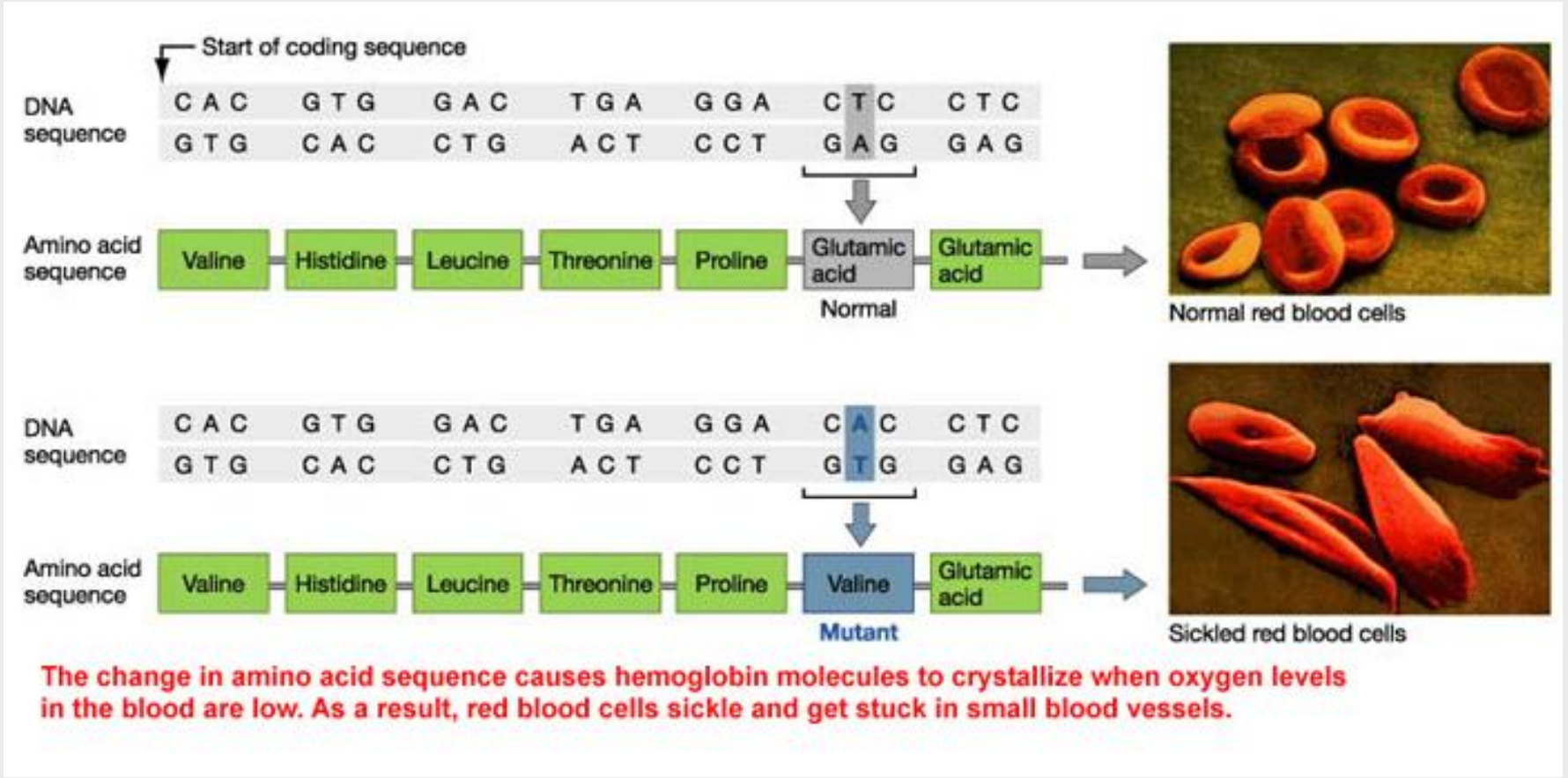
High/full penetrance: Genetic mutation

Causes disease



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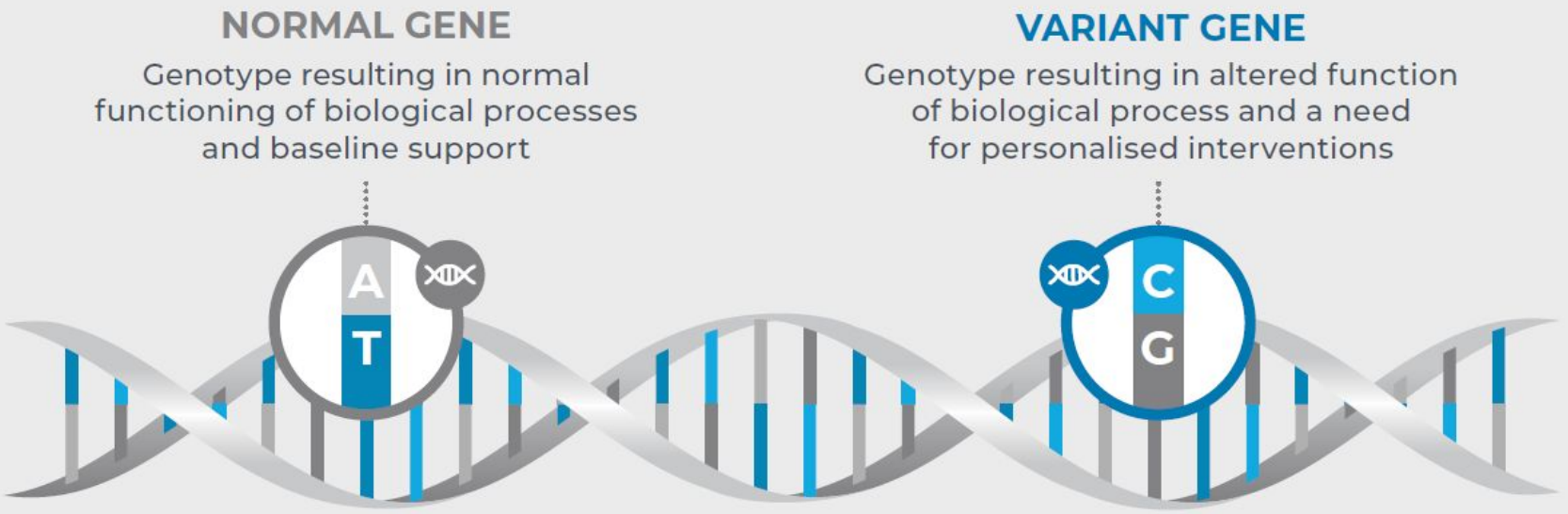
Low penetrance: Genetic variation

- Low Penetrance: Minor impact, does not cause disease on its own (Genotype + Environment = Phenotype)
- Usually **s**ingle **n**ucleotide **p**olymorphisms (SNP), a small sequence of nucleotides, insertions / deletions
- Convey *susceptibility* to disease, act as biological markers indicating a *predisposition* towards a behaviour, physical or physiological attribute



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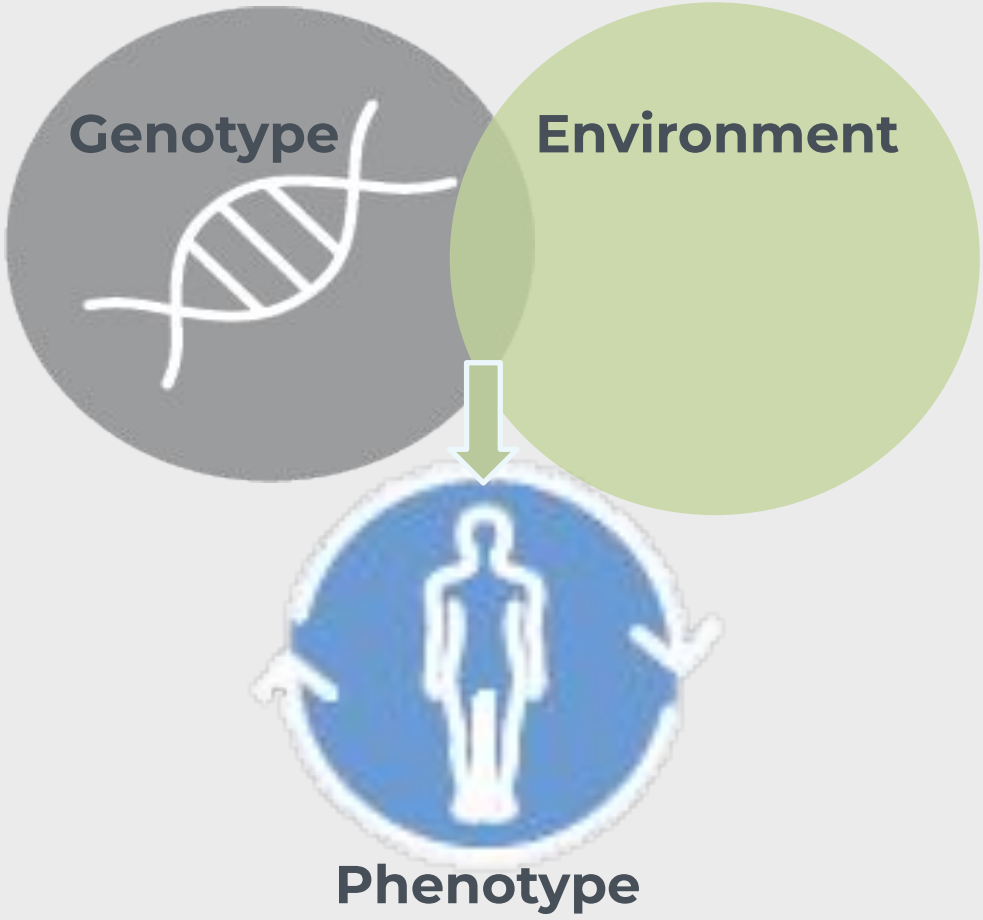
Nutritional genomics

- A science studying the relationship between the human genome, nutrition/environmental exposures and health.



