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PERSONALIZED SPORT NUTRITION & PERFORMANCE REPORT

Hello Caroline:

Nutrigenomix is pleased to provide you with your Personalized Sport Nutrition and Performance Report based on your individual genetic profile. Your recommendations are based on the most current evidence-based scientific research that has been published in peer-reviewed journals and reviewed by our team of world-renowned experts in the field of nutrigenomics.

Our laboratory has used state-of-the-art genetic testing procedures to analyze the DNA from your saliva sample. We analyzed your genetic code to determine how your genes can influence recommendations related to weight management, body composition, nutrient metabolism and requirements, cardiometabolic health, food intolerances, eating habits, various performance-related elements and injury risk. Based on these results, we developed a series of nutrition and performance-related recommendations that are aligned with your genetic profile. As new discoveries in the field of nutrigenomics are made, you will have the opportunity to access this information to further fine-tune your personalized nutrition and training plan.

You and your healthcare or fitness professional can now use the personalized recommendations contained in this report to help you create a plan that will optimize dietary and other performance-related strategies for achieving athletic excellence and maximizing your genetic potential. In this way, you can create a plan to maximize your genetic potential to give you an edge above the competition by starting to eat and train according to your genes!

Ahmed El-Sohemy, PhD
Chief Scientific Officer

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Summary of Results

Nutrient Metabolism

Dietary Component	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Recommendations
Vitamin A	BCMO1, rs11645428	GG	GG	Elevated	Focus on consuming pre-formed sources of vitamin A.
Vitamin B_{12}	FUT2, rs601338	GG or GA	GA	Elevated	Focus on consuming bioavailable sources of vitamin B12.
Vitamin C	GSTT1, rs2266633	Del	Ins	Typical	Meet the RDA for vitamin C daily.
Vitamin D	CYP2R1, rs10741657	Algorithm	GA	Elevated	Consume 1000 IU (25 mcg) vitamin D daily.
	GC, rs2282679		GG		
Vitamin E	F5, rs6025	CT or TT	CC	Typical	Meet the RDA for vitamin E daily.
Folate	MTHFR, rs1801133	CT or TT	TT	Elevated	Meet the RDA for folate daily.
Iron Overload	SLC17A1 rs17342717	Algorithm	CC	Low	Follow the recommendations provided in the Low Iron Status section.
	HFE rs1800562		GG		
	HFE rs1799945		CC		
Low Iron Status	TMPRSS6 rs4820268	Algorithm	GA	Elevated	Meet the RDA for iron and consume sources of vitamin C with iron-rich foods.
	TFR2 rs7385804		CA		
	TF rs3811647		AA		
Calcium	GC, rs7041	Algorithm	TG	Elevated	Consume 1200mg of calcium daily.
	GC, rs4588		CA		

Cardiometabolic Health

Dietary Component	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Recommendations
Caffeine	CYP1A2, rs2472300	GA or AA	AA	Elevated	Limit caffeine intake to 200 mg/day.
Whole Grains	TCF7L2, rs12255372	TT or GT	GT	Elevated	Consume most grain products as whole grains.
Sodium	ACE, rs4343	GA or AA	AA	Elevated	Limit sodium intake to 1500 mg/day.
Omega-3 Fat	NOS3, rs1799983	TT or GT	GG	Typical	Consume between 200-500 mg per day of omega-3 fat.
Saturated Fat	APOA2, rs5082	CC	TC	Typical	Limit intake of saturated fat to no more than 10% of energy.

Weight Management and Body Composition

Dietary/ Fitness Component	Gene, rs Number	Response Variant	Your Variant	Your Response	Recommendations
Energy Balance	UCP1, rs1800592	GG or GA	GA	Diminished	Aim for an energy deficit of 650 calories/day from your calculated energy needs for weight loss.
Physical Activity	FTO, rs9939609	AA	TA	Typical	Aim for 150 min/week of cardio and at least 2 days/ week of muscle-strengthening activities.
Protein	FTO, rs9939609	AA	TA	Typical	Consume 20-30% of energy from protein or 1.2-1.4 g protein/kg body weight.
Total Fat	TCF7L2, rs7903146	TT	CC	Typical	Consume 20-35% of energy from fat.
Saturated and Unsaturated Fat	FTO, rs9939609	TA or AA	TA	Enhanced	Limit intake of saturated fat to no more than 10% of energy. Consume at least 5% of energy from polyunsaturated fat.
Monounsaturated Fat	PPARγ2, rs1801282	GG or GC	CC	Typical	Aim for a balance of saturated, monounsaturated and polyunsaturated fats to meet your total daily fat intake.

Food Intolerances

Dietary Component	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Recommendations
Lactose	MCM6, rs4988235	CC or CT	CT	Slightly Elevated	Limit dairy intake.
Gluten	HLA, rs2395182	Algorithm	GT	Medium	Medium risk for gluten intolerance.
	HLA, rs7775228		TT		
	HLA, rs2187668		CT		
	HLA, rs4639334		GG		
	HLA, rs7454108		TT		
	HLA, rs4713586		AA		

Eating Habits

Dietary Component	Gene, rs Number	Risk Variant	Your Variant	Your Risk/Response	Recommendations
Fat Taste Perception	CD36, rs1761667	GG or GA	AA	Typical	Your ability to sense the fatty taste of foods is typical.
Sugar Preference	GLUT2, rs5400	CT or TT	CT	Elevated	You have a high preference for sugar.
Eating Between Meals	MC4R, rs17782313	CC or CT	TT	Typical	Your tendency to eat between meals is typical.
Starch	AMY1, rs4244372	AA	AT	Typical	Your ability to metabolize starch is typical.

Fitness and Physical Activity

Fitness Component	Gene , rs Number	Response/ Risk Variant	Your Variant	Your Response /Risk	Implications
Motivation to Exercise	BDNF, rs6265	AA or AG	AA	Enhanced	You have an enhanced innate motivation to exercise.
Exercise Behavior	CYP19A1, rs2470158	Algorithm	GG	Typical	You have a typical likelihood of engaging in physical activity.
	LEPR, rs12405556		GT		
Power and Strength	ACTN3, rs1815739	TC or CC	TT	Typical	Your potential to excel in power sports is typical.
Endurance	ADRB3, rs4994	Algorithm	TT	Typical	Your endurance potential is typical.
	NRF2, rs12594956		CA		
	GSTP1, rs1695		AG		
	NFIA-AS2, rs1572312		CC		
Pain	COMT, rs4680	GG or GA	GA	Enhanced	You have a heightened pain tolerance.
Achilles Tendon Injury	COL5A1, rs12722	CT or TT	CC	Typical	You have a typical risk for Achilles tendon injury.

The Science Behind Nutrigenomix

One man's food is another man's poison - Lucretius

Nutrition is a key factor that contributes to success in sport. The foods, fluids and supplements you choose in training and competition will impact your performance, adaptations to training, body composition, and risk of illness or injury. Whether you're a weekend warrior or an Olympian, in competitive sports an athlete's nutritional strategies are vital to athletic success. Dietary and supplement strategies in both training and competition should be individually assessed and guided. Knowing about your genes and following tailored sport nutrition guidelines aligned with your personal genetic profile can assist you in optimizing athletic performance.

Over the past decade, there has been growing recognition of the importance of how genes influence our nutritional status, which directly impacts our health and performance. The human genome consists of about 25,000 genes and virtually all can exist in different forms. The variations in our genes make us unique from one another. Genetic variation determines not only the color of our eyes and hair, but how we metabolize and utilize the foods, nutrients and supplements we ingest. Nutrigenomics is the science that applies genomic information and advanced technologies to uncover the relationship between genes, nutrition and human health. Sport Nutrigenomics takes this a step further and aims to help athletes gain an edge in training and competition by maximizing their genetic potential. The term nutrigenomics refers to both the study of how the food, beverages and supplements we consume affects our genes and how our genes can influence our body's response to what we consume.

