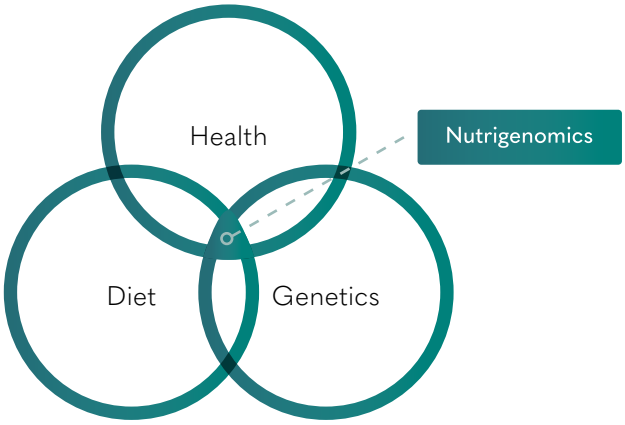
Contents

Nutrition and Lifestyle Genomics

Nutrition and lifestyle genomics is one of the most exciting and revolutionary fields in nutrition, genetics and personalised medicine. It explores the relationship between nutrients, diet, lifestyle factors and gene expression.



Given the increasing global burden of nutrition-related diseases such as obesity and type II diabetes, nutrition and lifestyle genomics could help to develop more sustainable approaches to encouraging healthy lifestyle changes. A healthy lifestyle can influence how our genes express themselves (how they turn on and off) and these changes may reduce disease risk, even if you are genetically predisposed.

Everyone absorbs, metabolises, and transports nutrients differently based on their genetic makeup. The Randox Nutrition and Lifestyle Genomics test can help you unlock your unique genetic blueprint and give you the tools to make healthier lifestyle choices suited to your body.

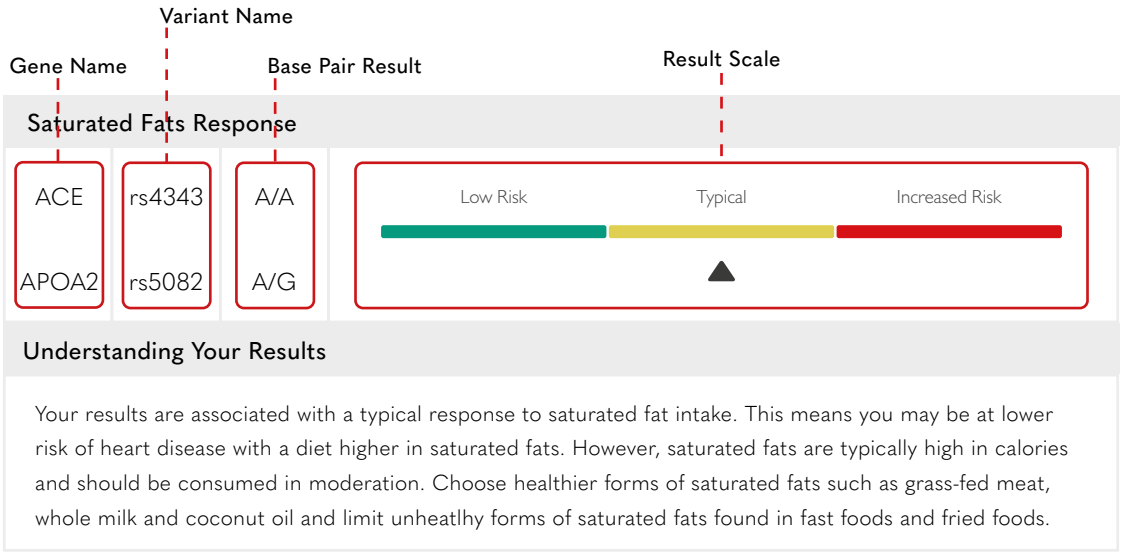
Reading Your Results

In this report you will find your personalised results from your personalised DNA analysis. It provides detailed information on elements that influence your response to nutrition, exercise and other lifestyle factors as well as your predisposition to certain nutritional diseases. Remember, carrying a risk variant does not necessarily mean that you will develop a disease, you may just be at higher risk of developing the disease.

In your report, the names of analysed genes are given along with an 'rs' number for each variant analysed in that gene. The 'rs' number is simply a unique ID number given to a genetic variant (SNP). Variants are represented by 2 letters (e.g. A/A) which represent the base pair present at the analysed location of the gene. A visual scale is also included to help you gage your results.

The glossary at the back of the report contains more information on each subject tested. You can also find more information on each gene tested in the 'Gene Glossary' at the back of the report.

Example Report



Disclaimer

The information provided is only valid for research and educational purposes and should not be used for diagnostic or treatment purposes. Any changes you wish to make to your diet and lifestyle should be guided by healthcare professionals.

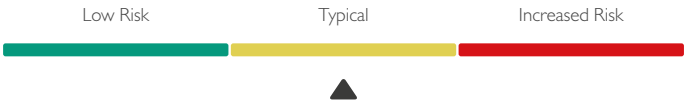
Results

Randox Laboratories Ltd.
Randox Science Park
Randalstown Road
Co. Antrim
United Kingdom
BT41 4LP

URN:	153662
Gender:	Male
Date of Birth:	31-Oct-1973
Sample Collection Date:	12-Apr-22
Date of Receipt:	12-Apr-22
Date of Report:	21-Apr-22

DIET AND NUTRITION

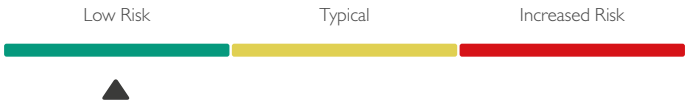
Genes	SNPs	Results
Saturated Fats Response		
ACE APOA2	rs4343 rs5082	A/A A/G



Understanding Your Results

Your results are associated with a typical response to saturated fat intake. This means you may be at lower risk of heart disease with a diet higher in saturated fats. However, saturated fats are typically high in calories and should be consumed in moderation. Choose healthier forms of saturated fats such as grass-fed meat, whole milk and coconut oil and limit unhealthy forms of saturated fats found in fast foods and fried foods.

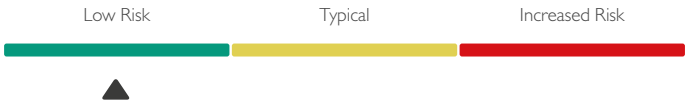
Intolerances - Lactose Intolerance		
MCM6	rs4988235 rs182549 rs145946881	A/A T/T C/C



Understanding Your Results

Your results show you carry genetic variants associated with continued lactase production and means that lactose intolerance is unlikely.

Intolerances - Gluten Intolerance		
HLA-DQ2.5 HLA-DQ8	rs2187668 rs7454108	C/C T/T



Understanding Your Results

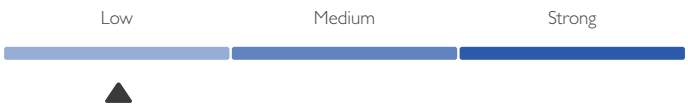
Your results show that you carry variants associated with the lowest risk of coeliac disease.