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Nutrigenetics: a practical example

CYP1A2 C>A
gene variant



CVD

Nutrigenetics

Investigating the modifying effects of gene variants on environmental exposures, micronutrient uptake and metabolism as well as dietary effects on health

"Responsiveness"

Gene x Environment

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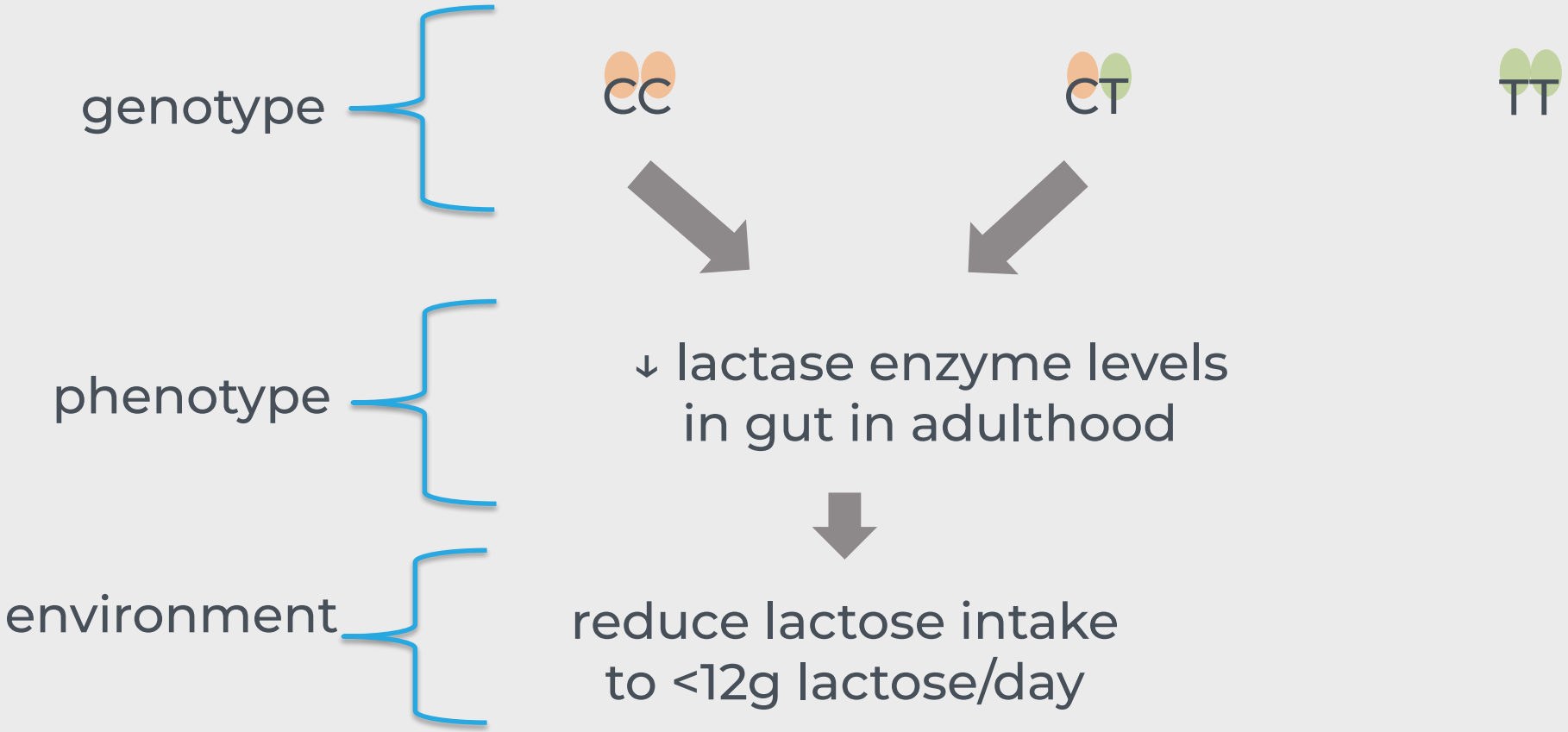
Nutrigenetics: a practical example

MCM6 -13910 C>T



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Practical application of nutrigenetics

The applications of this science can be used in the prevention of disease, personalising diet plans for improved weight management outcomes, as well as in a therapeutic manner for specific disease states or particular disorders, by gaining insight to individuals' responsiveness to environmental exposures, particular nutrients and doses of nutrients.





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Practical application of genetic testing

Improving health: Where is the science, & where do we start for recommendations?

- **Manage weight** ~ overweight & obesity increases risk for type 2 diabetes mellitus (T2DM), cardiovascular disease (CVD) & some cancers
- **Exercise** ~ Exercise decreases risk for T2DM, CVD, cognitive decline, and mood disorders
- **Targeted nutraceutical intake** ~ Avoiding nutrient insufficiencies decreases risk for cognitive decline, mood disorders, autoimmune disorders, & improves immunity
- **Supporting key biochemical pathways through therapeutic recommendations of nutrition, nutrients & lifestyle** ~ Decreases risk for chronic disease (CVD, T2DM) & may assist with improved longevity

https://www.cdc.gov/obesity/about-obesity/index.html#:~:text=Obesity%20can%20lead%20to%20type,age%20and%20continuing%20throughout%20life.
Prim Care Companion J Clin Psychiatry. 2006; 8(2): 106.
doi: 10.4088/pcc.v08n0208a
Bohn et al., 2017; Carvalho-Wells et al., 2012; Day et al., 2017; Fallaize et al., 2016; Gibney et al., 2019; Griffin et al., 2018; Lockyer et al., 2012; Oberg et al., 2015; San-Cristobal et al., 2017; Shab-Bidar et al., 2015a, 2015b

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Selecting a genetic test

Relevant:

- Gene variant exerts direct influence over specific biochemical processes that create known symptoms or disease

Prevalent:

- Gene variant relatively common in the general population (generally >5% minor allele frequency)

Modifiable:

- Gene expression modifiable by environmental factors such as diet and lifestyle

Measurable:

- Impact of clinical interventions to modify expression of genes/pathway function measurable by laboratory assays- biochemistry/clinical observations

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Selecting a genetic test

Evidence:

- Documented Gene x Environment interactions
- Documented positive effect of diet or lifestyle change
- A minimum of three reported studies from reputable peer reviewed journals

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Using DNA Core in Practice



DNALYSIS
Biotechnology

DNA Core

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- Next generation in nutrigenetic reporting
- Pulling together for simplified insights & effective recommendations
- Decreasing barriers & improving compliance

- 4 core areas of health insights with targeted recommendations
  - Biological processes
  - Nutrition
  - Weight management
  - Exercise Response

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DNA Core case study

65 year-old female

- Married, 2 children, housewife
- Main concerns:
  - Overweight
  - IBS
  - Arthritis
- Family history:
  - Mother had osteoporosis
  - Father overweight, dyslipidemia

DNA Core case study

Diet

- Breakfast: breakfast biscuit/egg on toast (brown)
- Lunch: Salad with animal protein
- Dinner: Chicken & fish 6x/week with starch and veg/salad, BBQ (lamb/beef) 1x/week – large portions
- Snacks: biscuits, chocolate