Different versions of a gene can make us respond differently to certain components in food such as the lactose in milk, the gluten in bread, the caffeine in coffee, along with the carbohydrates, fats, proteins vitamins and minerals found in various foods. We are all familiar with people who are lactose intolerant or cannot eat gluten. These differences between individuals can be explained by gene variations within the population. Through decades of science and research we have learned that genetic variations in the population and between individuals affect a wide variety of responses to key components of the human diet. For instance, some individuals may gain health, body composition or performance benefits from limiting their consumption of caffeine or saturated fat or increasing their intake of vitamin D or protein, while others can follow the general recommendation for either or both. Your best performance diet depends on the specific variants you have for these nutrient-related genes. Understanding your genetic profile and its implications on your unique response to the foods, supplements and beverages you consume, will provide you with the tools needed to adopt the best dietary strategies for optimal athletic performance.

The science of how specific genes change how we respond to dietary components enable us to use nutrition to its fullest potential to optimize athletic performance. These personalized diets can enhance an individual's nutritional status and empower them to better focus on the nutrition they need to support optimal health and performance. General dietary recommendations or the one-size-fits-all approach to nutritional advice will limit individuals from reaching their full genetic potential. By tailoring an athlete's nutritional needs to their genetic profile, the benefits of nutrition for optimal health and athletic performance can be maximized.

1in5

People with Risk Variant

Your Results

Gene	Marker
BCMO1	rs11645428

Risk Variant	Your Variant
GG	GG

Your Risk

Elevated

only when vitamin A intake is low

Recommendation

Since you possess the GG variant of the BCMO1 gene, it is important for you to meet the RDA for vitamin A. Consuming foods that are higher in pre-formed vitamin A can help you to meet your needs more easily. These foods include fish, liver, eggs, and dairy products. Meeting your recommendations for vitamin A will help to support healthy immunity, vision, and reproductive health. It will also act as an antioxidant when consumed in the form of beta-carotene (plant-sources). Women should aim for 700 mcg RAE/day and men should aim for 900 mcg RAE/day.

Focus on consuming pre-formed sources of vitamin A.

Vitamin A (Beta-Carotene)

Vitamin A is a fat-soluble vitamin that is important for eye health and vision, thus playing a role in optimizing hand-eye coordination and visual precision, which are key determinants of performance in many sports. Vitamin A also contributes to a strong immune system to support an athlete's demanding training and competition schedule. Beta-carotene is a precursor of active vitamin A and is an antioxidant found in certain fruits and vegetables that are orange-red in color. Beta-carotene can be converted to pre-formed vitamin A (retinol) in the body to exert its biological functions. Research shows that individuals with the GG version of the BCMO1 gene are inefficient at converting beta-carotene to active vitamin A*. These individuals are considered low responders to dietary beta-carotene so consuming enough active vitamin A can help ensure circulating levels of active vitamin A are adequate to support vision, immunity and reproductive functions.

* Lietz G et al. Single nucleotide polymorphisms upstream from the β-carotene 15,15'-monoxygenase gene influence provitamin A conversion efficiency in female volunteers. Journal of Nutrition. 2012;142:161S-5S.

BCMO1

Beta-carotene mono-oxygenase 1 (BCMO1) is an enzyme that plays a key role in the conversion of beta-carotene into the active form of vitamin A. Beta-carotene is the plant form of vitamin A. Individuals who possess the GG version of the BCMO1 gene are inefficient at converting beta-carotene into the active form of vitamin A. These individuals need to ensure they are consuming adequate amounts of vitamin A, particularly pre-formed vitamin A.

Sources of Vitamin A

	High in Preformed Vitamin A	Amount (mcg RAE)
Pumpkin, canned (1/2 cup)		1010
Carrots, cooked (1/2 cup)		650
Sweet potato, boiled without skin (1/2 medium)		600
Bluefin tuna (75g)	✓	530
Spinach, boiled (1/2 cup)		500
Butternut squash (1/2 cup)		410
Goat cheese, hard (50g)	✓	240
Eggs (2 large)	✓	220
Mackerel (75g)	✓	190

Source: Health Canada's Nutrient Value of Some Common Foods and Dietitians of Canada Food Sources of Vitamin A

Vitamin B_{12}

Vitamin B_{12} (cyanocobalamin) is important for normal brain and nervous system functioning. Vitamin B_{12} is also essential in the production of healthy red blood cells, and vitamin B_{12} deficiency may potentially cause megaloblastic anaemia. This condition results in the production of larger than normal red blood cells which cannot provide oxygen to cells as efficiently, and therefore reduces the oxygen-carrying capacity of the blood, resulting in weakness, fatigue, and a reduction in aerobic performance. Being deficient in vitamin B_{12} is also associated with pallor (pale skin) and irritability. Research shows that some individuals are at a greater risk than others for vitamin B_{12} deficiency based on the FUT2 gene*. Since animal products are the primary sources of vitamin B_{12}, individuals following a vegetarian diet are at an even greater risk of vitamin B_{12} deficiency.

*Hazra A et al. Common variants of FUT2 are associated with plasma vitamin B12 levels. Nature Genetics. 2008 Oct;40(10):1160-2.

FUT2

The fucosyltransferase 2 (FUT2) enzyme is encoded by the fucosyltransferase 2 gene and is involved in vitamin B_{12} absorption and transport between cells. Variants of this gene have been linked to low blood levels of vitamin B_{12} especially when consuming a vegetarian diet. However, for individuals with the risk variant, consuming adequate vitamin B_{12} can help reduce the risk of vitamin B_{12} deficiency.

Sources of Vitamin B_{12}

	Amount (mcg)
Clams, boiled or steamed (5 large)	59.0
Oysters, boiled or steamed (6 medium)	14.7
Atlantic herring (75g)	14.0
Nutritional yeast (1 Tbsp)	3.9
Ground beef, lean (75g)	2.2
Fortified soy beverage (1 cup)	2.2
Atlantic salmon (75g)	2.1
Lamb (75g)	1.7
Soy 'burger' patty (1)	1.7
Eggs, hard boiled (2)	1.1

Source: Health Canada's Nutrient Value of Some Common Foods and http://nutritiondata.self.com

1in2

People with Risk Variant

Your Results

Gene	Marker
FUT2	rs601338

Risk Variant	Your Variant
GG or GA	GA

Your Risk

Elevated

only when vitamin B12 intake is low

Recommendation

Since you possess an elevated risk variant for vitamin B12 deficiency, you should aim to meet the RDA for vitamin B12 of 2.4 mcg daily. You should focus on eating foods with a high bioavailability of vitamin B12 (foods with a form of vitamin B12 that your body uses more effectively). Meat and fish products have a higher bioavailability than eggs or plant sources of vitamin B12 including soy products or fortified milk alternatives such as soy, almond and rice beverages, and vegetarian meat alternatives. If you follow a vegetarian or vegan diet, you are at an even greater risk for vitamin B12 deficiency and depending on your food choices, a supplement may be warranted.

Focus on consuming bioavailable sources of vitamin B12.

1in5

People with Risk Variant

Your Results

Gene	Marker
GSTT1	Ins or Del

Risk Variant	Your Variant
Del	Ins

Your Risk

Typical

Recommendation

Since you possess the Ins variant of GSTT1, there is no increased risk of vitamin C deficiency, and supplementation is discouraged as it may be potentially counter-productive to training. Therefore, following the RDA guidelines for vitamin C is sufficient for you. The RDA for vitamin C is 75 mg per day for women and 90 mg per day for men. Smokers require an additional 35 mg per day. Citrus fruits and juices, strawberries, tomatoes, red and green peppers, broccoli, potatoes, spinach, cauliflower and cabbage are examples of foods that are good sources of vitamin C.

Meet the RDA for vitamin C daily.

Vitamin C

Vitamin C is a powerful antioxidant that can aid in the reduction of exercise-induced free-radical production, which can damage healthy tissues and cause premature fatigue during exercise. Vitamin C also aids in the absorption of non-heme (plant) iron, and supports immune function and the formation of collagen, a protein used to make skin, connective tissue, and blood vessels, along with supporting bone and tissue repair. However, too much vitamin C as a supplement may interfere with an athlete's adaptations to exercise training. Research has shown that the amount of vitamin C absorbed into the blood can differ between people even when the same amount is consumed. Some people do not process vitamin C from the diet as efficiently as others and are at a greater risk of vitamin C deficiency. Two recent studies* have shown that the ability to process vitamin C efficiently depends on a gene called GSTT1.

* Cahill LE et al. Functional genetic variants of glutathione S-transferase protect against serum ascorbic acid deficiency. American Journal of Clinical Nutrition. 2009;90:1411-7.
Horska A et al. Vitamin C levels in blood are influenced by polymorphisms in glutathione S-transferases. European Journal of Nutrition. 2011;50:437-46.