Intolerances - Gluten Intolerance		
TAS2R38	rs713598	G/G

Understanding Your Results

You are likely to have a greater bitter taste perception of foods such as broccoli, brussel sprouts, cabbage, and mustard. This could make the taste of these foods unpleasant and result in you eating less of them. Try to incorporate these foods into your diet as they contain glucosinolates which are known to have antioxidant properties and have been found to aid in fighting cancer.

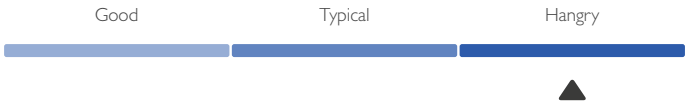
Appetite Patterns - Sweet Taste Perception

TAS1R3	rs307355	T/T	

Understanding Your Results

You carry a variant that may decrease your sensitivity to sweet tastes. This may put you at risk of consuming more sugar to compensate for this decreased sensitivity. Monitor your sugar intake as high sugar intake could lead to health issues such as obesity, type II diabetes and cancer.

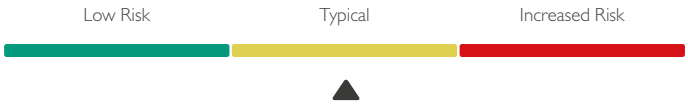
Appetite Patterns - Fasting Response

GNB3	rs5443	T/T	

Understanding Your Results

Your results show that fasting is likely to result in intense hunger and a drop in mood. In short, you get hangry. You may not respond well to intermittent fasting and you could benefit from eating smaller meals more frequently. Avoid letting yourself get ravenous as this is likely to cause overeating and put you at higher risk of obesity and type II diabetes.

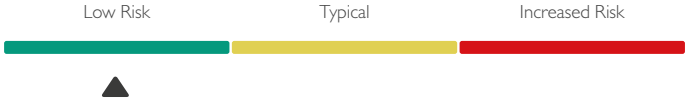
Vitamins and Minerals - Vitamin A Deficiency Risk

BCOM1	rs7501331 rs12934922	C/C A/A	

Understanding Your Results

Your results are associated with normal function of the BCOM1 gene and you are likely able to convert beta-carotene from plants into the useful form of vitamin A.

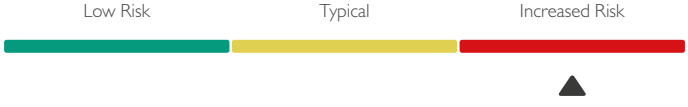
Vitamins and Minerals - Vitamin B12 Deficiency Risk

TCN1 MTHFR	rs526934 rs1801133	A/G A/G	

Understanding Your Results

Your results show that you may be at higher risk of vitamin B12 deficiency. Consider monitoring your B12 levels and speak to a pharmacist about possible supplementation options should your levels be low.

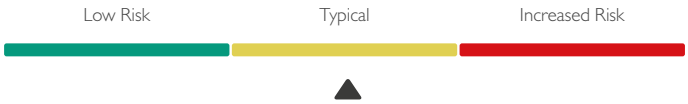
Vitamins and Minerals - Folate Deficiency Risk

MTHFR	rs1801133 rs1801131	A/G G/T	

Understanding Your Results

Your results are associated with reduced folate conversion and you may be at higher risk of folate deficiency should diet and lifestyle factors not be optimal. Consider additional testing to determine folate levels or speak to a pharmacist about folate supplementation.

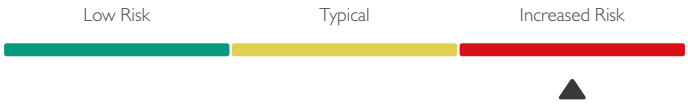
Vitamins and Minerals - Vitamin C Deficiency Risk

SLC23A1 SLC23A2	rs6133175 rs33972313	A/G C/C	

Understanding Your Results

Your results are associated with typical vitamin C levels. You are likely to absorb a regular amount of vitamin C from food and are not at increased risk of deficiency when other genetic, diet and lifestyle factors are optimal.

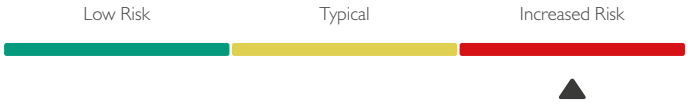
Vitamins and Minerals - Vitamin D Deficiency Risk

GC CYP2R1	rs2282679 rs2060793	G/T A/A	

Understanding Your Results

Your results show that you could be at risk of lower vitamin D levels, increasing your risk of vitamin D deficiency. Follow a healthy and balanced diet and ensure you are getting a safe amount of sunlight each day. You may consider additional testing to determine vitamin D levels and speak to a doctor should they be low.

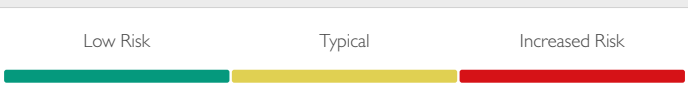
Vitamins and Minerals - Magnesium Deficiency Risk

TRPM6	rs3750425	T/T	

Understanding Your Results

Your results are associated with reduced magnesium levels. You may be at higher risk of magnesium deficiency and should ensure that you are consuming enough magnesium daily. Speak to your doctor should you be experiencing symptoms of magnesium deficiency (migraines, muscle weakness, twitches, tremors and/or heart palpitations).

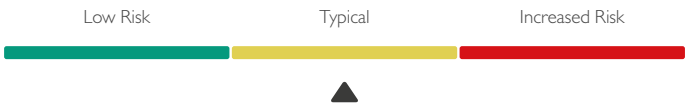
Vitamins and Minerals - Selenium Deficiency Risk

SEP15	rs561104	C/T	

Understanding Your Results

You carry a variant that is associated with typical levels of selenium. This means that you may not be at an increased risk of selenium deficiency or toxicity should other genetic, diet and lifestyle factors be optimal.

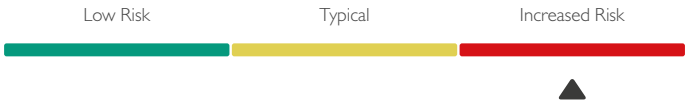
Vitamins and Minerals - Zinc Deficiency Risk

CA1	rs1532423	G/G	

Understanding Your Results

You carry a variant that is associated with typical serum zinc levels. Should other genetic, diet and lifestyle factors be optimal, you are likely not at risk of zinc deficiency.

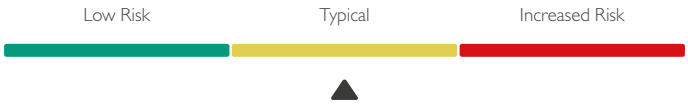
Vitamins and Minerals - Calcium Deficiency Risk

LRP5	rs3736228	C/T	

Understanding Your Results

Your results is associated with a loss of function in the LRP5 gene. This variant has been associated with lower bone mineral density and an increased risk of developing osteoporosis. Reducing alcohol consumption, not smoking, consuming enough calcium in the diet and getting enough vitamin D can help manage your osteoporosis risk.