Wine on weekends, 2 cappuccinos daily

Does not like vegetables

Exercise

- Pilates 2x/week
- Walking for 20 minutes, 2x/week

Supplements

- Good quality multivitamin
- Omega 3

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DNA Core case study

Biochemistry

- Mildly insulin resistant
- Low vitamin D

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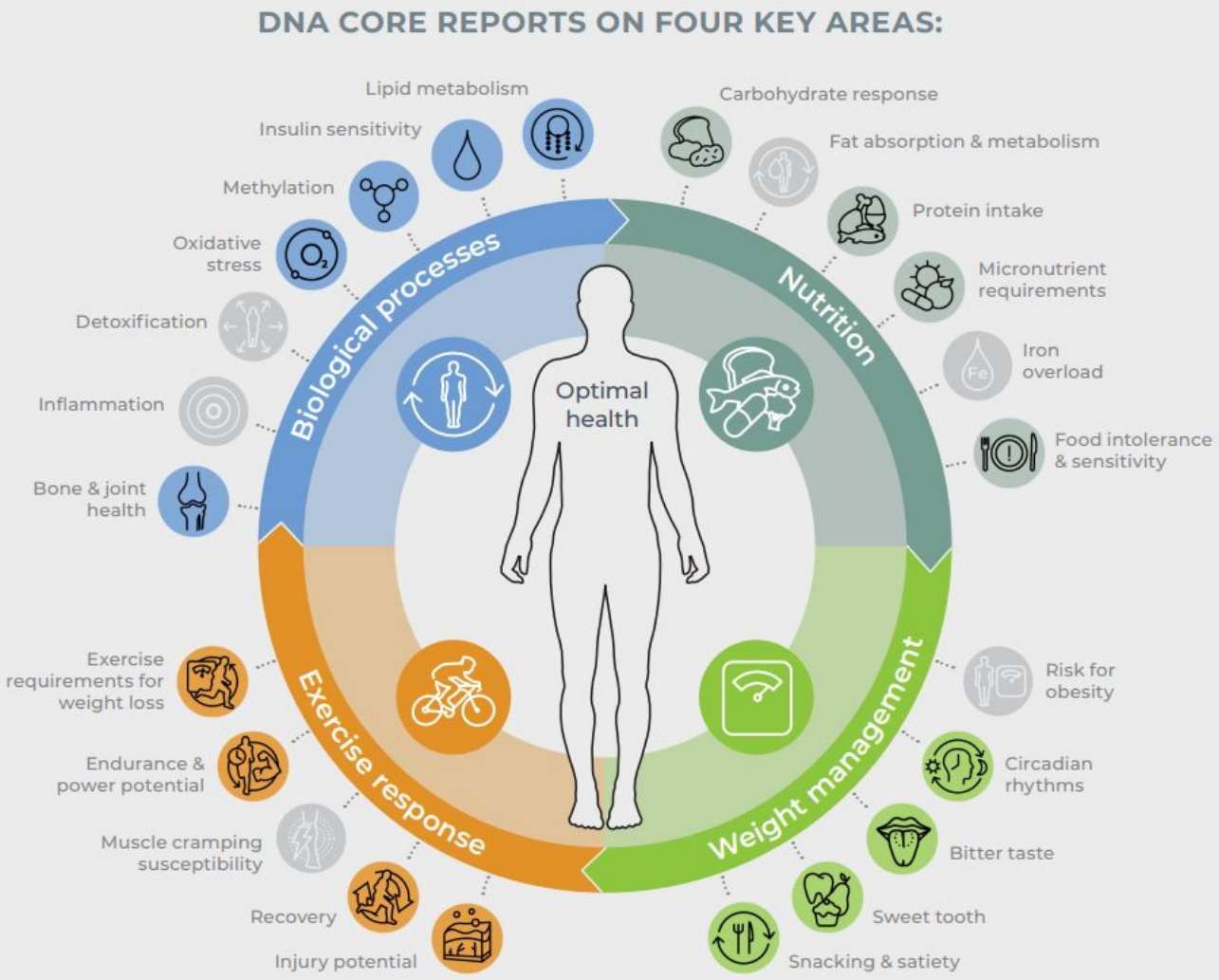
DNA Core report



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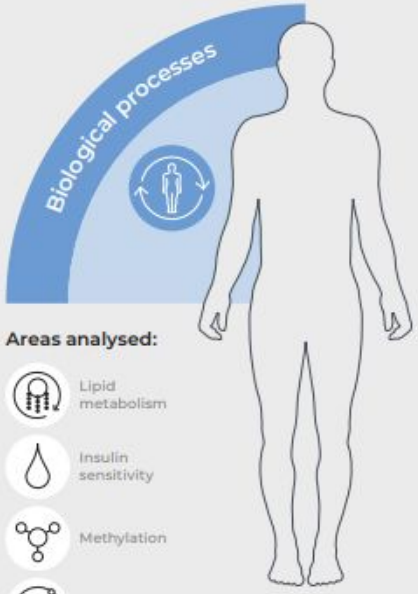
DNA Core report

Summary of core areas

Your biological processes summary

The biological processes that have been identified as priority areas which require additional support, are highlighted in blue below. The greyed-out results indicate a normal or typical outcome.



Areas analysed:

- Lipid metabolism
- Insulin sensitivity
- Methylation
- Oxidative stress
- Detoxification
- Inflammation
- Bone and joint health

Your lipid metabolism results:

Elevated risk for high triglycerides
Altered triglyceride metabolism negatively impacts heart health (triglycerides = energy stored as fats in the blood)

Typical risk for dyslipidaemia
Regular metabolism of "good" & "bad" cholesterol

Typical risk for lipid oxidation
Functioning antioxidant enzyme to protect your blood vessels

Your insulin sensitivity results:

Elevated risk for type 2 diabetes
Poor insulin response to food intake, raising blood glucose levels

Your methylation results:

Elevated risk for raised homocysteine levels
Raised homocysteine levels negatively impacts heart & mental health, mood, ageing & reproduction

Your oxidative stress results:

Suboptimal function of antioxidant enzymes
High risk of oxidative stress, cell damage & premature ageing

Your detoxification results:

Accelerated function of phase I detoxification enzymes
Heightened response to environmental pollutants & risk of cell damage

Typical function of phase II detoxification enzymes
Regulated ability to clear toxins & metabolites from the body with low risk of cell damage

Your inflammation results:

Typical risk for chronic inflammation
Negatively impacts heart & mental health, weight management, & recovery

Your bone and joint health results:

Elevated risk for low bone mineral density
Poor bone health increases risk for osteoporosis & fractures

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DNA Core report

Summary of core areas

Your nutrition summary: Nutrient requirements

The areas that have been identified as priority areas which require additional support, are highlighted in green below. The greyed-out results indicate a normal or typical outcome.



Areas analysed:

- Carbohydrate response
- Fat absorption and metabolism
- Protein intake
- Micronutrient requirements
- Iron overload

Your macronutrient requirements:

- **Moderate barrier to weight loss with carbohydrate intake**
  You may experience weight loss-resistance when eating a carbohydrate-rich diet
- Low-to-moderate barrier to weight loss with higher saturated fat intake. Possible resistance to weight loss with a high saturated fat intake
- Typical benefit for weight management when eating standard recommendations of mono-unsaturated fats
- Typical benefit for weight management when eating standard recommendations of polyunsaturated fats
- **Enhanced benefit for weight management when eating more good-quality protein foods**

Your micronutrient requirements:

- Vitamin A: Typical
  Able to activate vitamin A from food source
- **Vitamin B2: Increased**
  Susceptible to insufficiency: fatigue & compromised DNA health
- **Vitamin B6: Increased**
  Susceptible to insufficiency: negatively impacts heart & mental health, immunity & energy metabolism
- **Folate: Increased**
  Susceptible to insufficiency: negatively impacts heart, mental health & DNA health, with fatigue
- **Vitamin B12: Increased**
  Susceptible to insufficiency: anaemia, fatigue, poor heart health & cognitive function
- Choline: Typical
  Efficient utilisation of the essential nutrient
- Vitamin C: Typical
  Efficient utilisation of the essential vitamin
- **Vitamin D: Increased**
  Susceptible to insufficiency: essential in growth & development, immunity, mental health & skeletal health
- **Calcium: Increased**
  Susceptible to insufficiency: essential in growth & development & skeletal health
- You are at not risk of iron overload
  Normal regulation of iron turnover in the body

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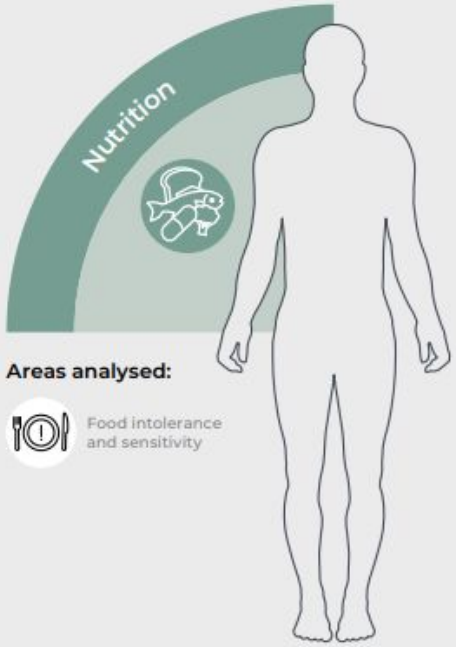
DNA Core report

Summary of core areas

Your nutrition summary: Food intolerance and sensitivity

The areas that have been identified as priority areas which require additional support, are highlighted in green below. The greyed-out results indicate a normal or typical outcome.



Areas analysed:

Food intolerance and sensitivity

Lactose intolerance:

You are lactose intolerant
You likely cannot break down lactose, & may experience undesired abdominal symptoms

Your risk for coeliac disease (gluten intolerance):

You are at increased risk for coeliac disease
You may experience adverse symptoms with gluten intake

Your alcohol metabolism:

Typical alcohol metabolism
No significant increased risk of liver disease with moderate alcohol consumption

Your food sensitivities:

You are caffeine sensitive
Caffeine may negatively affect your sleep, anxiety, heart & bone health

You are salt sensitive
Eating salt & salty foods will increase blood pressure

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DNA Core report

Summary of core areas

Your weight management summary

The areas that have been identified as priority areas which require additional support, are highlighted in green below. The greyed-out results indicate a normal or typical outcome.



Areas analysed:

- Risk for obesity
- Circadian rhythms
- Bitter taste
- Sweet tooth
- Snacking & satiety

Your weight and body composition:

Low-moderate risk for obesity & weight loss resistance
You may encounter some barriers to weight loss

Circadian rhythm influence on your weight and exercise performance:

You are more likely to be a morning person
You may prefer waking up early, getting to bed early & require less effort when exercising earlier in the day

Your eating behaviours:

Increased taste sensitivity to bitter foods
You may have an aversion to vegetables with a bitter taste

Enhanced "sweet tooth"
You are more likely to crave high quantities of sweet foods

Elevated snacking & satiety behaviour
You may feel less satisfied after meals & be more likely to snack often

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DNA Core report

Summary of core areas

Your exercise response summary

The areas that have been identified as priority areas which require additional support, are highlighted in green below. The greyed-out results indicate a normal or typical outcome.