GSTT1

The GSTT1 gene produces a protein for the glutathione S-transferase enzyme family. These enzymes play a key role in the utilization of vitamin C. The GSTT1 gene can exist in one of two forms. The insertion ("Ins") form is considered functional while the deletion ("Del") form is not functional. The different versions of this gene interact to influence the way vitamin C is utilized in the body. A deletion version of the gene results in a reduced ability to process vitamin C. This means that people who possess the deletion version (Del) will have lower blood levels of vitamin C at a given level of intake than people who possess the insertion version (Ins) of the gene.

Sources of Vitamin C

	Amount (mg)
Red peppers (1 pepper)	216
Strawberries (1 cup)	96
Pineapple (1 cup)	92
Brussels sprouts (1 cup)	90
Orange juice (1 cup)	86
Broccoli (1 cup)	82
Grapefruit (1 fruit)	78
Mango (1 fruit)	75
Kiwi (1 fruit)	70

Source: TACO (UNICAMP), Canadian Nutrient File and USDA Nutrient Database

Vitamin D

Vitamin D is essential to calcium metabolism and increasing calcium absorption. Low levels of vitamin D are associated with decreased bone mineral density and an increased risk of stress fractures. Vitamin D also seems to play an important role in heart health, immune function, neuromuscular function, and may help in muscle recovery and muscle-building during intense training. Vitamin D can be synthesized by the skin from UV light or it can be obtained from the diet. Vitamin D deficiency is diagnosed by measuring the most common form of vitamin D in the blood, which is 25-hydroxy vitamin D. Research shows that variations in the CYP2R1 and GC genes can affect your risk for low circulating 25-hydroxy vitamin D levels*.

* Slater NA et al. Genetic Variation in CYP2R1 and GC Genes Associated With Vitamin D Deficiency Status. Journal of Pharmacy Practice. 2015:1-6.
Wang TJ et al. Common genetic determinants of vitamin D insufficiency: a genome-wide association study. Lancet. 2010;376:180-88.

CYP2R1 & GC

Vitamin D 25-hydroxylase is the key enzyme that activates vitamin D from its pre-formed type, which is obtained through sun exposure and the diet. This enzyme is encoded by the CYP2R1 gene and a variant of this gene has been associated with an increased risk of low circulating levels of vitamin D. The GC gene encodes the vitamin D-binding protein, which binds vitamin D and transports it to tissues. A variant in this gene has also been associated with an increased risk of low circulating levels of vitamin D.

Sources of Vitamin D

	Amount (IU)
Sockeye salmon (75g)	680
Whitefish (75g)	448
Sardines, canned in oil (1/2 can)	254
Rainbow trout (75g)	192
Smoked salmon (40g)	168
Halibut (75g)	144
Fortified soy beverage (1 cup)	124
Arctic char (75g)	112
Milk (1 cup)	104
Orange juice, fortified with vitamin D (1/2 cup)	50

Source: Health Canada's Nutrient Value of Some Common Foods and Canadian Nutrient File

4in5

People with Risk Variant(s)

Your Results

Genes	Markers
CYP2R1 GC	rs10741657 rs2282679

Risk Variants	Your Variants
algorithm	GA GG

Your Risk

Elevated

only when vitamin D intake is low

Recommendation

Since you possess one or more elevated risk variants, you are at an increased risk for low circulating vitamin D levels, so getting enough vitamin D is important. Aim for 1000 IU (25 mcg) vitamin D per day. This can help to maintain and/or improve your bone health, muscle and brain function, immunity, and heart health. Since it may be challenging to get enough vitamin D in the diet, supplementation may be beneficial. Do not exceed 2000 IU (50 mcg) per day without first having your blood levels of vitamin D assessed and monitored by a healthcare professional.

Consume 1000 IU (25 mcg) vitamin D daily.

1in20

People with Risk Variant

Your Results

Gene	Marker
F5	rs6025
Risk Variant	**Your Variant**
CT or TT	CC

Your Risk

Typical

Recommendation

Since you possess the typical risk variant of the F5 gene, you would not benefit from taking a vitamin E supplement to lower your risk of VTE. Meet the RDA for vitamin E of 15 mg/day (21 IU/day). Good sources of vitamin E include almonds, sunflower seeds, sunflower oil, hazelnuts, and grapeseed oil.

Meet the RDA for vitamin E daily.

Vitamin E

Vitamin E is an effective fat-soluble antioxidant that protects cells from oxidative damage. Vitamin E is also essential for building a strong immune system, as well as supporting skin and eye health, and it may also help to reduce the risk of cardiovascular disease. Most vegetable oils, nuts and seeds are excellent sources of vitamin E. Grapeseed oil, sunflower oil, canola oil, and flaxseed oil are very high in vitamin E. While vitamin E deficiencies are rare, research has shown that some individuals might benefit from higher intakes of vitamin E for the prevention of venous thromboembolism (VTE). VTE consists of deep vein thrombosis (DVT) (blood clots, usually in the legs) and pulmonary embolism (blood clots that travel to the lungs from other parts of the body). VTE blood clots can cause pain, swelling, and redness. The risk of VTE is dependent, in part, on variations in the F5 gene, but research shows this risk is reduced in those who take a vitamin E supplement*.

* Glynn RJ et al. Effects of random allocation to vitamin E supplementation on the occurrence of venous thromboembolism: report from the Women's Health Study. Circulation. 2007;116:1497-503.

F5

The F5 gene helps to produce a protein called coagulation factor 5. Coagulation factors are involved in the formation of blood clots. Blood clotting can be beneficial for stopping bleeding and sealing off blood vessels in a wound or scrape. However, more serious blood clots can occur in cases such as VTE where the clot occurs in a vein and obstructs the flow of blood. These clots can travel to the lungs resulting in pulmonary embolism. Variations in the F5 gene have been associated with an increased risk of VTE.

Sources of Vitamin E

	Amount (mg)
Almonds (1/4 cup)	9.3
Sunflower seeds, roasted (1/4 cup)	8.5
Sunflower oil (1 Tbsp)	5.7
Hazelnuts, dry roasted (1/4 cup)	5.2
Grapeseed oil (1 Tbsp)	4.0
Peanut butter (2 Tbsp)	2.9
Peanuts, dry roasted (1/4 cup)	2.6
Flaxseed oil (1Tbsp)	2.4
Canola oil (1 Tbsp)	2.4
Halibut (75g)	2.2
Eggs, hard boiled (2 large)	1.0

Source: Health Canada's Nutrient Value of Some Common Foods

Folate

Folate is a water-soluble B vitamin that is necessary for cell growth and development. Low blood levels of folate have been associated with increased risk of heart disease and stroke via high homocysteine levels. Intense physical activity has also been shown to raise homocysteine levels, therefore training athletes may have an increased risk especially if coupled with folate deficiency. Research has shown that the amount of folate absorbed into the blood can differ between individuals even when the same amount of folate is consumed. Some people do not utilize dietary folate as efficiently as others and are consequently at a greater risk of folate deficiency. Studies* have shown that an individual's ability to process dietary folate efficiently depends on a gene called MTHFR.

* Currò M, Di Mauro D, Bruschetta D, D'Amico F, Vecchio M, Trimarchi F, Ientile R, Caccamo D. Influence of MTHFR polymorphisms on cardiovascular risk markers in elite athletes. Clin Biochem. 2016 Jan;49(1):183-5
Solis C et al. Folate Intake at RDA Levels Is Inadequate for Mexican American Men with the Methylenetetrahydrofolate Reductase 677TT Genotype. Journal of Nutrition. 2008 ;138 :67-72.
Guinotte CL et al. Methylenetetrahydrofolate Reductase 677C T Variant Modulates Folate Status Response to Controlled Folate Intakes in Young Women. Journal of Nutrition. 2003;133 :1272-1280.

MTHFR

The MTHFR gene produces methylenetetrahydrofolate reductase (MTHFR), which is a vital enzyme for folate usage in the body. MTHFR converts folate obtained from the diet to an active form of the nutrient that can be used by the body at the cellular level. Variations in the MTHFR gene determine the way individuals can utilize dietary folate. Those people who have the CT or TT variant of the gene have reduced MTHFR enzyme activity and are at greater risk of folate deficiency when folate intake is low, compared to those with the CC variant.