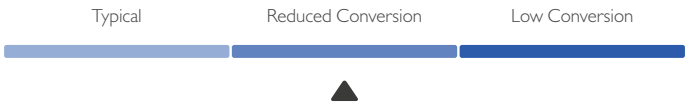
Vitamins and Minerals - Choline Deficiency Risk

PEMT	rs12325817	C/C	

Understanding Your Results

This variant is associated with normal PEMT gene function and choline production. This means that you are not likely to be at increased risk of choline deficiency when other genetic, diet and lifestyle factors are optimal.

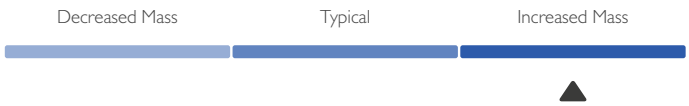
Appetite Patterns - Omega-3 and Omega-6

FADS1 FADS2	rs174546 rs1535	T/T A/G	

Understanding Your Results

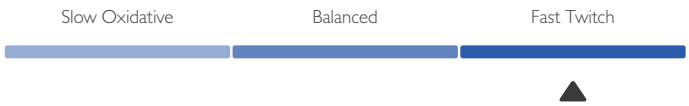
Your results show that you likely produce less omega-3 and omega-6 metabolism enzymes. This means that you probably have lower conversion of omega-6 to arachidonic acid. Arachidonic acid can be inflammatory in higher doses so reduced production can be beneficial in reducing the risk of inflammatory diseases such as heart disease and diabetes. However, you may be at risk of low omega-3 conversion from plant sources to brain benefiting EPA and DHA. As a result, your ratio of omega-3 and omega-6 consumption is particularly important. Keep your omega-6 intake low and increase your omega-3 intake from fish oil.

ATHLETC PERFORMANCE

Genes	SNPs	Results	
Muscle Mass			
MSTN	rs1805086	C/C	

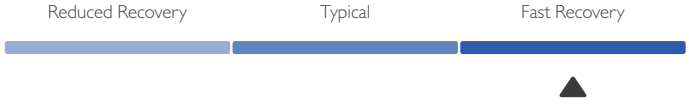
Understanding Your Results

This variant is associated with increased muscle mass. Should other genetic and lifestyle factors be optimal, you are likely to have larger muscles and increased muscle strength, especially in the thighs, calves and upper arms. You may be well suited to power-based events such as power lifting and may be somewhat protected against muscle loss in old age.

Muscle Composition			
ACTN3 AGTR2	rs1815739 rs11091046	C/C A/A	

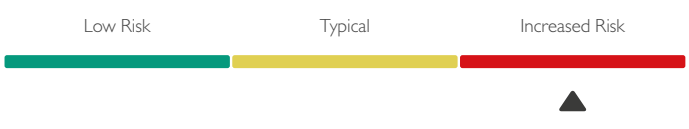
Understanding Your Results

You carry variants of the ACTN3 gene which allows for a more efficient accumulation of muscle mass through the ability to produce the structural protein found in type IIb muscle fibres. These muscle fibres are favourable for power-orientated sports such as sprinting and are positively associated with elite athlete status.

Muscle Recovery			
IL-6	rs1800795	G/G	

Understanding Your Results

This variant of the IL-6 gene has been associated with increased IL-6 levels, and therefore increased muscle growth and recovery after exercise. This variant has been found more frequently in elite power athletes and suggests that muscle recovery and growth are more beneficial to power athlete recovery and performance after training.

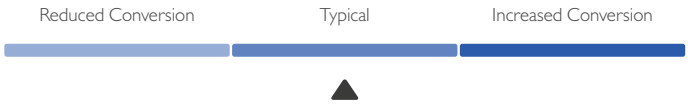
Injury Risk			
COL5A1	rs12722	T/T	

Understanding Your Results

Your results show that you may be at higher risk of suffering musculoskeletal injuries such as ACL injuries, Achilles tendinopathy and tennis elbow.

Take precautions, moderate training intensity and implement injury prevention training such as resistance or flexibility training. Furthermore, ensuring iron, vitamin C and protein intake is optimal will help with collagen synthesis to maintain healthy ligaments.

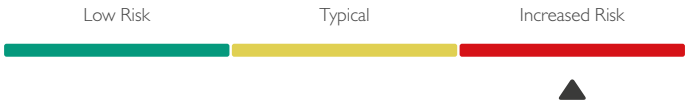
Creatine Conversion

Genes	SNPs		Results
CKM	rs11559024 rs8111989	T/T T/T	

Understanding Your Results

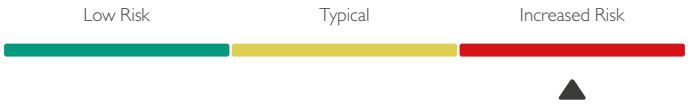
Your results are associated with typical creatine conversion. You are not likely to be at risk of decreased creatine conversion and if other diet and lifestyle factors are optimal you should not be at risk of low muscle mass or muscle weakness.

HEALTH AND WELLBEING

Genes	SNPs		Results
Genetic Obesity Risk			
FTO MC4R	rs9939609 rs12970134	A/T A/A	

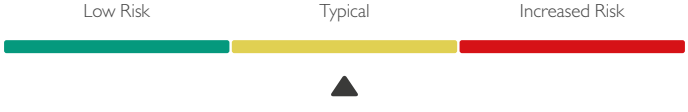
Understanding Your Results

Your results show that you may be at greater risk of obesity. These variants are associated with increased preference for calorie-dense, high fat foods such as cakes, sweets, and fast foods as well as reduced satiety signalling when eating. Be mindful of this when eating and implement habits to prevent overeating- remove distractions when eating, eat smaller meals more regularly and eat protein with every meal. Studies on subjects with these variants demonstrated that limiting saturated fats and overall calorie intake as well as consistent exercise helped overcome this genetic predisposition to obesity.

Genes	SNPs		Results
Genetic Type II Diabetes Risk			
SLC30A8 TCF7L2	rs13266634 rs7903146	C/T C/T	

Understanding Your Results

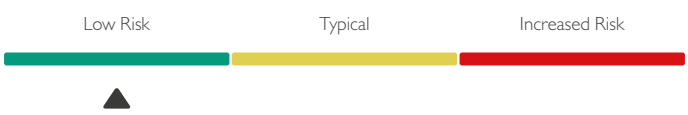
Your results show that you may be at higher risk of type II diabetes. Consider monitoring your blood glucose levels and speak to your doctor if your blood glucose is high. Following a healthy diet and active lifestyle may help prevent the onset of diabetes.

Genes	SNPs		Results
Hypertension Risk			
ADD1	rs4961	G/G	

Understanding Your Results

This variant is associated with typical risk for hypertension (high blood pressure). Should other genetic, lifestyle and diet factors be adequate, you should not be at greater risk of hypertension.