Areas analysed:

- Exercise requirements for weight loss
- Endurance and power potential
- Muscle cramping susceptibility
- Recovery
- Injury potential

Your exercise requirements for weight loss:

You require a LOW-to-MODERATE MET HOURS exercise plan
to mobilise fat stores & manage weight in response to exercise

Your endurance and power potential:

Power potential
A higher genetic potential for power-based exercise

Your muscle cramping susceptibility:

Typical cramping susceptibility
You are not likely to suffer from muscle cramps

Your recovery from exercise:

Slow recovery
You recover slower from strenuous exercise

Your risk for soft tissue injuries:

Elevated injury risk
Poor ability to rebuild collagen with strenuous activity

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How to read the DNA Core: Genotype results table



DNA Core report: genotype results table

○ No Impact ⊘ Beneficial Impact ○ Low Impact ○○ Moderate Impact ○○○ High Impact

INSIGHT	GENE NAME	GENE VARIATION	GENE RESULT	GENE IMPACT			
				Biological areas	Nutrition	Weight management	Exercise response
Lipid metabolism	APOC3	3175 C>G	CC	○			
	APOE	E2/E3/E4	E3/E2	○○			
	CETP	279 G>A	AG	●			
	LPL	1595 C>G	CC	○			
	PON1	A>G	AA	○			
Insulin sensitivity	PPARG	Pro12Ala or C>G	CC	○○	○	○	○
	TCF7L2	C>T	CC	○	○	○	
	SLC2A2	Thr110Ile	TC	●	○○	○○	
	FTO	T>A	AT	●	○○	○○	○○
	IRS1	T>C					
		G>A					
Methylation	MTHFD1	1958 G>A	GG	○	○		
	MTHFR	677 C>T	CT	○○	○○		
		1298 A>C	CA	●	●		
	MTR	2576 A>G	AA	○	○		
	MTRR	66 A>G	AG	●	●		
	CBS	699 C>T	TC	●	●		
	COMT	472 G>A	AA	○○○	○○○		
Phase I detoxification	CYP1A1	Ile462Val A>G	AA	○			
		T>C	CC	○○○			
Phase I detoxification - caffeine	CYP1A2	A>C	AA		⊘		
Phase II detoxification	GSTM1	Insertion/Deletion	Insertion	○			
	GSTP1	313 A>G	AG	●			
	GSTT1	Insertion/Deletion	Insertion	○	○		
	NQO1	609 C>T	○○	○	○		
Antioxidant enzymes	eNOS	894 G>T	GG	○			○
	MnSOD/ SOD2	47 T>C (Val16Ala)	CC	○○○			○○○
	GPx	Pro198Leu	CT	○○			
	CAT	-262 C>T	CT	●			

APOE E2/E3

In general, E2 carriers have lower total cholesterol levels and improved antioxidant capacity but reduced ability to clear certain fats, often resulting in lower LDL cholesterol but potentially higher triglyceride levels. Cholesterol binding to receptors may be impaired leading to hyperlipidemia.

Insulin Sensitivity

PPARG - CC - 2.5 times increased risk for T2D, increased risk of conversion from insulin resistance to T2D

SLC2A2 - TC - T allele had a significantly higher intake of sugars, suggesting an underlying glucose-sensing mechanism, rather than glucose/insulin levels, that regulates food intake.

FTO - AT - The A allele has been associated with higher BMI, higher body fat percentage and higher waist circumference, especially in individuals with a sedentary lifestyle. Overweight individuals with the A allele are at increased risk for insulin resistance and diabetes, especially when there is a high fat intake.

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DNA Core report: genotype results table

○ No Impact ⊘ Beneficial Impact ○ Low Impact ○○ Moderate Impact ○○○ High Impact

INSIGHT	GENE NAME	GENE VARIATION	GENE RESULT	GENE IMPACT			
				Biological areas	Nutrition	Weight management	Exercise response
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	APOE	E2/E3/E4	E3/E2	○○			
	CETP	279 G>A	AG	●			
	LPL	1595 C>G	CC	○			
	PON1	A>G	AA	○			
Insulin sensitivity	PPARG	Pro12Ala or C>G	CC	○○	○	○	○
	TCF7L2	C>T	CC	○	○	○	
	SLC2A2	Thr110Ile	TC	●	○○	○○	
	FTO	T>A	AT	●	○○	○○	○○
	IRS1	T>C					
		G>A					
Methylation	MTHFD1	1958 G>A	GG	○	○		
	MTHFR	677 C>T	CT	○○	○○		
		1298 A>C	CA	●	●		
	MTR	2576 A>G	AA	○	○		
	MTRR	66 A>G	AG	●	●		
	CBS	699 C>T	TC	●	●		
	COMT	472 G>A	AA	○○○	○○○		
Phase I detoxification	CYP1A1	Ile462Val A>G	AA	○			
		T>C	CC	○○○			
Phase I detoxification - caffeine	CYP1A2	A>C	AA		⊘		
Phase II detoxification	GSTM1	Insertion/Deletion	Insertion	○			
	GSTP1	313 A>G	AG	●			
	GSTT1	Insertion/Deletion	Insertion	○	○		
	NQ01	609 C>T	○○	○	○		
Antioxidant enzymes	eNOS	894 G>T	GG	○			○
	MnSOD/ SOD2	47 T>C (Val16Ala)	CC	○○○			○○○
	GPx	Pro198Leu	CT	○○			
	CAT	-262 C>T	CT	●			

Methylation

MTHFR 677- CT - The T allele reduces the stability and lowers activity of the MTHFR enzyme, which results in an increase in homocysteine levels, a decrease in DNA methylation, and thus an increase in DNA adducts. T allele carriers have increased folate, vitamin B2, B6 and B12 requirements. Enzyme function is only 70% of optimal in CT individuals.

COMT - AA - The A allele is associated with a 3-4 fold reduction in the methylation activity of the COMT enzyme and so is associated with higher dopamine (stress) levels, a lower pain threshold, and enhanced vulnerability to stress.

Phase 1 Detox - CYP1A1 - CC - C allele has been associated with increased transcript half-life and an increase in enzyme activity, leading to elevated levels of activated metabolites such as PAHs, and subsequently, DNA damage.

Antioxidant enzymes - SOD 2 CC - increased risk of oxidative damage. Excess weight and sedentary lifestyle increase risk of chronic disease

DNA Core report

Your core priority areas – the detail

In this section, all of your genetic priorities per core area are again highlighted for you. This time, further detail is provided to describe the priority area, what it potentially means for you health-wise, and most importantly, what to do to support these areas.

Biological processes

Lipid metabolism



Risk of hypertriglyceridemia

Triglycerides are a type of fat, or lipid, found in your body, and can circulate in your blood. Triglycerides are made from excess calories that you have eaten. The formation of triglycerides is a way of storing energy that your body does not need to use right away. Having high triglyceride levels can lead to hardening and damage of your blood vessels and can increase your risk of heart disease and metabolic syndrome.

Your results

Your genotype increases your risk for having high triglyceride levels.

Risk

TYPICAL ELEVATED

Outcomes

Avoid refined carbohydrate intake such as instant noodles, white bread, pizza, and pastries and crisps. Replace carbohydrates and saturated fats (burgers, chicken skin, butter, coconut oil) with monounsaturated fats (peanut butter, olive oil). Manage your weight and speak to your healthcare provider about taking a good quality omega-3 supplement.

GENE VARIATION	GENE RESULT	GENE IMPACT
APOC3 3175 C>G	CC	○
APOE E2/E3/E4	E3/E2	○○

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Homocysteine and methionine regulation

Methylation is a simple but key biochemical process that regulates the functioning of several biological systems. Methylation is involved in regulating mood and sleep through production of neurotransmitters, supporting DNA replication for growth and repair, forming the supportive structures that wrap around our nerves, ensuring appropriate nervous system function and cognition, production of immune cells needed for protection against infections, and ensuring healthy cell structure and appropriate communication between cells. The actual process of methylation involves making the special building blocks that can be used in regulating the above-mentioned biological systems. Methylation is also essential to help switch genes on and off, and it plays an important role in protein metabolism and breaking down homocysteine, an amino acid which can become harmful when levels in the body become too high. The methylation process is dependent on "methyl-nutrients" including our B-vitamin family as well as choline and betaine. Poor levels of these nutrients, together with variation in genes involved in methylation, can lead to suboptimal functioning of this process and an increased risk for several disorders.

Your results

Your genotype combination leads to suboptimal functioning of these enzymes, which means elevated support is required to better optimise methylation. Poor methylation can be experienced as feelings of low mood, poor heart health, fatigue, and hormonal imbalances. Certain blood tests may also reveal that homocysteine levels (a kind of protein your body makes as a by-product of methylation) may be elevated.