Sources of Folate

	Amount (mcg)
Chicken liver (75mg)	420
Edamame (soybeans) (1/2 cup)	382
Lentils, cooked (3/4 cup)	265
Spinach, cooked (1/2 cup)	130
Asparagus (6 spears)	128
Chickpeas (3/4 cup)	119
Black beans (1/4 cup)	108
Kale, raw (1 cup)	100
Avocado (1/2 fruit)	81

Source: Canadian Nutrient File and USDA Nutrient Database

2in3

People with Risk Variant

Your Results

Gene	Marker
MTHFR	rs1801133
Risk Variant	**Your Variant**
CT or TT	TT

Your Risk

Elevated

only when folate intake is low

Recommendation

Since you possess the TT or CT variant of the MTHFR gene, there is a greater risk of folate deficiency if the RDA is not met on a daily basis. Ensure that folate intake is at least 400 mcg per day in order to reduce the risk of deficiency. Foods that are naturally high in folate include lentils, romano beans, black beans, white beans, okra, asparagus, spinach, and other leafy greens. Enriched ready-to-eat cereals, bread, and bread products are also good sources of folate. A folate supplement may be warranted if adequate intakes through dietary sources cannot be achieved.

Meet the RDA for folate daily.

1in150

People with risk variant(s)

Your Results

Genes	Markers
SLC17A1 HFE HFE	rs17342717 rs1800562 rs1799945

Risk Variants	Your Variants
algorithm	CC GG CC

Your Risk

Low

Recommendation

Since you do not possess any risk variants for iron overload, you have a low risk for iron overload. Follow the recommendations given in the next section for Low Iron Status.

Follow the recommendations provided in the Low Iron Status section.

Iron Overload

Hemochromatosis is a condition where the body absorbs too much iron (i.e. iron "overload") and can result in liver disease, arthritis and heart conditions. If you have a high risk for iron overload it is important to monitor your iron intake and blood markers of iron status such as ferritin, hepcidin or transferrin saturation. There are two main types of dietary iron: heme and non-heme iron. Non-heme iron is found in certain plant products and is not absorbed as effectively as heme iron, but vitamin C can substantially increase the absorption of non-heme iron. Hereditary hemochromatosis is an iron overload condition that is linked to variations in the HFE or SLC17A1 genes*. Interestingly, the prevalence of genetic variation in the HFE and SLC17A1 genes, leading to iron overload, is much higher in elite level athletes compared to the general population. While this genetic variation appears to have a favorable impact on performance, it is important for athletes with a medium or high risk to avoid iron supplementation as this could lead to severe organ dysfunction.

* Allen KJ et al. Iron-overload-related disease in HFE hereditary hemochromatosis. New England Journal of Medicine. 2008;358:221-30.
Pichler I et al. Identification of a common variant in the TFR2 gene implicated in the physiological regulation of serum iron levels. Human Molecular Genetics. 2011;15:1232-40.
Chicharro et al. Mutations in the hereditary haemochromatosis gene HFE in professional endurance athletes. Br J Sports Med. 2004;38(4):418-21. Erratum in: Br J Sports Med. 2004 Dec;38(6):793.

HFE and SLC17A1

The human hemochromatosis protein is encoded by the HFE gene and variations in the gene sequence have been linked to iron overload. The SLC17A1 gene is located near the HFE gene and variations in SLC17A1 have also been linked to iron overload. The HFE protein functions to regulate iron uptake in the small intestine. Those with elevated risk variants need to be careful not to consume too much iron and should have their blood markers of iron monitored. This test detects approximately 95% of cases of iron overload.

Sources of Iron

Sources of Heme Iron	Sources of Non-Heme Iron
Beef	Almonds
Chicken	Chickpeas
Fish	Parsley
Organ meats	Spinach
Shrimp	Tofu
Veal	White beans

Low Iron Status

Iron is an essential mineral that plays a fundamental role in processes related to physical exercise and immune function. Iron is required in the formation of red blood cells, which transport oxygen in the body. It is also a component of certain enzymes and proteins, which are essential for energy production and optimizing physical performance. Low iron status is determined by measuring certain blood markers such as ferritin, hepcidin or transferrin. Low iron stores can lead to anemia, which is associated with fatigue, weakness, shortness of breath, dizziness and reduced aerobic capacity. Low iron status, even in the absence of anemia, can cause fatigue and poor performance. Many athletes are at higher risk of low iron stores than the general population. Several genes can impact the risk of having low iron status including TMPRSS6, TFR2, and TF*.

*Pichler I et al. Identification of a common variant in the TFR2 gene implicated in the physiological regulation of serum iron levels. Human Molecular Genetics. 2011;15:1232-40.
Benyamin B et al. Variants in TF and HFE explain approximately 40% of genetic variation in serum-transferrin levels. Am J Hum Gen. 2009;84:60–65.

TMPRSS6, TFR2, and TF

The TMPRSS6 gene codes for the protein matriptase-2, which affects hepcidin levels that help to regulate iron balance. The transferrin receptor 2 (TFR2) gene codes for the TFR2 protein, which helps iron to enter into cells. The transferrin (TF) gene codes for the protein transferrin, which is mainly responsible for transferring iron in the body. Together, variations in these genes can impact the risk of low iron status.

Sources of Iron

	Amount (mg)
Chicken liver (75mg)	9.8
White beans (175ml)	5.8
Pumpkin seeds (2 Tbsp)	5.2
Spinach, boiled (1/2 cup)	3.4
Tahini (2 Tbsp)	2.7
Chickpeas (3/4 cup)	2.4
Extra lean ground beef (75g)	2.1
Almonds (1/4 cup)	1.5
Tofu (150g)	1.2
Lean ground chicken (75g)	1.2

Source: Health Canada's Nutrient Value of Some Common Foods

2in3

People with risk variant(s)

Your Results

Genes	Markers
TMPRSS6 TFR2 TF	rs4820268 rs7385804 rs3811647

Risk Variants	Your Variants
algorithm	GA CA AA

Your Risk

Elevated

only when iron intake is low

Recommendation

You are at an increased risk for low iron status. To minimize your risk for low iron, meet the RDA for iron and consume food sources of vitamin C with non-heme iron-containing foods to increase iron absorption. Focus on foods with a high bioavailability such as animal products (heme iron) and cooked spinach. Although iron supplementation might be warranted, too much iron can be toxic and can also result in reduced exercise performance. Therefore the decision to use iron supplements should carefully consider bloodwork assessment and the supervision of a healthcare professional. Men aged 19 years and older and women over 50 should aim for 8 mg/day. Women 19-50 years old should aim for 18 mg/day.

Meet the RDA for iron and consume sources of vitamin C with iron-rich foods.

1in6

People with Risk Variant(s)

Your Results

Gene	Markers
GC	rs7041 rs4588

Risk Variants	Your Variants
algorithm	TG CA

Your Risk

Elevated

only when calcium intake is low

Recommendation

Based on your GC gene, you have an increased risk for bone fractures if your calcium intake is below the recommendation of 1200 mg per day. Meeting these recommendations will bring your elevated risk down to typical. Adults 19-50 years old should not exceed 2500 mg calcium per day and adults over 50 should not exceed 2000 mg per day. Aim to meet your recommended daily intake of calcium through dietary sources.

Consume 1200mg of calcium daily.

Calcium

Calcium is important for growth, maintenance and repair of bone tissue. It is also involved in maintenance of blood calcium levels, regulation of muscle contraction, nerve conduction, and normal blood clotting. In order to absorb calcium, we also need adequate vitamin D intake (refer to the vitamin D section for your specific recommendations). Inadequate dietary calcium and vitamin D increase the risk of low bone mineral density and stress fractures. Low energy intakes and menstrual dysfunction in female athletes along with low vitamin D and calcium intakes further increase the risk of stress fractures. Research now shows that some people do not utilize dietary calcium as efficiently as others and this may depend on variations in the GC gene*.

* Fang Y et al. Vitamin D binding protein genotype and osteoporosis. Calcif Tissue Int. 2009;85:85-93.