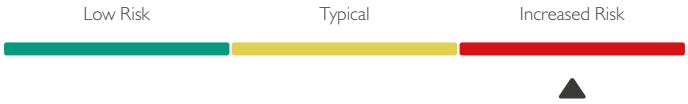
High Cholesterol and Cardiovascular Disease Risk

LDLR	rs6511720	G/T	

Understanding Your Results

Your results show that you likely have a decreased risk of high cholesterol and cardiovascular disease should other genetic, diet and lifestyle factors be optimal.

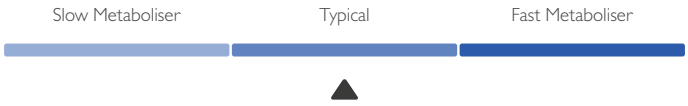
Familial Hypercholesterolaemia

APOB	rs144467873 rs5742904	A/G C/T	

Understanding Your Results

Your results show that you are a carrier of familial hypercholesterolaemia (FH)- FH causes very high cholesterol levels and increases risk of premature heart disease. If extra cholesterol builds up in the arteries, you may experience symptoms such as bumps around the knees, knuckles or elbows, swollen or painful Achilles tendon and/or yellowing around the eyes. Speak to your doctor about testing your cholesterol levels. Finding and treating FH early can significantly reduce risk of heart disease.

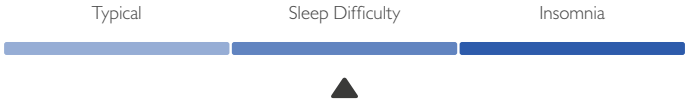
Caffeine Metabolism

CYP1A2 ADORA2A	rs762551 rs5751876	A/C T/T	

Understanding Your Results

You carry a slow caffeine metaboliser variant. Your body may take longer to fully eliminate caffeine from your system, and you are likely to experience elevated blood pressure, anxiety, jitters, and sleep disturbance with even low doses of caffeine. Be aware of the total caffeine content in food and beverages and limit your caffeine intake, especially late in the day.

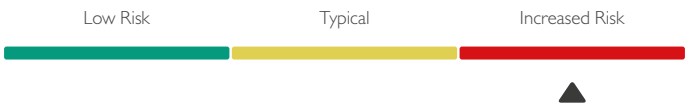
Sleep

CLOCK GABRA6	rs11932595 rs1801260 rs3219151	A/A A/A C/C	

Understanding Your Results

Your results are not associated with delayed sleep onset, sleep difficulty or insomnia. Should other genetic and environmental factors be optimal, you are likely to fall asleep quickly and have good sleep quality.

Mental Health

HTR1B NPAS2	rs6296 rs1123857	C/G G/G	

Understanding Your Results

Your results show that you could be at higher risk for mental health conditions such as anxiety, depression and bipolar disorder, especially after stressful life events. Speak to your doctor should you be experiencing poor mental health and implement stress relieving activities into your daily routine to help manage stress.

Glossary

DIET & NUTRITION

Saturated Fats Response

Saturated fats are present in many animal products and tropical oils. They are solid at room temperature and are found in cheese, butter, beef, pork, poultry, lamb and coconut oil.

Saturated fats have typically been seen as 'unhealthy' fats and health professionals usually recommend reducing saturated fat intake. Excessive saturated fat consumption is known to increase bad cholesterol levels which is linked with an increased risk of heart disease. However, research has shown that not all saturated fats are 'bad' for health. Highly processed foods such as fast food and fried food are rich in saturated fats and have been associated with heart disease, obesity and type II diabetes. On the other hand, full fat dairy milk, grass-fed meat, avocados, nuts, coconut oil and coconut flakes are saturated fat rich foods that have been known to benefit health. Healthy fats are essential for brain health, cholesterol regulation, immune health and bone health.

Saturated fats are typically calorie dense and excessive consumption can lead to weight gain and obesity. Studies have shown that genes play an important role in how our bodies respond to saturated fat intake. Certain genetic variants may put you at higher risk of high cholesterol, high blood pressure, obesity and/or type II diabetes with increased saturated fat intake.

Lactose Intolerance

Lactose intolerance is a common digestive problem. It is caused by the absence of the digestive enzyme, lactase. This results in the inability to digest the sugar (lactose) found in milk and milk products. Common symptoms include flatulence, diarrhoea, bloating, stomach pains and nausea within a few hours of consuming food containing lactose.

Babies require lactase to digest breast milk but for many people lactase production stops before adulthood. The ability to digest lactose in adulthood comes from a genetic variant that allows the production of the lactase enzyme in the cells that line the small intestine. The European Caucasian population are the most likely to carry this variant causing lactose tolerance.

Gluten Intolerance (Coeliac Disease)

Gluten is a protein found in wheat, barley, rye, and some oats. Coeliac disease is a chronic autoimmune disease in which the immune system attacks the intestinal lining when gluten is consumed. Symptoms include diarrhoea, fatigue, weight loss, bloating and anaemia. If ignored, coeliac disease can have serious complications including malnutrition, bone weakening, infertility and miscarriage, increased risk of cancer and nervous system problems.

Coeliac disease is often caused by a combination of genetic and environmental factors. For a person to be susceptible to coeliac disease, certain genetic variants must be present. Almost everyone with coeliac disease has variants in the Class II Human Leukocyte Antigen (HLA) genes known as HLA-DQ2.5 and HLA-DQ8. These genes aid the immune system in differentiating foreign proteins (such as bacteria and viruses) from the body's own proteins. Variants in these genes can cause an immune response to gluten, causing the immune system to attack the intestinal lining.

90-95% of people with coeliac disease carry the HLA-DQ2.5 risk variant and up to 10% carry the HLA-DQ8 risk variant. However, having these variants does not always mean you will get coeliac disease. Approximately one quarter of the population carry these variants but only around 1% of the population develop coeliac disease.

If you are a carrier of these variants and experience symptoms of coeliac disease, speak to a doctor for a coeliac diagnosis via blood tests or intestinal biopsy.

Taste Perception

Food tastes different to everyone. When substances enter the mouth, they bind to taste buds on the tongue and trigger brain signals that tell us what we are tasting- bitter, sweet, sour, salty and umami. The ability to taste is vital for human survival, allowing us to gauge whether a food is safe to eat or not.

People eat more of the foods they like the taste of. These taste preferences can affect nutrient intake and even lead to diseases such as obesity, type II diabetes and vitamin deficiencies.

Approximately 50% of taste perception is heritable, however, environmental influences such as culture, food availability and psychological factors also play a role in the foods we like and dislike.

Fasting Response

Everyone gets hungry at first after not eating for a while, but most people lose the intense desire to eat after a period of fasting and can handle intermittent fasting well.
However, some people have more hunger and a poor mood when fasting. This is referred to as being 'hangry'.

Variants in the GNB3 gene may be responsible for this mood drop when hungry. The same variant in this gene that causes hunger and poor mood when fasting has also been linked to an increased risk of obesity.