Support

TYPICAL — ELEVATED

Outcomes

Increase your intake of vitamin B and choline-rich foods including dark green leafy vegetables, lentils, whole grains, nuts and seeds, fish and eggs. Consider supplementing with a vitamin B complex that contains L-5-methyltetrahydrofolate and methylcobalamin, but speak to your healthcare provider for advice on a good quality supplement and what is best for you based on a full assessment of your personal needs. Manage stress and avoid alcohol.

GENE VARIATION	GENE RESULT	GENE IMPACT
MTHFD1 1958 G>A	GG	○
MTHFR 677 C>T	CT	●○
MTHFR 1298 A>C	CA	●
MTR 2576 A>G	AA	○
MTRR 66 A>G	AG	●
CBS 699 C>T	TC	●
COMT 472 G>A	AA	○○

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DNA Core report: genotype results table

INSIGHT	GENE NAME	GENE VARIATION	GENE RESULT	GENE IMPACT			
				Biological areas	Nutrition	Weight management	Exercise response
Inflammation	CRP	G>A	AA	○			○
	IL-1A	4845 G>T	GG	○			
		-889 C>T	CC	○			
	IL-1B	3954 C>T	CC	○			
		-511 A>G	AA	○			
	IL-1RN	2018 C>T	TT	○○			
	IL-6	-174 G>C	CG	○○			○○
	IL-6R	A>C	CA				○○
	TNFA	-308 G>A	GG	○	○	○	○
Vitamin D metabolism & bone health	VDR	Fok1 T>C	TC	●	●		
		Bsm1 G>A	AA	○○○	○○○		
		Taq1 T>C	CC	○○○	○○○		Ⓟ*
	CYP2R1	A>G	AA		○		
	GC	T>G	GT		○○		
		1296 G>T	TG		○○		
Vitamin A metabolism	BCO1	G>T	TT		○		
		Ala379Val (C>T)	CC		○		
Vitamin B12 transport	FUT2	Gly258Ser G>A	GA		○○		
Lactose Intolerance	MCM6	-13910 C>T	CC		○○○		
Gluten intolerance	HLA	DQ2 / DQ8	DQ2.2		○○		
Alcohol metabolism	ALDH2	rs671 G>A	GG		○		
Iron overload	HFE	C282Y & H63D	282CC & 63HH		○		
Fat absorption & metabolism	ADIPOQ	-11391 G>A	GG		○○	○○	
	APOA2	-256 T>C	CT		●	●	
	APOA5	-1131 T>C	TT		○○	○○	
	FABP2	Ala54Thr G>A	GG		○	○	
	PLIN	11482 G>A	GG		○	○	

*The Ⓟ (Power) and/or Ⓔ (Endurance) impact in the exercise response column refers to a moderate or high gene impact in the Endurance and/or Power Potential section indicating a genetic benefit to you. See page 52 for more information on your Endurance and Power Potential results.

Inflammation - IL-1RN TT and IL-6 CG - Certain genetic variations in IL-1A and IL-B and IL-1 RN lead to a more active inflammatory response, and have been associated with increased risk for a number of chronic diseases.

IL-6 - C allele of this functional SNP has been associated with raised IL-6 and CRP concentrations

Vitamin D and Bone Health:

VDR Bsm1 AA - A allele is associated with reduced BMD and predisposes to osteoporosis, especially when calcium intake is low. Women with the AA genotype have high bone loss when their caffeine intake is more than 300 mg/day.

Taq1 - CC - CC genotype have higher bone turnover and increased bone loss. This is highest when there is a low calcium intake. Individuals with the CC genotype have higher bone loss when caffeine intake is more than 300 mg/d.

Vitamin D - GC T>G - GT - G allele leads to a decrease in the vitamin D binding capacity of the protein. Individuals carrying the TG or GG genotypes have been associated with lower 25(OH)D concentrations and supplementation may lead to lower incremental increases in serum levels.

Vitamin D - GC 1296 - TG - with lower vitamin D binding protein (VDBP) levels and lower serum vitamin D levels.

DNA Core report: genotype results table

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		-889 C>T	CC	○			
	IL-1B	3954 C>T	CC	○			
		-511 A>G	AA	○			
	IL-1RN	2018 C>T	TT	●●			
	IL-6	-174 G>C	CG	●●			●●
	IL-6R	A>C	CA				●●
	TNFA	-308 G>A	GG	○	○	○	○
Vitamin D metabolism & bone health	VDR	FokI T>C	TC	●	●		
		BsmI G>A	AA	●●●	●●●		
		TaqI T>C	CC	●●●	●●●		Ⓟ*
	CYP2R1	A>G	AA		○		
	GC	T>G	GT		●●		
		1296 G>T	TG		●●		
Vitamin A metabolism	BCO1	G>T	TT		○		
		Ala379Val (C>T)	CC		○		
Vitamin B12 transport	FUT2	Gly258Ser G>A	GA		●●		
Lactose Intolerance	MCM6	-13910 C>T	CC		●●●		
Gluten intolerance	HLA	DQ2 / DQ8	DQ2.2		●●		
Alcohol metabolism	ALDH2	rs671 G>A	GG		○		
Iron overload	HFE	C282Y & H63D	282CC & 63HH		○		
Fat absorption & metabolism	ADIPOQ	-11391 G>A	GG		●●	●●	
	APOA2	-256 T>C	CT		●	●	
	APOA5	-1131 T>C	TT		●●	●●	
	FABP2	Ala54Thr G>A	GG		○	○	
	PLIN	11482 G>A	GG		○	○	

*The Ⓟ (Power) and/or Ⓔ (Endurance) impact in the exercise response column refers to a moderate or high gene impact in the Endurance and/or Power Potential section indicating a genetic benefit to you. See page 52 for more information on your Endurance and Power Potential results.

Nutrients and sensitivities

Vitamin B12 - FUT2 - GA - increased activity of the FUT2 enzyme; this is associated with lower serum vitamin B12 levels and an increased risk for life-long lower vitamin B12 and higher homocysteine levels, particularly in at-risk individuals such as those on certain medications and with comorbidities. The SNP is also linked to an altered gut microbiome and increased intestinal permeability.

Lactose intolerance - CC - Individuals with this genotype should avoid intake of dairy products. The CT and TT genotypes are associated lactase persistence in the Caucasian population.

Gluten intolerance - positive HLA - significantly greater chance of developing gluten intolerance.

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DNA Core report: genotype results table

INSIGHT	GENE NAME	GENE VARIATION	GENE RESULT	GENE IMPACT			
				Biological areas	Nutrition	Weight management	Exercise response
Polyunsaturated fatty acid metabolism	FADS1	G>T	GT		●●		
Energy homeostasis	UCP1	-3826 A>G	GA			●	
	UCP2	-866 G>A	GG			○	
	UCP3	55 C>T	TC			◕	
Epinephrine receptors - energy mobilisation	ADRB2	Arg16Gly	GG			●●	●●
		Gln27Glu	GG		●●●	●●●	●●●
	ADRB3	Trp64Arg	TT			○	○
Dopamine receptor	DRD2	C>T	CC		○	○	
Taste sensitivity	TAS1R2	Ile191Val	GG		○	○	
	TAS2R38	Pro49Ala Ala262Val Val296Ile	Medium Taster			●●	
Snacking & satiety	MC4R	V103I	CT		●●	●●	
Circadian rhythms	CLOCK	3111 T>C	TT			○	
Blood flow & respiration	AGT	T>C	TC		●●		○
	ACE	I>D	DD		○		Ⓟ*
	BDKRB2	C>T	CT				Ⓔ*
	VEGF	C>G	CG				○
Energy during exercise	NRF2	A>G	AA				○
	PPARGC1A	G>A	GG				Ⓔ*
	PPARA	G>C	GG				Ⓔ*
Fuel during exercise	TRHR	C>T	TT				Ⓟ*
Musculoskeletal properties	ACTN3	R>X	XR				Ⓟ*
Muscle cramping susceptibility	AMPD1	G>A	GG				●
Collagen production	COL1A1	1546 G>T	TG	●●			●●
	GDF5	C>T	CC				○
	COL5A1	C>T	TT				●●●

PUFA - FADS1 GT - The G allele is associated with enhanced conversion of DGLA to AA due to increased enzymatic efficiency and thus appears to be associated with higher levels of AA, systemic inflammation and inflammatory disorders especially in the presence of a modern western diet.

ADRB2 - GG - The G allele has been associated with increased BMI and fat mass. Carriers of the G allele are less able to use fat stores as a source of fuel during exercise compared to the CC genotype.
Individuals with the G allele have been shown to have a greater risk of obesity and elevated insulin levels when carbohydrate intake is greater than 49% of total energy. Decreasing intake of CHO has been shown to reduce insulin levels and is beneficial in weight management.