GC

The GC gene encodes the vitamin D-binding protein, which binds vitamin D and then transports it to various tissues. Since vitamin D is needed for the absorption of calcium, this binding protein can impact calcium levels in the body and, therefore, bone fracture risk. Research shows that two variations in the GC gene are associated with an increased risk of bone fractures when calcium intake is low.

Sources of Calcium

	Amount (mg)
Low-fat cheddar cheese (50g)	450
Yogurt, plain (3/4 cup)	330
Skim milk (1 cup)	325
Fortified soy or rice beverage (1 cup)	320
Tofu, firm (150g)	235
Canned salmon, with bones (75g)	210
Sardines, canned in oil (1/2 can)	200
Kefir, plain (3/4 cup)	185
Edamame (soybeans) (1/2 cup)	130
Spinach, boiled (1/2 cup)	130

Source: Health Canada's Nutrient Value of Some Common Foods

Caffeine

Caffeine is the most widely consumed stimulant in the world and many athletes use it to try to enhance training and performance. Although coffee is one of the most significant sources of caffeine, athletes also obtain caffeine from colas, energy drinks and shots as well as various supplements. Research has shown that caffeine can influence cardiovascular health as well as athletic performance.* Specifically, the cardiovascular health and endurance performance effects of caffeine depend on an individual's variant in the CYP1A2 gene.

* Womack CJ et al. The influence of a CYP1A2 polymorphism on the ergogenic effects of caffeine. J Int Soc Sports Nutr. 2012 Mar 15;9(1):7. doi: 10.1186/1550-2783-9-7.
Cornelis et al. Coffee, CYP1A2 genotype, and risk of myocardial infarction. Journal of the American Medical Association. 2006;295:1135-41.
Palatini P et al. CYP1A2 genotype modifies the association between coffee intake and the risk of hypertension. Journal of Hypertension. 2009;27:1594-1601.

CYP1A2

The CYP1A2 gene produces an enzyme called cytochrome P450 1A2 (CYP1A2), which is the main enzyme responsible for breaking down caffeine in the body. Variations in the CYP1A2 gene affect the rate that caffeine is broken down, which determines the impact of caffeine on cardiovascular health and athletic performance. Individuals who possess the GA or AA variant of CYP1A2 break down caffeine more slowly and are at greater risk of high blood pressure and heart attack when caffeine intake is high. These individuals do not experience endurance performance benefits from caffeine. In fact, caffeine may diminish endurance performance in individuals with the AA variant. Those who have the GG variant actually have a lower risk of heart disease with moderate coffee consumption. Caffeine is also more effective at improving endurance performance in athletes with the GG variant.*

Sources of Caffeine

	Amount (mg)
Coffee (1 cup)	100
Energy drinks (1cup)	80
Espresso (1 shot)	85
Black tea (1 cup)	50
Green tea (1 cup)	45
Cola (1 can)	26
Chocolate, dark (40 g)	27
Decaf coffee, espresso, tea (1 cup)	0-15
Herbal tea (1 cup)	0

Source: Canadian Nutrient File and USDA Nutrient Database

1in2

People with Risk Variant

Your Results

Gene	Marker
CYP1A2	rs2472300

Risk Variant	Your Variant
GA or AA	AA

Your Risk

Elevated

only when caffeine intake is high

Recommendation

Since you possess the AA or GA variant of the CYP1A2 gene, you are a slow metabolizer of caffeine and are less likely to benefit from the endurance performance-enhancing effects of caffeine. Additionally, there is an increased risk of high blood pressure and heart attack if you are consuming more than 200 mg of caffeine per day. Limit caffeine consumption to no more than 200 mg per day in order to reduce your risk of heart disease. If you have the AA variant, monitor your response to caffeine in training and competition as caffeine may worsen your performance. Caffeine occurs naturally in coffee, tea, cocoa, kola and guarana. It is also manufactured synthetically and added to cola, energy drinks, and certain over the counter cold remedies.

Limit caffeine intake to 200 mg/day.

1in2

People with Risk Variant

Your Results

Gene	Marker
TCF7L2	rs12255372
Risk Variant	**Your Variant**
GT or TT	GT

Your Risk

Elevated

only when whole grain intake is low

Recommendation

Since you possess the TT or GT variant of the TCF7L2 gene, there is an increased risk of developing type 2 diabetes if your whole grain consumption is low. Replacing high glycemic index carbohydrates in the diet with low glycemic index carbohydrates may help to reduce this risk. The food replacement table provides you with some ideas for whole grain products that can replace high glycemic index carbohydrates. Be mindful that whole grains are high in fibre and consuming excess fibre too close to beginning your training or competition can lead to gastrointestinal upset and hinder performance. Try to consume high-fiber foods well after exercise or at least 3-4 hours before exercise.

Consume most grain products as whole grains.

Whole Grains

Whole grains are a low glycemic index carbohydrate that have more fiber than refined grains. They also contain more essential micronutrients such as folic acid, magnesium and vitamin E. Years of research have shown that whole grains may help to reduce the risk of several diseases, in particular, type 2 diabetes. Scientists have also demonstrated that the TCF7L2 gene is strongly associated with developing type 2 diabetes. Research now shows that some individuals might benefit more from increasing their whole grain consumption*.

* Cornelis MC et al. TCF7L2, dietary carbohydrate, and risk of type 2 diabetes in US women. American Journal of Clinical Nutrition. 2009;89:1256-62.

TCF7L2

The TCF7L2 gene produces a protein called transcription factor-7 like 2 (TCF7L2). This protein, in turn, affects how the body turns on or off a number of other genes. The interaction of these proteins and genes is complex, and not yet fully understood. However, the TCF7L2 gene is one of the most consistent predictors of the likelihood of developing type 2 diabetes. People who possess the high risk GT or TT variant of the gene are at greater risk of developing type 2 diabetes. Yet, recent studies have shown that consuming whole grain foods can reduce the risk of type 2 diabetes in individuals who carry the GT or TT variant of the TCF7L2 gene.

Replace these foods...	with these foods...
white bread, bagels, pitas	100% whole grain bread, bagels and pitas
White rice	Brown or wild rice, quinoa
White pasta	100% whole wheat pasta or brown rice pasta
High sugar cold cereals	Cooked oatmeal or 100% whole grain cold cereal
White flour baked goods	100% whole wheat flour baked goods

Sodium

Sodium is an essential micronutrient that regulates blood pressure and blood volume. Most people consume more sodium than the body requires. However, ,sodium requirements may be higher in athletes who sweat considerably during training than for the general public. The major adverse effect of excess sodium intake is elevated blood pressure, which predisposes to hypertension and heart disease. However, some individuals do not experience as great an increase in blood pressure in response to excess sodium intake as others. Research* now shows that the effect of sodium intake on blood pressure is influenced by variations in a gene called ACE.

* Poch E et al. Molecular basis of salt sensitivity in human hypertension: Evaluation of renin-angiotensin-aldosterone system gene polymorphisms. Hypertension. 2001;38:1204-9.

ACE

The ACE gene directs the body to produce the angiotensin-converting enzyme (ACE), which is known to play a role in regulating the response of blood pressure to sodium intake. It is now known that a person's specific blood pressure response to excess sodium intake is dependent on which variant of the ACE gene they possess. Those who have the GA or AA variant of the ACE gene are at a greater risk of experiencing elevated blood pressure when higher amounts of sodium are consumed than those possessing the GG variant of the gene.

Sources of Sodium

	Amount (mg)
Ramen noodles, with flavour (1 package)	1760
Breakfast bagel w/ham, egg and cheese	1260
Canned soup (1 cup)	1130
Ham (75g)	1040
Pickle (1 medium)	830
Tomato sauce, canned (1/2 cup)	650
Feta cheese (50g)	560
Potato chips (1 small bag)	390
Cold cereal (1 cup)	350
Bread (1 slice)	230

Source: Canadian Nutrient File and USDA Nutrient Database

7in10

People with Risk Variant

Your Results

Gene	Marker
ACE	rs4343
Risk Variant	**Your Variant**
GA or AA	AA

Your Risk

Elevated

only when sodium intake is high

Recommendation

Since you possess the AA or GA variant of the ACE gene, there is an increased risk of elevated blood pressure when sodium intake is high. Limiting sodium consumption to the Adequate Intake (AI) level of 1500 mg per day should help to reduce the risk. However, this recommendation should be outside of training when you are not losing sodium in your sweat. During training or competition you may require additional sodium to replace losses from sweating. The AI is equivalent to 3⁄4 teaspoon of salt per day, which includes sodium that is found naturally in food as well as salt that is added during processing and preparation.