Vitamin A Deficiency Risk

Vitamin A, also known as retinol, is a fat-soluble vitamin that is needed for many functions in the body such as vision, growth, and immunity. Vitamin A is obtained through the diet in different forms. Animal sources include beef liver, milk, eggs and fish oils and these provide the body with retinol. Retinol can be stored in the body to be converted into its active form for use in bodily functions. Plant-based sources include leafy green vegetables, orange and yellow vegetables and fruits like mango and tomatoes, and they provide the body with beta-carotene. Beta-carotene must be broken down into retinol in the intestines before it can be stored, ready to be converted to its active form when needed.

A vitamin A deficiency can lead to poor night vision, fatigue, susceptibility to diseases, dry skin and hair and infertility. Diseases such as coeliac disease and Crohn's disease affect digestion and can cause malabsorption of vitamin A. Variants in the BCMO1 gene can affect the conversion of beta-carotenes into retinol which affects the amount of vitamin A available for the body to use.

Vitamin B12 Deficiency Risk

Vitamin B12 plays a key role in many essential body functions such as red blood cell formation, DNA synthesis and the function and development of brain and nerve cells. It is found in many animal products including meat, eggs, dairy and fish. Vegetarian and vegan diets usually lack in B12 and supplementation is recommended.

Vitamin B12 deficiency can cause a cascade of symptoms- tiredness, irritability, mental confusion, mouth ulcers and pins and needles in hands and feet and can even lead to megaloblastic anaemia- a blood disorder that causes enlarged red blood cells with reduced oxygen carrying capabilities. Genetic variants can alter how readily available vitamin B12 is for use in the body.

Folate Conversion

Folate is a B-vitamin that is essential for DNA synthesis in the body. It also plays a role in breaking down homocysteine- an amino acid which can increase the risk of dementia, heart disease and stroke if present in high amounts in the body.

Folate is naturally present in many foods such as beef liver, leafy green vegetables, legumes and nuts and is often added to foods such as bread, flour, pasta and breakfast cereals as folic acid. Folate is also available as a supplement and is added to prenatal vitamins.

Folate deficiency is rare in the modern world as it is added to many staple foods, but genetic variants can cause deficiency resulting in weakness, fatigue, trouble concentrating, irritability, headache, heart palpitations, and shortness of breath. It is important for women of child-bearing age to get enough folate to help prevent neural tube defects in babies.

Folate must be converted into an active form before it can be used in the body. Genetic variants of the MTHFR gene can cause decreased efficiency of folate conversion into this active form. It is important that those carrying any of these variants consume plenty of folate-rich foods.

Vitamin C Deficiency Risk

Vitamin C is essential for a variety of functions in the body. It is an antioxidant and is needed to maintain healthy hair, skin, blood vessels and bones. Vitamin C aids in wound healing and is important for healthy immune system function.

Vitamin C is obtained through the diet via citrus fruits, peppers, potatoes, broccoli, strawberries and blackcurrants. It is not stored in the body, so it is important to consume this vitamin daily. Vitamin C deficiency may lead to complications that could include slow wound healing, fatigue, easy bleeding and hair loss. Diseases associated with vitamin C deficiency include cardiovascular disease, gout and stomach cancer.

Genetic variant can determine how vitamin C is transported and absorbed in the body. Some people can absorb higher amounts of vitamin C from food and may not need to consume as much vitamin C rich food to reach the recommended daily amount (75 mg a day for women and 90 mg a day for men). Those who carry genetic variants associated with increased risk of Vitamin C deficiency may need to consume more vitamin C throughout the day.

Vitamin D Deficiency Risk

Vitamin D is important for many processes within the body. It is essential for calcium regulation and strong bones and is also essential for maintaining a healthy immune response. Vitamin D is synthesised in the skin when it is exposed to sunlight but can also be acquired from foods such as oily fish, red meat, liver, egg yolks and fortified foods.

Low levels of vitamin D have been associated with multiple chronic conditions- mood disorders, risk of cancer, immunity problems and low bone mineral density. Higher vitamin D levels generally correspond with a lower risk of developing these chronic diseases. Those living in parts of the world with limited sunlight exposure are typically at higher risk of vitamin D deficiency and could benefit from vitamin D supplements, especially during winter months. Certain variants in the GC and CYP2R1 genes have been associated with a risk of lower vitamin D levels.

Magnesium Deficiency Risk

Magnesium is an essential mineral needed for muscle contraction, nerve function, insulin metabolism, bone health and blood pressure regulation. Magnesium is also a cofactor for many enzymes in the body. This means that without magnesium, many processes such as DNA synthesis and energy metabolism cannot take place.

Magnesium is acquired from the diet and is stored in the bones, muscles, soft tissues and blood. Low magnesium levels have been implicated in many health conditions such as migraines, ADHD, high blood pressure, cardiovascular disease, type II diabetes and osteoporosis. Green leafy vegetables, nuts, legumes, seeds and whole grains are all good sources of magnesium and should be consumed daily.

Magnesium levels can be affected by several factors. Gastrointestinal diseases such as coeliac disease can impair magnesium absorption in the gut. High blood sugar levels caused by type II diabetes can cause higher amounts of magnesium to be excreted into urine, lowering magnesium levels in the body. Certain genetic variants can also cause impaired magnesium absorption in the gut, increasing the risk of magnesium deficiency.

Selenium Deficiency Risk

SE

Selenium is a mineral found in soil and is naturally found in water, brazil nuts, saltwater fish such as tuna and cod, beef, poultry and grains.

Selenium has an antioxidant effect, assisting in lowering oxidative stress which causes DNA damage and possibly cancer. Selenium also plays a vital role in a healthy immune system and thyroid function. Selenium deficiency has been associated with decreased immune function, brain fog, hair loss, thyroid issues, metabolic syndrome and prostate cancer. However, too much selenium can be toxic and lead to metabolic syndrome and an increased risk of certain cancers. It is therefore vital to ensure that selenium levels are present at a normal range in the body. Genetics and lifestyle factors play a role in determining how much selenium is right for you.

Zinc Deficiency Risk

ZN

Zinc is an essential nutrient found in a variety of plants and animal products. It is needed for the function of many enzymes in the body that are responsible for cell growth, skin health, wound healing and immune function. The body does not naturally produce or store zinc and it must therefore be acquired from the diet or through supplementation. Shellfish, meat, poultry, legumes, nuts and seeds, eggs, dairy products, fortified breakfast cereals and whole grains are all good sources of zinc. Zinc deficiency is rare but genetic variants can cause an increased risk of deficiency. Zinc deficiency can cause decreased immunity, impaired wound healing, thinning hair, dry skin and infertility. High doses of zinc can also cause negative side effects such as diarrhoea, nausea and headaches, so it is important to stick to the recommended daily amount.

Calcium Deficiency Risk

Calcium is a vital mineral needed to build and maintain strong bones and teeth. Calcium is also needed to maintain adequate muscle function, especially in the heart and is essential for blood clot formation. Calcium must be obtained through the diet and is found abundantly in cheese, milk and soy milk, tofu, green leafy vegetables and canned sardines.