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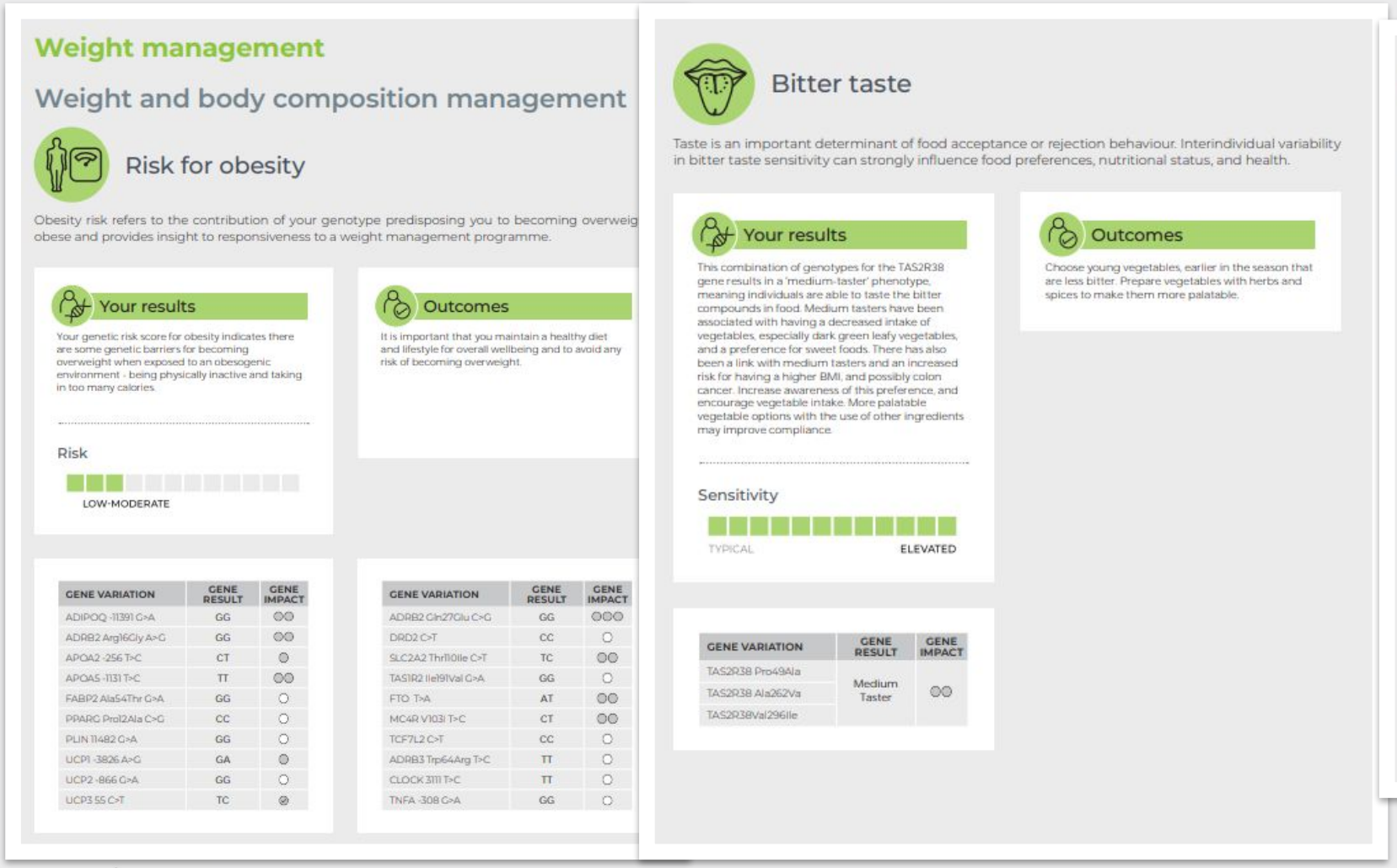

Weight management

Weight and body composition management

Risk for obesity

Obesity risk refers to the contribution of your genotype predisposing you to becoming overweig obese and provides insight to responsiveness to a weight management programme.

Your results

Your genetic risk score for obesity indicates there are some genetic barriers for becoming overweight when exposed to an obesogenic environment - being physically inactive and taking in too many calories.

Risk

LOW-MODERATE

Outcomes

It is important that you maintain a healthy diet and lifestyle for overall wellbeing and to avoid any risk of becoming overweight.

GENE VARIATION	GENE RESULT	GENE IMPACT
ADIPOQ -11391 G>A	GG	○○
ADRB2 Arg16Gly A>G	GG	○○
APOA2 -256 T>C	CT	○
APOA5 -1131 T>C	TT	○○
FABP2 Ala54Thr G>A	GG	○
PPARG Pro12Ala C>G	CC	○
PLIN 11482 G>A	GG	○
UCP1 -3826 A>G	GA	○
UCP2 -866 G>A	GG	○
UCP3 55 C>T	TC	○

GENE VARIATION	GENE RESULT	GENE IMPACT
ADRB2 Gln27Glu C>G	GG	○○○
DRD2 C>T	CC	○
SLC2A2 Thr110Ile C>T	TC	○○
TAS1R2 Ile191Val G>A	GG	○
FTO T>A	AT	○○
MC4R V103I T>C	CT	○○
TCF7L2 C>T	CC	○
ADRB3 Trp64Arg T>C	TT	○
CLOCK 3111 T>C	TT	○
TNFA -308 G>A	GG	○

Bitter taste

Taste is an important determinant of food acceptance or rejection behaviour. Interindividual variability in bitter taste sensitivity can strongly influence food preferences, nutritional status, and health.

Your results

This combination of genotypes for the TAS2R38 gene results in a 'medium-taster' phenotype, meaning individuals are able to taste the bitter compounds in food. Medium tasters have been associated with having a decreased intake of vegetables, especially dark green leafy vegetables, and a preference for sweet foods. There has also been a link with medium tasters and an increased risk for having a higher BMI, and possibly colon cancer. Increase awareness of this preference, and encourage vegetable intake. More palatable vegetable options with the use of other ingredients may improve compliance.

Sensitivity

TYPICAL ELEVATED

Outcomes

Choose young vegetables, earlier in the season that are less bitter. Prepare vegetables with herbs and spices to make them more palatable.

GENE VARIATION	GENE RESULT	GENE IMPACT
TAS2R38 Pro49Ala	Medium Taster	○○
TAS2R38 Ala262Va		
TAS2R38Val296Ile		

Snacking and satiety

Satiety can be described as the feeling of fullness after a meal. Some individuals have an increased tendency to snack more often and to experience reduced feelings of satiety

Your results

You may have a tendency for increased snacking behaviour and experience reduced feelings of satiety.

Snacking behaviour

TYPICAL ELEVATED

GENE VARIATION	GENE RESULT	GENE IMPACT
TCF7L2 C>T	CC	○
MC4R V103I T>C	CT	○○
FTO T>A	AT	○○

Outcomes

Try not to skip meals, opt for healthy snacks such as vegetables and fibre-rich foods, and make use of mindful eating techniques (sit at a table for all meals, eat only what is plated, don't eat on-the-run or in front of the TV, don't snack directly from the cupboard or fridge).

Food sources

Healthy snacking

REPLACE	WITH
Ice cream with toppings	Low fat yoghurt with berries
Pizza slice	Sandwich with animal protein and vegetables
Pasta salad	Fresh vegetables with low fat dip
Nachos and cheese dip	Whole wheat crackers
Potato crisps	Popcorn original

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Exercise response

Exercise requirements for weight loss

Many people believe that if they are doing some sort of exercise and eating healthy, they will lose weight. In theory this is correct, but our genes tell a bit of a different story. Surprisingly, the amount and intensity of exercise you do, can play a key role in whether your weight loss journey will be successful.

Your results

A LOW - to - MODERATE INTENSITY exercise program of 3 x 60-minute sessions a week is suggested for you as a minimum in order to manage your weight. These can be broken down into 6 x 30-minute sessions or other possible variations.

Intensity

LOW-MODERATE

Outcomes

You require slightly higher amounts of physical activity to help achieve and maintain weight loss. Try to aim for a minimum of 20 MET Hours per week.
One of the most important elements is the intensity of your workout. But how do you know if you're working at a low - moderate intensity level? There's no precise definition, but there are ways to monitor how hard you're working: for example, if you are working at a low - moderate intensity level, you should be breathing heavily but still able to hold short conversations with someone else. You should still feel somewhat comfortable, becoming noticeably more challenged though. The energy expenditure will be different for every single person as it depends on a multitude of factors such as age, gender, body composition, and current level of fitness. Something that might seem very easy for you, may be much more difficult for someone else.

GENE VARIATION	GENE RESULT	GENE IMPACT
ADRB2 Arg16Gly A>G	GG	○○
ADRB2 Gln27Glu C>G	GG	○○○
ADRB3 Trp64Arg T>C	TT	○
FTO T>A	AT	○○
PPARG Pro12Ala C>G	CC	○

Your results

Your genotype shows that you are likely to recover at a slow rate from hard exercise.

Recovery

TYPICAL — SLOW

GENE VARIATION	GENE RESULT	GENE IMPACT
IL-6 -174 G>C	CG	○○
IL-6R A>C	CA	○○
CRP G>A	AA	○
TNFA -308 G>A	GG	○
MnSOD/SOD2 47 T>C (Val16Ala)	CC	○○○
eNOS 894 G>T	GG	○

Outcomes

It is important to progress your training at an appropriate rate and provide sufficient recovery time in order to be ready for your next training session. You should follow planned recovery strategies to gain the best returns from your training and optimise performance. Sleep is vitally important for recovery and you should look to obtain enough sleep so that you feel refreshed upon rising in the morning. Managing your nutrition is also important for optimal recovery. Because inflammation and oxidative stress influence recovery rates, you should look to consume mostly anti-inflammatory and anti-oxidant foods in your diet and avoid those that are pro-inflammatory. Focus on fruits and vegetables of many different colours: green leafy vegetables and cruciferous vegetables have particularly good anti-oxidant properties. Include fish in your diet: ensure that you are meeting adequate levels of omega-3 intake or you may wish to consider supplementation. Consuming carbohydrate based beverages during prolonged exhaustive exercise can help to reduce levels of inflammatory cytokines such as IL-6 and CRP following exercise. Consumption of a mixed protein and low GI carbohydrate meal after exercise is also known to decrease inflammation and assist recovery. Long term, regular, light and moderate intensity exercise leads to an increase in function of anti-oxidant enzymes, as well as decrease in baseline inflammatory cytokines: beneficial to exercise training, performance and optimal health. Avoid smoking of any kind.