Limit sodium intake to 1500 mg/day.

1in2

People with Risk Variant

Your Results

Gene	Marker
NOS3	rs1799983

Risk Variant	Your Variant
GT or TT	GG

Your Risk

Typical

Recommendation

Since you possess the GG variant of the NOS3 gene, there is no benefit to increasing omega-3 intake in order to lower serum triglyceride levels. You should, therefore, follow the recommendation to consume 200-500 mg daily in order to optimize cardiometabolic health.

Consume between 200-500 mg per day of omega-3 fat.

Omega-3 Fat

Omega-3 fats, such as those found in fatty fish, have been associated with a reduced risk of heart disease. This is likely due, in part, to their ability to lower blood levels of triglyceride that impair blood circulation. A healthy blood lipid profile is important for cardiovascular health not only to lower the risk of heart disease but also for general health and optimal performance. Previous studies have produced mixed results relating to the effects of omega-3 fat on triglyceride levels between individuals. Some people experience a significant reduction in triglyceride levels in response to increasing omega-3 fat intake, whereas others experience little benefit. The reasons for these differences have been unclear until a recent breakthrough study* showed that the effect of omega-3 fat on triglyceride levels depends on variations in a gene called NOS3.

* Ferguson J et al. NOS3 gene polymorphisms are associated with risk markers of cardiovascular disease, and interact with omega-3 polyunsaturated fatty acids. Atherosclerosis. 2010;211:539-544.

NOS3

The NOS3 gene directs the production of an enzyme called nitric oxide synthase. This enzyme is responsible for making nitric oxide, which plays an important role in the function of cells that line our blood vessels. Current research shows that variations in the NOS3 gene interact with omega-3 fat in different ways to impact how the body processes triglycerides. Those who have the GT or TT variant of the gene are at greater risk of elevated triglyceride levels when consuming a diet low in omega-3 fats, compared to those who have the GG variant.

Sources of Omega-3 Fat*

	Amount (g)
Salmon (75g)	1.6
Herring (75g)	1.5
Anchovy (75g)	1.3
Mackarel (75g)	0.9
Trout (75g)	0.7
Tuna, white (75g)	0.6
Lobster (75g)	0.4
Crab (75g)	0.3
Tuna, light (75g)	0.2

* Long chain omega-3s EPA + DHA
Source: Canadian Nutrient File and USDA Nutrient Database

Saturated Fat

Saturated fats, such as those found in red meat and baked goods have long been associated with health conditions such as diabetes, cardiovascular disease and obesity. However, the connection between saturated fats and obesity, has been poorly understood. In the past, scientists could not explain why certain people seemed prone to obesity when consuming a diet high in saturated fats, but others were less susceptible. A number of studies* have now shown that the effect of saturated fat on high body fat and obesity can be influenced by variations in a gene called APOA2.

*Corella D et al. APOA2, dietary fat, and body mass index: replication of a gene- diet interaction in 3 independent populations. Archives of Internal Medicine. 2009;169:1897-906.

APOA2

The APOA2 gene directs the body to produce a specific protein called apolipoprotein A-II, which plays an important role in the body's ability to utilize different kinds of fat. Scientists now understand that there are different variations in the APOA2 gene present in the human population and that these different versions of the gene interact with saturated fat in unique ways to influence energy balance and ultimately the risk of high body fat levels and obesity. Those people who have the CC variant of the gene are at a higher risk of developing high body fat levels and obesity when consuming a diet high in saturated fats than those possessing the TT or TC variant of the gene.

Sources of Saturated Fat

	Amount (g)
Short ribs (75g)	11
Cheddar cheese (50g)	10
Ice cream, premium (1/2 cup)	11
Butter (1 tbsp)	8
Salami (75g)	8
Regular ground beef, cooked (75g)	7
Cheeseburger (single patty)	6
Muffin (1 small)	5
French fries (20-25 fries)	5
Coffee cream, 18% MF (1 tbsp)	2

Source: Canadian Nutrient File and USDA Nutrient Database

1in7

People with Risk Variant

Your Results

Gene	Marker
APOA2	rs5082

Risk Variant	Your Variant
CC	TC

Your Risk

Typical

Recommendation

Since you possess the TT or TC variant of the APOA2 gene, there is no increased risk of high body fat with a diet high in saturated fat. However, you should still limit saturated fat intake to less than 10% of total energy intake in order to reduce the general risk of other associated health issues such as cardiovascular disease. Foods high in saturated fat include coconut and palm oils, fatty meats, butter, cheese, fried foods and baked goods. Alternatives low in saturated fat include olive and vegetable oils, lean meats, low-fat dairy products, fish, and plant protein sources such as beans, nuts/seeds or soy-based proteins.

Limit intake of saturated fat to no more than 10% of energy.

7in10

People with Response Variant

Your Results

Gene	Marker
UCP1	rs1800592
Response Variant	**Your Variant**
GG or GA	GA

Your Response

Diminished

Recommendation

Since you possess the GG or GA variant of the UCP1 gene, your daily RMR may be approximately 150 calories (about 10%) lower than those with the typical risk variants. This is about 10% lower than individuals with the typical risk genotype. If you are trying to lose fat mass, reducing your energy intake from food or increasing your energy output through exercise by approximately 650 calories per day from your calculated energy needs can be helpful. For example, decreasing your energy consumed by 450 calories and increasing your energy output through physical activity by 200 calories per day is equal to a 650 calorie deficit.

Aim for an energy deficit of 650 calories/day from your calculated energy needs for weight loss.

Energy Balance

Energy is used to fuel all of the body's functions. A calorie is a commonly used unit of measurement to quantify energy. Energy comes from the foods and beverages consumed. The body then uses energy to complete essential processes such as digestion, breathing, brain function and maintaining a normal body temperature. The energy burned during these essential processes is referred to as the Resting Metabolic Rate (RMR), which can vary substantially between individuals. Variability in RMR can depend on differences in muscle mass, weight, age and genetics. Research shows that variation in the UCP1 gene affects RMR*. Total energy output is the sum of the RMR plus energy burned during physical activity. Consuming less energy and/or expending more energy can lead to weight loss.

* Nagai N et al. UCP1 genetic polymorphism (-3826A/G) diminishes resting energy expenditure and thermoregulatory sympathetic nervous system activity in young females. Int J Obesity. 2011;35:1050-5.

UCP1

Uncoupling protein 1 (UCP1) is found in fat tissue and is involved in metabolic processes that create energy and then release it in the form of heat. The UCP1 gene is important for regulating normal body temperature and can impact RMR. Research shows that individuals with the GG or GA variants tend to have lower RMRs compared to individuals with the AA variant. As such, they need to consume less energy to maintain regular bodily functions.

Sources of High Energy Foods

	Amount (calories)
Double patty hamburger (1)	580
Chicken Caesar salad (2 cups)	490
Pizza with pepperoni and cheese (1/2 of 12")	440
Mixed nuts, roasted (1/2 cup)	410
Carrot muffin (1 medium)	340
Avocado (1 fruit)	320
Cheeseburger (1)	320
Donut, chocolate covered (1)	270
French fries (20-25)	240
Croissant (1)	230

Source: Health Canada's Nutrient Value of Some Common Foods

Physical Activity

Physical activity has important benefits for mental health, physical fitness, weight maintenance and the prevention of many chronic illnesses. Cardiovascular conditioning exercises include those that elevate your heart rate for a sustained period of time such as running, swimming and cycling, and improve the function of your heart, lungs and blood vessels. Skeletal muscle conditioning exercises include activities such as weight lifting or certain types of yoga, which improve muscle strength and power and improve bone health. Most forms of physical activity are beneficial, however, different baseline levels of physical activity, depending on variation in the FTO gene, are needed to achieve/maintain a healthy body weight. Competitive athletes are most likely achieving the minimum physical activity recommendation when they are in-season. However, it is important to ensure that the recommended baseline physical activity level is achieved during the off-season when activity levels tend to fall. Research shows that variants in the FTO gene can impact your metabolic response to physical activity*. Physical activity can reduce the effects of the FTO gene on risk of overweight and obesity by as much as 75%**.