Calcium deficiency can be detrimental to long term health and can lead to conditions such as dental issues, cataracts and osteoporosis. Several factors can prevent sufficient calcium intake. Allergies to calcium rich foods, medication, vitamin D deficiency, hypothyroidism and genetic factors can all contribute to reduced calcium levels in the body.

Choline Deficiency Risk

Choline is an essential nutrient that is required for numerous body functions such as healthy brain development, metabolism, fat and cholesterol transport and muscle movement. The liver makes a small amount of choline, but the majority must be acquired through the diet to prevent deficiency. Beef and chicken liver, eggs, oysters, salmon, broccoli, cauliflower, mushrooms and soybeans are all good sources of choline.

Choline deficiency is rare but can lead to liver and muscle damage. Choline is essential in pregnancy and a deficiency could lead to premature birth and neural tube defects in unborn babies. Certain genetic variants may increase an individual's choline requirements, therefore, increasing their risk of choline deficiency. Strenuous exercise also reduces choline levels so athletes and individuals who participate in intense exercise may have increased choline demands.

Omega-3 and Omega-6

Omega-3 fatty and omega-6 fatty acids are important for health for several reasons. They make up the membranes of body cells, are essential for brain health and are used to produce hormones involved in allergic inflammation and blood clot formation.
Sources of omega-3 include flaxseeds, canola oil, walnuts, soy, seaweed, salmon, mackerel and sardines. Omega-6 is found in nuts, corn, seeds, eggs and vegetable oils. Plant based sources of omega-3 have to be converted in the body into a useful form and most people can do this. However, some people carry a genetic variant that prevents this conversion and they must acquire omega-3 from fish oils.

The FADS1 and FADS2 genes produce enzymes that convert omega-3 and omega-6 in the body. These enzymes convert omega-3 into eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) which are associated with lowering heart disease risk and brain health benefits. Omega-6 is converted into arachidonic acid which is used to make hormones and build muscle mass. High levels of arachidonic acid have been linked to a risk of inflammatory diseases and mood disorders.

The balance of omega-3 and omega-6 levels in the body is important to health. In modern Western diets, substantially more omega-6 is consumed due to the presence of corn products in cattle and poultry feed. Omega-3 and omega-6 are converted by the same limited number of enzymes, so if omega-6 levels are higher, more omega-6 will be converted into arachidonic acid and less omega-3 will be converted into brain benefiting EPA and DHA. This could lead to increased risk of inflammatory diseases such as heart disease and inflammatory bowel disease and limit the brain benefiting effects of EPA and DHA.

ATHLETIC PERFORMANCE

Muscle Mass

Muscle mass refers to the weight of muscle in the body. Muscle mass is not only beneficial for workout performance- it plays an important role in health and disease. Increased muscle mass and less body fat can lead to a stronger immune system, improved energy and prevent chronic disease.

Muscle mass can affect athletic performance. Studies have shown that greater muscle mass is beneficial for power-based events such as weightlifting and sprinting, whilst lower muscle mass is beneficial to endurance-based events such as long-distance running and swimming. It is important to remember that even if your genetics do not favour greater muscle mass, you may still build muscle mass, it may just take you longer.

Muscle Composition

Skeletal muscle is composed of a range of muscle fibres. Muscle fibre composition is heritable and has been linked to athletic performance and success. Type IIb muscle fibres are known as 'fast twitch' muscle fibres and are used during explosive power-based sports such as sprinting, tennis and power lifting. Type I muscle fibres are known as 'slow oxidative' muscle fibres and are mainly used in endurance sports such as long-distance running and endurance swimming.

Individuals may be better adapted to specific sports based on their varying proportions of muscle fibres. Those with a larger proportion of Type IIb muscle fibres are more likely to succeed at explosive power-based sports, whilst those with a greater proportion of Type I muscle fibres are more likely to succeed at aerobic endurance-based events.

Muscle Recovery

Muscle recovery after exercise and training is an important part of fitness. Recovery aids in improving performance, preventing injury and avoiding burn out. Exercise places stress on the body and recovery aims to bring it back to homeostasis. Recovery allows the body to rebuild muscle proteins and glycogen stores lost during exercise and allows the health benefits of exercise to kick in.

Recovery times vary person to person- age, fitness levels, stress levels, training intensity and genetics can all play a role in how much recovery time you need.

Injury Risk

Tendons are the fibrous connective tissue that connect muscle tissue to the bone and are responsible for transferring the force of muscle contraction to the bones to facilitate movement. Ligaments are the connective tissue between bone-to-bone attachment with the function of providing support and stability for the joints.

Athletes are at a higher risk of musculoskeletal soft tissue injuries such as anterior cruciate ligament (ACL) injuries due to the higher risk of collision and impact. Achilles' tendon pathology (ATP) and tennis elbow are also common injuries that occur due to the repetitive strain placed on tendons with performing movements frequently and regularly over time. Genetic variants can make us more prone to these sport or occupational related injuries. Understanding injury risk is important for all athletes so that prevention strategies may be worked into training routines.

Creatine Conversion

Creatine is a naturally occurring substance found in muscle cells. It acts as a backup energy source for muscles and creates energy during high intensity muscle contraction. Creatine is produced in the liver but can also be acquired from animal muscle meats. Creatine is a common supplement for athletes as it can increase muscular strength, muscle mass and reduce recovery time.

Genetic variants can alter how creatine is converted for energy in muscles. Some variants are associated with decreased creatine conversion and muscle weakness. Others are associated with increased creatine conversion which is beneficial to athletic performance.

Genetic Obesity Risk

Obesity is defined as being very overweight, with a lot of body fat. It is a common problem in the UK and according to the NHS, around 1 in 4 adults are obese.

Obesity is generally caused by consuming too many calories and living a sedentary lifestyle. Obesity is an increasingly common problem as modern living involves eating excessive amounts of cheap high-calorie food and spending a lot of time sitting down at desks, on sofas or in cars. Research shows that approximately 60% of obesity risk is due to genetics. Variants in the FTO and MC4R gene have been shown to increase genetic obesity risk.

It is important to understand our risks for obesity so that we can make lifestyle changes to prevent it. Obesity may lead to other chronic conditions such as type II diabetes and cancer. Do not worry if you carry a variant that puts you at higher risk as obesity can be prevented or improved with a better diet and a more active lifestyle.

It is also important to remember that carrying risk variants for obesity does not necessarily mean that you will become obese. Your genes interact with the environment- genes can be turned on and off through diet and lifestyle.

Genetic Type II Diabetes Risk

Type II diabetes is a condition condition that causes glucose (sugar) levels in the blood to become too high. Normally, the hormone insulin helps the body utilise glucose, so blood glucose levels remain within a healthy range. However, in those with type II diabetes, the body continues to produce insulin but fails to respond to it, a phenomenon known as “insulin resistance”. It is a long-term chronic condition that can lead to other complications of the heart, nervous system, and immune system.