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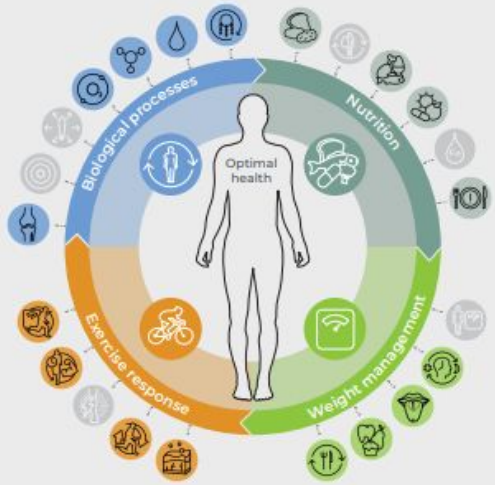

Biological processes

Support lipid metabolism:
- Nutrients: Omega 3 fatty acids, fibre
- Focus foods: Fatty fish (mackerel) walnuts, vegetables & legumes
- Limit refined carbohydrates, sugar & alcohol
- Manage weight & practice portion control

Support insulin sensitivity:
- Nutrients: Good quality fats, fibre, protein
- Focus foods: High-fibre, nutrient-dense wholefoods, limiting carbohydrate-rich foods
- Maintain a healthy weight, regular meal-timing with portion control
- Exercise regularly & manage stress

Support methylation:
- Nutrients: Vitamin B complex (with methylfolate), choline, magnesium, zinc
- Focus foods: Green leafy vegetables, nuts & seeds, lentils, eggs
- Manage stress & avoid alcohol

Support antioxidant status:
- Nutrients: Vitamins C & E, selenium, zinc, copper, resveratrol, quercetin
- Focus foods: Colourful fruits (citrus, apples, berries), nuts, seeds, leafy greens, lean meat
- Exercise at moderate intensity, daily
- Manage stress & limit toxin exposure (pollutants, chemicals etc.)

Support bone health:
- Nutrients: Vitamin D & K, calcium, magnesium
- Focus foods: Dairy, fatty fish, nuts, leafy greens, tofu
- Do load bearing exercise
- Limit caffeine to less than 3 cups of coffee per day

Nutrition

Your recommended diet:
- Follow a low carbohydrate diet
- Limit carbohydrate intake to less than 45% of total energy (calories consumed)
- Increase protein intake (plant-based & lean) to make up 25% of total calorie consumption

Micronutrient requirements:
- Avoid insufficiency with nutrient-rich foods & supplementation

Vitamin A	Folate	Vitamin C
Vitamin B2	Vitamin B12	Vitamin D
Vitamin B6	Choline	Calcium-rich foods

Food intolerances and sensitivities:
- Avoid lactose (milk, cheese)
- Check for gluten intolerance & eliminate gluten
- Limit caffeine to 1 cup coffee/day in the morning
- Avoid salt & salty foods

Weight management

Circadian rhythm influence:
- Exercise in the morning for best results

Challenge your bitter taste sensitivity:
- Add herbs & spices to young vegetables

Control your sweet tooth:
- Avoid all high-sugar & artificially sweetened foods

Incorporate mindful eating practices:
- Don't skip meals, choose healthy snacks & monitor portion-size

Exercise response

Exercise for weight management:
- Follow an exercise program that reaches at least 20 MET hours per week

A power-based training program will improve performance:
- Strength, speed and power training will help you to gain the best results

Optimise recovery:
- Ensure sufficient rest between intensive sessions with good sleep hygiene

Manage your risk of soft tissue injuries:
- Practice 'prehabilitative' & flexibility training & support collagen health with nutrition

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DNA Core case study

65 year-old female

- Married, 2 children, housewife
- Main concerns:
  - Overweight
  - IBS
  - Arthritis
- Family history:
  - Mother had osteoporosis
  - Father overweight, dyslipidemia

DNA Core case study

Diet

- Breakfast: breakfast biscuit/egg on toast (brown)
- Lunch: Salad with animal protein
- Dinner: Chicken & fish 6x/week with starch and veg/salad, BBQ (lamb/beef) 1x/week – large portions
- Snacks: biscuits, chocolate

Wine on weekends, 2 cappuccinos daily

Does not like vegetables

Exercise

- Pilates 2x/week
- Walking for 20 minutes, 2x/week

Supplements

- Good quality multivitamin
- Omega 3

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DNA Core case study

Biochemistry

- Mildly insulin resistant
- Low vitamin D

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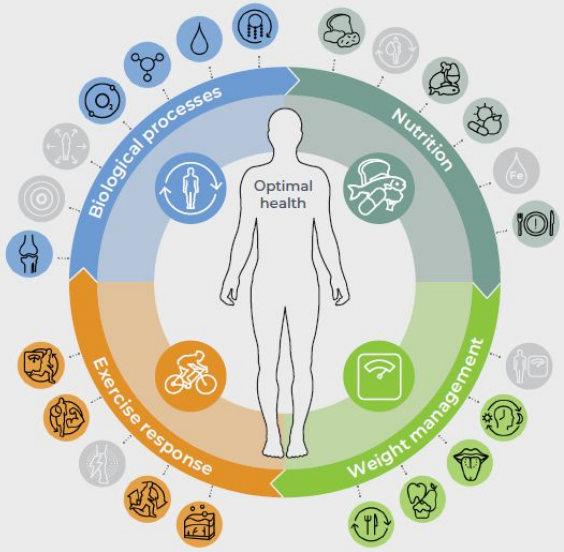
DNA Core case study



Recommendations

- Low carbohydrate diet
    - Emphasis on good quality protein
    - Good quality fats & fibre
    - Good nutrient diversity and plant based intake
- Avoid lactose, reduce gluten
- Reduce coffee to 1 per day
- Stress management
- Reduce toxic load
- Include cruciferous veg, onion and garlic to support liver function

- Supplementation: Extra vitamin D, Methylated b-complex. Check dose on Omega 3
- Adopt a regular exercise routine – strength & cardiovascular

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Appendix

Factsheets

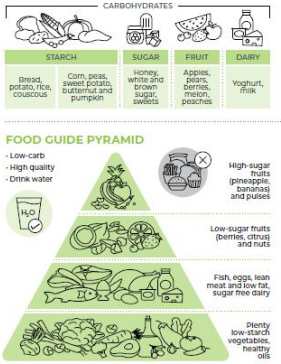
- Diet type for weight management
- Exercise and MET hours for weight management
- Improving sports performance

Diet type for weight management
Low carbohydrate diet

Low carbohydrate diets have a positive impact on obesity, serum lipids, impaired glucose metabolism and hypertension, but it is important to understand what constitutes a low carbohydrate diet. There is no need to completely cut out carbohydrates from the diet; the same positive results can still be achieved with a smaller intake of carbohydrates as described in the recommendations below.

A low carbohydrate diet limits intake to 30-130g of carbohydrates per day that are unrefined and of good quality, usually starting with the lower level in the first week or two, increasing to 60-70g/day by week three, eventually maintaining approximately 100-130g/day.

WHAT IS A CARBOHYDRATE?



FOOD GUIDE PYRAMID

THE DIET IS BEST DESCRIBED AS:

- Refined carbohydrates, most whole-grains and all sugars should be avoided, including natural sugars.
- Carbohydrates will be consumed in an array of vegetables and fruits, legumes, seeds and nuts, and dairy. All these foods do contain an amount of carbohydrates and need to be accounted for in your diet plan.
- Avoid starchy vegetables as they are high in carbohydrates and include leafy green vegetables where possible. Fruit will also be restricted.
- Fat intake should focus on mono-unsaturated fatty acids, mostly from olive oil, and omega 3 polyunsaturated fat-rich foods such as fatty fish.
- Eat 3 meals and 2 snacks a day - never skip meals.
- Avoid drinks and foods with artificial sweeteners, and ensure adequate intake of water.
- Learn to read food labels. Most food contains carbohydrates and you need to learn to identify foods that contain hidden carbohydrates, especially sugar. As an example, tomato sauce and salad dressing are both very high in sugar.

Exercise and MET hours for weight management

Below you will find a detailed explanation of exactly what MET HOURS are, and a guide to plan your exercise week to meet your recommended MET HOURS. Remember to consult your healthcare practitioner before embarking on a new exercise programme, and to stop exercising if you feel nauseous or short of breath.

What is a MET?

MET stands for Metabolic Equivalent Task. METs are a **way to measure how much energy you burn up during any chosen physical activity**. Every activity, from watching TV to going for a run, has a MET value. The more vigorous the activity, the higher the MET value.

What are MET HOURS?

Whereas METs are a way to measure the intensity of a particular activity, MET HOURS **allow you to calculate how many hours of your chosen activities you need to do** in a week.

Three easy steps to calculating your weekly MET HOURS score

Refer to your exercise requirements, and to the table of activities divided into light, moderate and vigorous intensity on page 17.