*Andreasen et al. Low physical activity accentuates the effect of the FTO rs9939609 polymorphism on body fat accumulation. Diabetes. 2008;57:95-101.
**Reddon et al. Physical activity and genetic predisposition to obesity in a multiethnic longitudinal study. Scientific Reports. 2016;6:1-10.

FTO

UThe FTO gene is also known as the 'fat mass and obesity-associated gene' since it can impact weight management and body composition. This gene's role in the body is related to metabolic rate, energy expenditure and energy balance. It is also expressed in regions of the brain that are involved in the regulation of energy intake. Current research shows that specific dietary and physical activity recommendations can substantially help with weight loss and weight maintenance in individuals with certain variants of the FTO gene.

Endurance Sports

Cross-country skiing	Rowing
Cycling	Soccer
Distance running	Triathlon

Strength/Power Sports

Baseball	Racket sports
Hockey	Track and field
Martial arts	Weight lifting

1in6

People with Response Variant

Your Results

Gene	Marker
FTO	rs9939609
Response Variant	**Your Variant**
AA	TA

Your Response

Typical

Recommendation

Since you possess the TA or TT variant, you have typical baseline physical activity requirements for weight management. At a minimum, meet the general physical activity guidelines. This can have a positive impact on cholesterol levels, body composition, weight management, mental health, blood pressure, blood sugars, and many other health-related factors. It can also help avoid unwanted weight gain during the off-season. Aim for 150 minutes per week of moderate-vigorous cardiovascular activity in bouts of 10 minutes or more and strengthening activities (involving major muscle groups) at least 2 days per week. You will likely require greater levels of activity in-season or during periods of intense training.

Aim for 150 min/week of cardio and at least 2 days/week of muscle-strengthening activities.

1in6

People with Response Variant

Your Results

Gene	Marker
FTO	rs9939609

Response Variant	Your Variant
AA	TA

Your Response

Typical

Recommendation

Since you have the TA or TT variant of the FTO gene, you have a typical fat loss response from consuming a moderate-to-high protein diet. Consume 1.2-1.4 grams of protein per kilogram of body weight or approximately 20-30% of your energy from protein sources as part of a controlled-energy diet. Note that for larger athletes or those with higher energy intakes due to heavy training and/or high energy expenditures the grams per kilogram recommendations remain the same, but protein as a percent (%) may decrease markedly.

Consume 20-30% of energy from protein or 1.2-1.4 g protein/kg body weight.

Protein

Protein is an essential nutrient for muscle growth and repair, wound healing, healthy hair, skin and nails and proper immune function. Both endurance and power/strength athletes need adequate protein to build strength and repair damaged muscle that occurs during regular training. Protein has also been shown to regulate appetite by filling you up and allowing you to feel more satisfied with fewer calories. For athletes at risk for carrying extra fat mass or are unable to easily achieve their desired lean physique a high protein diet can help with these fat loss goals and maintenance of a lean physique over both the short-term and long-term*.

* Zhang X et al. FTO genotype and 2-year change in body composition and fat distribution in response to weight-loss diets: The POUNDS LOST trial. Diabetes. 2012;61:3005-3011.

FTO

The FTO gene is also known as the 'fat mass and obesity-associated gene' since it can impact weight management and body composition. This gene's role in the body is related to your metabolism, energy expenditure and energy balance. It is also expressed in regions of the brain that are involved in the regulation of energy or food intake. Current research shows that specific dietary and exercise recommendations can substantially help with fat loss and weight maintenance in individuals with certain variants of the FTO gene.

Sources of Protein

	Amount (g)
Chicken breast (75g)	25
Extra lean ground beef (75g)	23
Tofu, regular, extra firm (150g)	21
Salmon, baked (75g)	20
Cottage cheese (1/2 cup)	15
Lentils (3/4 cup)	14
Chickpeas (3/4 cup)	9
Skim milk (1 cup)	9
Almonds (1/4 cup)	8
Whole egg (1)	6

Source: Health Canada's Nutrient Value of Some Common Foods

Fat

Fat is an essential part of a healthy diet, provides energy for aerobic type exercise, and is needed for the absorption of the fat-soluble vitamins A, D, E, and K. Fat provides more than double the number of calories as carbohydrates or protein on a gram per gram basis. The total amount and types of fats that you choose may play a role in how effective your dietary strategies are for fat loss and achieving an optimal body composition for your sport. In general, unsaturated fats are heart-healthier than saturated or trans fats. The TCF7L2 gene is involved in body weight regulation and body composition. Research shows that individuals who possess the TT variant of TCF7L2 experience greater weight loss when they consume lower-to-moderate fat diets, in comparison to when they consume higher fat diets. For those with the CC or TC variant, there is no difference in weight loss based on the amount of fat consumed, although lower total energy intakes are needed to create a calorie deficit*.

* Grau K et al. TCF7L2 rs7903146-macronutrient interaction in obese individuals' responses to a 10-wk randomized hypoenergetic diet. American Journal of Clinical Nutrition. 2010;91:472-9.
Mattei J et al. TCF7L2 genetic variants modulate the effect of dietary fat intake on changes in body composition during a weight-loss intervention. American Journal of Clinical Nutrition. 2012;96:1129-36.

TCF7L2

The TCF7L2 gene produces a protein called transcription factor-7 like 2. This protein affects how the body turns on or off a number of other genes. Research shows that for individuals who possess the TT variant of the TCF7L2 gene, the amount of fat in the diet can significantly impact body composition (lean/muscle mass vs. fat mass) as well as the risk for being overweight. Furthermore, possessing the TT variant puts you at an increased risk for insulin resistance (weakened ability to control blood sugars) when your total fat intake is high. Consuming a low-to-moderate fat intake can help facilitate weight loss in individuals with the TT variant, which can in turn help with insulin resistance.

Sources of Fat

	Amount (g)
Macadamia nuts (1/4 cup)	26
Cheddar cheese (50g)	17
Butter (1 Tbsp)	16
Olive oil (1 Tbsp)	14
Swiss cheese (50g)	14
Pistachios (1/4 cup)	14
Lean ground beef (75g)	11
Goat cheese (50g)	11
Yogurt, 2-4% M.F. (3/4 cup)	8
Sockeye salmon (75g)	8

Source: Health Canada's Nutrient Value of Some Common Foods

1in10

People with Response Variant

Your Results

Gene	Marker
TCF7L2	rs7903146

Response Variant	Your Variant
TT	CC

Your Response

Typical

Recommendation

Since you possess the CC or TC variant of the TCF7L2 gene, you have a typical weight loss response based on your fat intake. However, to help ensure that you are consuming a healthy, well-balanced diet, consume 20-35% of your total daily energy needs from fat as part of a controlled energy diet.

Consume 20-35% of energy from fat.

2in3

People with Response Variant

Your Results

Gene	Marker
FTO	rs9939609
Response Variant	**Your Variant**
TA or AA	TA

Your Response

Enhanced

when saturated fat intake is low and polyunsaturated fat intake is high

Recommendation

Since you have the TA or AA variant of the FTO gene, you can enhance your weight loss by limiting saturated fat intake to less than 10% of total energy intake and consuming the rest of your recommended daily fat intake from unsaturated fats. Your intake of polyunsaturated fats should be at least 5% of your total energy intake, and the rest should come from monounsaturated fats. This can further help to decrease your risk of having too much fat mass resulting in suboptimal body composition for peak athletic performance. This will help you to achieve the desired intake of protein, carbohydrates and unsaturated fats to maintain a high-quality performance diet while reducing your general risk for other associated health issues such as cardiovascular disease.

Limit intake of saturated fat to no more than 10% of energy. Consume at least 5% of energy from polyunsaturated fat.

Saturated and Unsaturated Fats

There are two main types of dietary fats: saturated and unsaturated. Saturated fats are primarily found in animal-derived foods such as fatty meats, cheese, butter and other whole milk dairy as well as prepared foods such as pizza, baked goods and many desserts. For athletes, it is important to focus on calories that are contributing to health and performance, while minimizing calories that play less of a role in your performance diet. Saturated fats should be limited in an athlete's diet since they are not necessary to improve health or performance and are only needed in very small amounts. Unsaturated fats, such as those found in olive oil, almonds and grape seed oil, may help to decrease the risk of many chronic diseases. Current research shows that variation in the FTO gene can impact the response to saturated and unsaturated fat. For individuals with the AA or TA variant, a high intake of unsaturated fat, and low intake of saturated fat in the diet can help facilitate weight loss, decrease fat stores around the abdomen and decrease the risk for obesity*.