It is often linked to old age or being overweight and those with a family history of the disease are at higher risk. Insulin contains a high amount of zinc so a zinc deficiency can also cause type II diabetes. It is not curable but can be managed through a healthy diet and active lifestyle. Genetic variants may make you more susceptible to type II diabetes and knowing your genetic susceptibility may help you put prevention strategies in place.

Hypertension Risk

Hypertension or high blood pressure refers to the pressure of blood flowing through the arteries. Pressure is required for blood to move and it naturally increases and decreases throughout the day. When blood pressure is consistently high, even at rest, it could lead to more serious health issues such as heart disease.

Hypertension rarely causes symptoms; however, symptoms that can occur include headaches, shortness of breath, nosebleeds, anxiety and pulsating feelings in the neck or head. If left untreated, hypertension can lead to more serious issues such as kidney damage, memory loss, vision loss, heart attacks and strokes.

Hypertension can be caused by a variety of genetic and environmental factors. Age, high salt intake, smoking, stress, poor diet, limited physical activity, birth control pills and thyroid problems have all been known to increase hypertension risk. Genetic variants can also increase hypertension risk by upsetting the water-salt balance in the body.

High Cholesterol and Cardiovascular Disease Risk

Cardiovascular disease (CVD) is the leading cause of death globally. Conventional risk factors for CVD include an individual's age, sex, ethnicity, cholesterol levels, blood pressure and body mass index (BMI). The risk of developing CVD will also increase if you smoke, have a family history of early CVD (<60 years of age) or have been diagnosed with a particular disease such as diabetes, chronic kidney disease or rheumatoid arthritis.

Cholesterol is essential for daily bodily processes such as creating hormones and vitamin D. Cholesterol needs to be present in the correct level to keep the body healthy- extremely high or low levels of cholesterol can cause ill health and lead to mortality. The body synthesises cholesterol in the liver, intestines, reproductive organs and the adrenal glands but it is also acquired from animal fats in foods.

There are two types of cholesterol in the body- LDL and HDL. LDL (bad cholesterol) is associated with CVD and stroke risk when it builds up in the arteries. HDL (good cholesterol) carries bad cholesterol out of the blood stream to the liver so that it may be removed from the body. The balance of LDL and HDL cholesterol is unique in individuals and depends on age, diet, lifestyle and genetics.

Caffeine Sensitivity

Caffeine is naturally found in seeds, nuts or leaves of certain plants and is processed into caffeinated foods and beverages such as coffee, certain teas and energy drinks. Caffeine acts mainly on the central nervous system, increasing sensitivity to dopamine and promotes a state of alertness.

Some people experience unpleasant effects following consumption of caffeinated beverages, such as feeling anxious or jittery. While coffee has been shown to have beneficial effects particularly on the liver, some people may have increased risk of elevated blood pressure (hypertension) if they consume coffee regularly. Genetic variants in the ADORA2A and CYP1A2 genes may alter your response to caffeine.

Sleep

Sleep is a crucial part of our daily routine and we sleep for approximately one third of our lives. Sleep is essential for brain function, removing toxins from the body and for cell repair. The right amount of sleep varies person to person, but it is recommended that adults get 7 to 9 hours per night. Sleep affects every tissue and system in the body and sleep disturbances can be detrimental to health. Sleep deprivation has been associated with an increased risk of heart disease, diabetes, obesity and depression.

Our body follows a natural 24-hour cycle called the 'circadian rhythm'. Humans are naturally programmed for being active during the day and sleeping at night. Shift work, jet lag, light from electronic devices and genetic variants can interfere with our natural circadian rhythm, leading to sleep disturbances and the associated health issues.

Certain genetic variants associated with the circadian rhythm have been linked to delayed sleep onset, reduced sleep duration, insomnia and an increased risk for neurodegenerative diseases.

Mental Health

Mental health includes our emotional, psychological and social wellbeing. It affects our mood, thinking and behaviour and is usually determined by several factors- genes, brain chemistry, life experiences and our environment.
Around 1 in 4 people experience poor mental health, ranging from anxiety and depression to bipolar disorder and schizophrenia. Poor mental health affects daily living and can be debilitating.

Variants in genes that control neurotransmitters such as serotonin, dopamine and acetylcholine have been linked to increased susceptibility to metal health conditions.

Gene Glossary

ACE

The Angiotensin I Converting Enzyme gene plays a role in regulating blood pressure and the balance of fluids and salts in the body. A variant in this gene can cause constricted blood vessels, increasing blood pressure and the risk of heart disease in those who consume a diet high in saturated fat. Studies have shown that people who do not carry this mutation tend to be at lesser risk of heart disease, even with a diet higher in saturated fats.

ACTN3

The Actinin alpha-3 gene helps make a protein found exclusively in Type IIb (fast twitch) muscle fibres. This protein helps build the structure of fast twitch muscles. These fast twitch muscle fibres are responsible for producing the explosive contractions at high velocity involved in power and speed movements. These fibres have been used as an indicator of elite athlete status in power-orientated sports such as sprinting and power lifting. Variants of the ACTN3 gene can prevent the production of the structural protein found in fast twitch muscle fibres. As a result, the individual is likely to have a smaller proportion of fast twitch muscle fibres and a greater proportion of slow oxidative muscle fibres.

ADD1

The Adducin 1 gene is involved in the transport of sodium through the kidneys. Variants in this gene can lead to impaired removal of salt from the body and increase the risk of salt-sensitive hypertension.

ADORA2A

The Adenosine A2a Receptor gene works as a receptor for adenosine. Adenosine is a molecule that that promotes the need to sleep to maintain the sleep-wake cycle. When caffeine enters the brain, it blocks adenine receptors, causing a reduction in sleepiness and increased alertness. The ADORA2A gene also regulates dopamine and glutamine release in the brain and genetic variants may cause increased anxiety when caffeine is consumed.

AGTR2

The Angiotensin II receptor type 2 gene plays a role in skeletal muscle development and metabolism.

APOA2

The Apolipoprotein A2 gene plays a role in the transport and utilization of fats and cholesterol in the body. It also works to produce 'good' cholesterol which transports 'bad' cholesterol and fat away from artery walls to the liver to be removed from the body. Variant in this gene can put you at greater risk of obesity with high saturated fat consumption.