1. **Match your activity of choice to the exercise description** to determine whether you are reaching your recommended amount of physical activity in MET HOURS. Try to balance high intensity sessions with light to moderate exercises to assist with recovery and decrease risk of injury and 'burning out'.

2. **Use this equation to calculate the MET HOURS for each activity:**

   MET VALUE x DURATION = MET HOURS SCORE (in hours)

   For example, if you play singles tennis for 1 hour and 40 minutes (1.60 hours):
   8 METS x 1.60 = 13 MET HOURS

3. **To calculate your weekly MET HOURS SCORE:**

   Add the MET HOURS SCORE of each workout for that week

   For example, if you played singles tennis for 1 hour and 40 minutes, ran for 30 minutes at a pace of 8 km/hour (8 x 0.5 = 4) and played 2 hours of golf (4.5 x 2 = 9), then your weekly MET HOURS SCORE will be 26 (13 + 4 + 9)

Improving sports performance

Cardio zone training table

If you are training with a heart rate monitor, use it to stay within range of the suggested heart rate percentages.

Calculating your target heart rate:

- Maximum heart rate = 220 – age
- Heart rate reserve = maximum heart rate – resting heart rate
- Target heart rate = (heart rate reserve x training %/100) + resting heart rate

If you are not training with a heart rate monitor, choose which zone you think you are in by assessing how you feel during the workout. Does it seem quite light and can you keep a conversation going? Or are you gasping for air throughout the entire session?

ZONE	HEART RATE (target heart rate)	EFFORT / FEEL	BENEFITS
1	95 - 114 (50 - 60%)	Very light	**Improved overall health:** body fat decreases, blood pressure and cholesterol are lowered, muscle mass increase, and helps recovery.
2	114 - 133 (60 - 70%)	Light	**Improved basic endurance:** gain muscle and lose fat mass, strengthen heart muscle, fat utilization zone.
3	133 - 152 (70 - 80%)	Moderate	**Improved aerobic fitness:** increase in the number and size of blood vessels, increased lung capacity and respiratory rate, as well as an increase in size and strength of the heart muscle.
4	152 – 171 (80 - 90%)	Hard	**Increased maximum performance capacity:** high total calories burned during exercise. Large amount of carbohydrates used for energy production. Improved lung capacity and higher tolerance for more strenuous exercises.
5	171 – 190 (90 - 100%)	Very hard	**Develops maximum performance and speed:** Highest total calories burned, but lowest percentage of fat calories. Spending too much time in this zone, even for elite athletes can be painful, cause injuries and lead to over training.

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Genetic testing for personalised healthcare

MTHFR 677 C>T and MTHFR 1298 A>C

Background

Methylenetetrahydrofolate reductase is a riboflavin-dependent (FAD) enzyme that catalyzes the NADPH-dependent reduction of 5,10-methylene-tetrahydrofolate (THF) to 5-methyl-THF, and is a key enzyme in the folate metabolism pathway – directing folate from the diet either to DNA synthesis or homocysteine remethylation, a process by which homocysteine is converted back to Methionine. The two polymorphisms described occur at relatively high frequencies in the population, approximately 10-30%, and lower the activity of the MTHFR enzyme.

Gene Impact

○ No Impact ● Low Impact ●● Moderate Impact ●●● High Impact ✓ Beneficial Impact

GENE	GENE VARIATION	GENOTYPE	GENE IMPACT
MTHFR	677 C>T	CC	○
		CT	●●
		TT	●●●
	1298 A>C	AA	○
		AC	●
		CC	●●

MTHFR 677 C>T

The **T allele** reduces the stability and lowers activity of the MTHFR enzyme, which results in an increase in homocysteine levels, a decrease in DNA methylation, and thus an increase in DNA adducts. T allele carriers have increased folate, vitamin B2, B6 and B12 requirements. Enzyme function is only 70% of optimal in CT individuals and 30-40% of optimal in TT in individuals.

MTHFR 1298 A>C

The **C allele** affects enzyme regulation by S-adenosylmethionine (SAMe), and is associated with decreased enzyme function.

Recommendations: T allele

Incorporate a folate and B vitamin rich diet. Decrease alcohol intake and cessation of smoking is recommended. Also consider supplementation of active folate (5-methyltetrahydrofolate/5-MTHF) and vitamins B2, B6 and B12.

Recommendations: C allele

Incorporate a folate and B vitamin rich diet. Decrease alcohol intake and cessation of smoking is recommended. Also consider supplementation of active folate (5-methyltetrahydrofolate/5-MTHF) and vitamins B2, B6 and B12.

DNA Health | Key Biological Areas | Methylation

SNP Interpretation Guide

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DNA Gut

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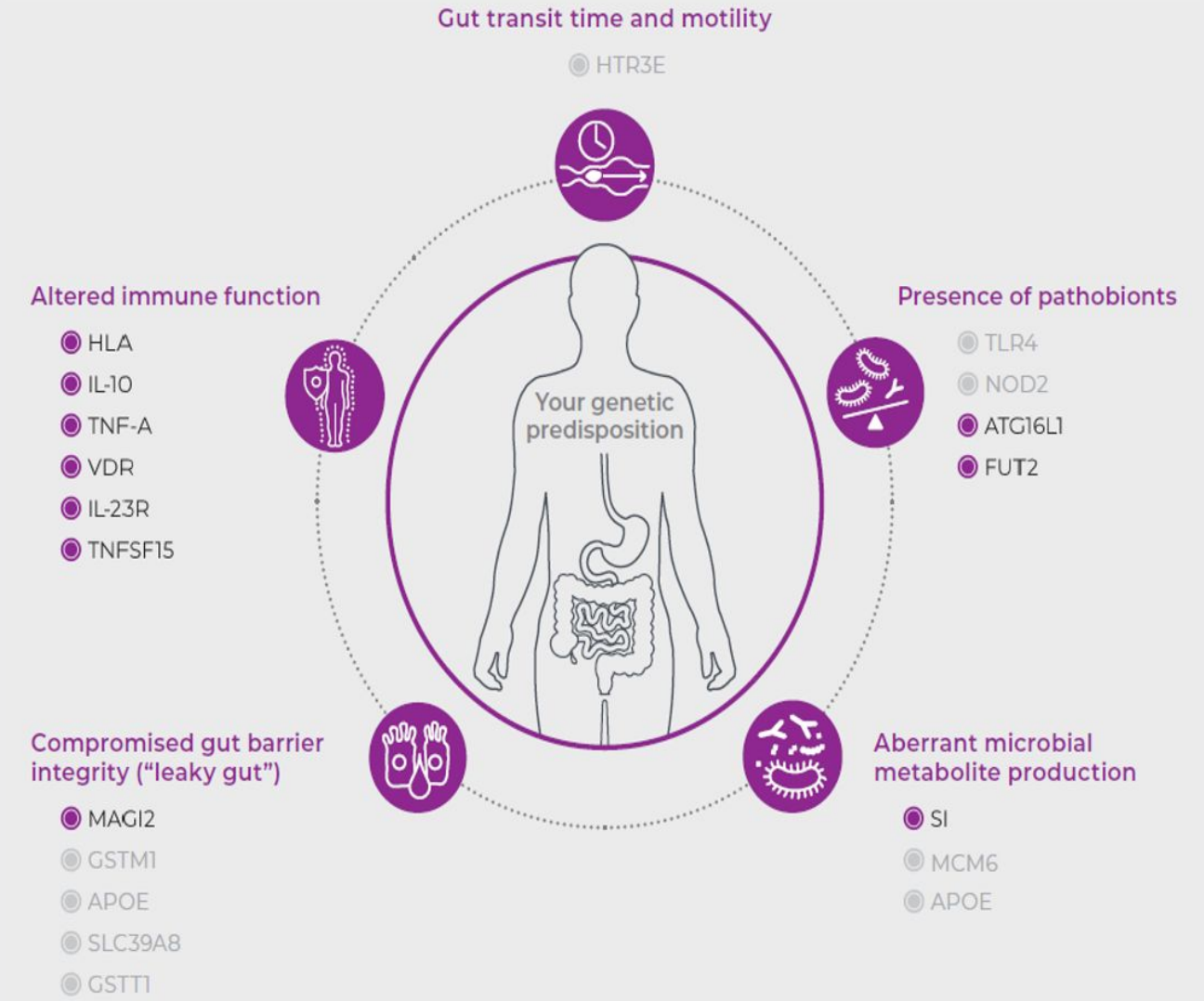

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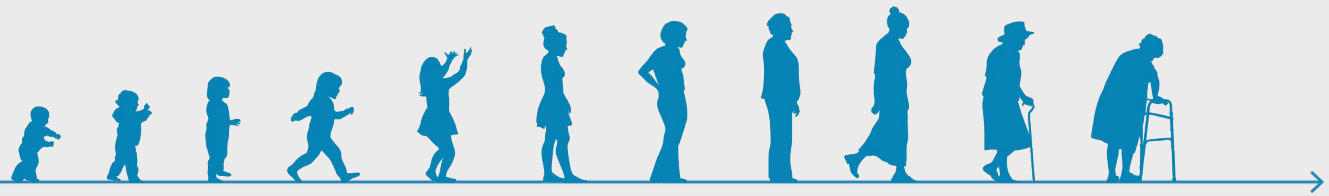

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