APOB	The Apolipoprotein B gene assists in carrying LDL cholesterol around the body. Variants in this gene could lead to high LDL levels and an increased cardiovascular disease risk. Rare variants in the APOB gene are associated with familial hypercholesterolaemia, a genetic form of very high cholesterol which increases the likelihood of CVD and mortality at a young age.
BCOM1	The Beta carotene oxygenase 1 gene works to convert beta-carotene from plants into retinol in the intestines, liver and lining of the lungs. Variants in this gene can cause different amounts of retinol to be produced from beta-carotenes.
CA1	The Carbonic Anhydrase 1 gene produces an enzyme that utilizes zinc to maintain a safe pH level in the body to prevent damage. Variants in this gene have been associated with serum zinc levels.
CKM	The Creatine Kinase M-Type gene works to convert creatine into phosphocreatine which can be used to restore energy reserves in muscles during intense muscle contraction.
CLOCK	The Circadian Locomotor Output Cycles Kaput gene helps to regulate the circadian rhythm. It works to regulate sleep, stress and memory.
COL5A1	Ligaments and tendons are made up of collagen. The Collagen Type V Alpha 1 Chain gene functions to produce collagen and has been strongly associated with tendon and ligament injuries. Studies have shown that a variant in the COL5A1 gene leads to a 50% reduction in collagen, decreased tensile strength and reduced stiffness of connective tissue, and can therefore increases the risk of injury in connective tissues.
CYP1A2	The Cytochrome P450 Family 1 Subfamily A Member 2 gene is responsible for metabolising over 95% of caffeine we consume. Therefore, a variant in this gene has an important influence on caffeine metabolism. Some people are slow metabolisers and some are fast metabolisers of caffeine. Research has shown that slow metabolisers are more likely to feel greater negative effects of coffee. This effect leads to elevated blood pressure and hypertension with increased caffeine consumption. Fast metabolisers may benefit from caffeine consumption and utilise the break down products to improve performance and endurance during exercise.

CYP2R1	The Cytochrome P450 Family 2 Subfamily R Member 1 gene plays a role in converting vitamin D into an active form that can be used by the body. Different variants in this gene have been associated with both increases and decreases in vitamin D levels.
FADS1 & FADS2	The Fatty Acid Desaturase genes produce enzymes that metabolise omega-3 and omega-6. Variants in these genes can slow down the production of these enzymes which reduces the conversion of omega-6 to arachidonic acid and reduces the conversion of omega-3 to EPA and DHA. Those carrying these variants may not benefit from plant-based sources of omega-3 and will need to acquire it from fish oils.
MSTN	The Myostatin gene functions to produce myostatin in muscle cells. Myostatin regulates muscle growth and ensures that muscles do not grow too large. Variants in this gene can cause less myostatin production which leads to enlarged muscles of the thighs, calves and upper arms and less overall body fat.
FTO	The Fat Mass and Obesity gene is one of the key genes that has been consistently shown to impact weight. It was one of the first genes discovered to be associated with obesity and was therefore called the 'Fat Mass and Obesity' gene. Researchers are still working to figure out exactly how the FTO gene works regarding obesity, but it is believed to affect hunger hormones and control food intake and food choices.
GABRA6	The Gamma-Aminobutyric Acid Type A Receptor Subunit Alpha6 gene helps to regulate the circadian rhythm. Variants in this gene can cause a change in the circadian rhythm and have been linked to increased risk of depression and insomnia- especially during stressful life events.
GC	The GC vitamin D Binding Protein gene binds to vitamin D molecules and transports them to cells in the body for use. Variants in this gene have been associated with lower vitamin D levels.
GNB3	The G Protein Subunit Beta 3 gene works in intracellular signalling and has been linked to mood disorders.

HLA-DQ2.5 & HLA-DQ8	Almost everyone with coeliac disease has variants in the Class II Human Leukocyte Antigen (HLA) genes. These genes aid the immune system in identifying foreign proteins (such as bacteria and viruses) from the body's own proteins. Variations in these genes can cause an immune response to gluten, causing the immune system to attack the intestinal lining.
HTR1B	The 5-Hydroxytryptamine Receptor 1B gene plays a role in serotonin reception in the brain and helps manage the release of serotonin, dopamine and acetylcholine in the brain. This gene has been implicated in mental health conditions.
IL-6	The Interleukin 6 gene induces IL-6 production in skeletal muscle and has been linked to muscle repair after exercise. IL-6 is released during exercise to provide glucose to muscles and IL-6 levels have been linked with increased muscle recovery and growth.
LDLR	The low-density lipoprotein receptor gene makes LDL receptors which allow the uptake of bad cholesterol into cells. Variants in this gene have been associated with lower LDL levels and decreased risk of CVD.
LRP5	The Low-density lipoprotein receptor-related protein 5 gene works in the regulation of bone mineral density and variants can cause bone mineral deficiency, bone weakness and can lead to osteoporosis.
MC4R	The Melanocortin 4 Receptor gene plays a role in leptin signalling. Leptin is also known as the hunger hormone and regulates body energy by making us feel hungry or full depending on what the body needs. Genetic variants in the MC4R gene can cause improper leptin signalling- the 'full' signal can be impaired, causing overeating and increased BMI.
MCM6	The Minichromosome Maintenance Complex Component 6 gene plays a role in regulating the function of another gene- the Lactase (LCT) gene. The LCT gene plays a role in lactase enzyme production. Variants in the MCM6 gene affect how the LCT gene works and ultimately affects lactase production in the digestive system.

MTHFR	The Methylenetetrahydrofolate Reductase gene converts folate into a useable form for use in the body. Vitamin B12 requires this active form of folate in order to be absorbed and used by body cells. Some MTHFR variants can hinder the ability to convert vitamin B12 and folate into useable forms which can lead to deficiencies and health issues.
NPAS2	The Neuronal PAS domain protein 2 gene is involved in regulating the circadian rhythm. Variants in this gene have been linked to depression and bipolar disorder.
PEMT	The Phosphatidylethanolamine N-methyltransferase gene plays a vital role in producing choline in the body. Variants in this gene could cause decreased production of choline in the body, requiring a greater amount of choline to be acquired from the diet.
SEP15	The 15-kDa Selenoprotein gene helps transport selenium around the body. Variants in this gene may put you at risk of increased or decreased selenium levels.
SLC23A1 & SLC23A2	The Solute Carrier Family 23 Member 1 and 2 genes plays a role in the transportation and absorption of vitamin C. Variants of this gene can affect plasma levels of vitamin C- some may cause higher levels and others may cause lower levels.
SLC30A8	The Solute Carrier Family 30 Member 8 gene is a zinc transporter gene found in the pancreas and has been associated with type II diabetes. Zinc plays an important role in the production and secretion of insulin and higher zinc levels have been associated with a lower risk of Type II Diabetes.
TAS1R3	The Taste receptor type 1 member 3 gene plays a role in making a taste receptor that controls the ability to taste sweet flavours from different sugars. Variants in the TAS1R3 gene could make you more or less sensitive to sweet taste.
TAS2R38	The Taste 2 Receptor Member 38 gene plays a role in making a taste receptor that controls the ability to taste glucosinolates- the bitter tasting compounds found in broccoli, brussel sprouts, cabbage and mustard. Variants in this gene could increase or decrease your sensitivity to bitter foods.

TCF7L2	The Transcription Factor 7-like 2 gene helps control blood glucose levels and variants in this gene are associated with an increased risk for type II diabetes through glucose intolerance and reduced insulin secretion.
TCN1	The transcobalamin 1 gene facilitates the transport of vitamin B12 into cells. Variants of this gene have been associated with lower vitamin B12 levels in the blood.
TRPM6	The Transient Receptor Potential Cation Channel Subfamily M Member 6 gene regulates magnesium uptake in the intestines and variants in this gene can cause impaired magnesium uptake and lower magnesium levels in the body.

RANDOX