* Phillips CM et al. High dietary saturated fat intake accentuates obesity risk associated with the fat mass and obesity-associated gene in adults. Journal of Nutrition. 2012;142:824-31.

FTO

The FTO gene is also known as the 'fat mass and obesity-associated gene' since it can impact weight management and body composition. This gene's role in the body is related to metabolic rate, energy expenditure and energy balance. It is also expressed in regions of the brain that are involved in the regulation of energy intake. Current research shows that specific dietary and exercise recommendations can substantially help with weight loss and weight maintenance in individuals with certain variants of the FTO gene.

Sources of Mono and Polyunsaturated Fat

Monounsaturated Fat	Amount (g)
Macadamia nuts (1/4 cup)	20
Almond butter (2 Tbsp)	12
Olive oil (1 Tbsp)	10
Canola oil (1 Tbsp)	8
Peanut butter (2 Tbsp)	8
Polyunsaturated Fat	**Amount (g)**
Flaxseed oil (1 Tbsp)	10
Grape seed oil (1 Tbsp)	10
Sunflower oil (1 Tbsp)	9
Soybean oil (1 Tbsp)	8
Brazil nuts (1/4 cup)	7

Source: Health Canada's Nutrient Value of Some Common Foods

Monounsaturated Fat

Monounsaturated fats such as olive oil, almonds and avocados have been associated with a reduced risk for heart disease and add many beneficial nutrients to your performance diet. Monounsaturated fats can help reduce 'bad' (LDL) cholesterol levels and may also help increase 'good' (HDL) cholesterol. Research shows that these fats can help facilitate weight loss and reduce body fat levels in some individuals based on their PPARγ2 gene*.

* Garaulet M et al. PPARγ Pro12Ala interacts with fat intake for obesity and weight loss in a behavioural treatment based on the Mediterranean diet. Molecular Nutrition and Food Research. 2011;55:1771-9.

PPARγ2

The PPARγ2 gene is involved in the formation of fat cells. This gene is mainly found in fat tissue. Because of its involvement in the formation of fat, PPARγ2 can impact weight management and body composition. Specifically, individuals who have the GG or GC variant of the gene tend to experience greater weight loss and lose more body fat, compared to those with the CC variant, when they consume a diet high in monounsaturated fats.

Sources of Monounsaturated Fat

	Amount (g)
Macadamia nuts (1/4 cup)	20
Almond butter (2 Tbsp)	12
Olive oil (1 Tbsp)	10
Canola oil (1 Tbsp)	8
Peanut butter (2 Tbsp)	8
Sesame oil (1 Tbsp)	6

Source: Health Canada's Nutrient Value of Some Common Foods

1in7

People with Response Variant

Your Results

Gene	Marker
PPARγ2	rs1801282
Response Variant	**Your Variant**
GG or GC	CC

Your Response

Typical

Recommendation

Since you possess the CC variant of the PPARg2 gene, consuming more monounsaturated fats will not necessarily help to facilitate weight loss and lower your body fat percentage. However, for heart health, you should aim for a balance of saturated, monounsaturated and polyunsaturated fats to meet your total daily fat intake recommendation.

Aim for a balance of saturated, monounsaturated and polyunsaturated fats to meet your total daily fat intake.

Your Results

Gene	Marker
MCM6	rs4988235

Risk Variant	Your Variant
CC or CT	CT

Your Risk

Slightly Elevated

Lactose

Lactose is a naturally occurring sugar found in dairy products. When lactose is properly digested, it is broken down into two different sugar molecules, glucose and galactose. Lactase is the enzyme needed to break down lactose. Some people do not produce any, or enough lactase. Because of this, lactose passes through the intestines undigested. When this occurs, gut bacteria in the intestines ferment the lactose, which produces gas that leads to bloating and cramps, and causes water to enter the intestine quickly leading to diarrhea. These are the uncomfortable symptoms associated with lactose intolerance. Some people with lactose intolerance cannot tolerate any milk products while others can tolerate small amounts of lactose. When dairy is consumed with a meal there can be minor symptoms or no symptoms at all, but consuming dairy on its own (especially fluid milk) can cause more severe symptoms. Individuals with an elevated risk variant are at an increased risk for low calcium intake and blood calcium levels*.

*Enattah NS et al. Identification of a variant associated with adult-type hypolactasia. Nature Genetics. 2002;30:233-7.
Koek et al. The T-13910C polymorphism in the lactase phlorizin hydrolase gene is associated with differences in serum calcium levels and calcium intake. Journal of Bone and Mineral Research. 2010;25(9):1980-7.
Dzialanski et al. Lactase persistence versus lactose intolerance: Is there an intermediate phenotype? Clinical Biochemistry. 2015. doi: 10.1016/j.clinbiochem.2015.11.001.

Lactose Intolerance

When lactose is not properly digested it can cause uncomfortable symptoms such as stomach upset, gas, bloating, and/or loose stools. These symptoms usually develop about one hour after you consume lactose-containing products. Typically, individuals with lactose intolerance will have to consume a lactose-free or lactose-reduced diet for life or be sure to consume dairy products with a meal. Your risk for lactose intolerance depends in part on the MCM6 gene. Sometimes you can develop short-term lactose intolerance when you are sick. This may occur, for example, in an individual with undiagnosed celiac disease who is not yet consuming a gluten-free diet. However, once this individual consumes a strict gluten-free diet, the lactose intolerance tends to subside.

MCM6

MCM6 is part of the MCM complex that helps to regulate the expression of the LCT gene, which encodes lactase – the enzyme, which plays a role in breaking down lactose. Variations in this gene can impact your ability to break down lactose, therefore, impacting your risk for lactose intolerance. Individuals who possess the CC or CT variant may produce some lactase but the amount of lactase produced is limited. This variant may not predict lactose intolerance risk for individuals who are not of European descent.

3in10 Caucasians — *People with Risk Variant*

8in10 African Americans — *People with Risk Variant*

9in10 Asians — *People with Risk Variant*

Nutrition Considerations with a Lactose-Free Diet

Research shows that individuals who consume a lactose-free diet are at a greater risk of inadequate calcium and vitamin D intake compared to individuals who can tolerate lactose*. Calcium and vitamin D are important for building and maintaining strong bones and teeth, and reducing the risk of low bone density and stress fractures that often occur in athletes, especially females with menstrual cycle dysfunction. If you have lactose intolerance, you can still get enough calcium and vitamin D in the diet through fortified milk alternatives such as soy, almond, and rice beverages. Calcium and vitamin D are not added to all milk alternatives, so be sure to read the label to check that the products you are choosing have been “fortified with calcium and vitamin D.”

*Koek et al. The T-13910C polymorphism in the lactase phlorizin hydrolase gene is associated with differences in serum calcium levels and calcium intake. Journal of Bone and Mineral Research. 2010;25(9):1980-7.

Sources of Lactose

	Amount (g)
Cow’s milk (1 cup)	12
Goat’s milk (1 cup)	11
Chocolate milk (1 cup)	10
Buttermilk (1 cup)	9
Yogurt (3/4 cup)	7
Frozen yogurt (1/2 cup)	5
Ice cream (1/2 cup)	5
Cottage cheese (1/2 cup)	3
Sour cream (1/4 cup)	2
Hard cheese, example: Parmesan (50g)	<1

Source: Dietitians of Canada, Food Sources of Lactose

Recommendation

Since you possess the CT variant of the MCM6 gene, you should limit your intake of dairy products. If you are experiencing symptoms of lactose intolerance, try avoiding lactose and monitoring if your symptoms disappear. Sometimes you can train your body to produce more lactase enzymes by slowly introducing lactose into your diet. Men & women 19-50 years old should aim to consume up to 2 servings of milk and/or alternatives daily while those over 50 years old should aim to consume up to 3 servings of milk and/or alternatives daily. Meet these recommendations by consuming lactose-containing products as tolerated as well as calcium- and vitamin D-fortified, lactose-free milk alternatives such as soy, almond, or rice beverage.

Limit dairy intake.

Your Results

Gene	Markers
HLA	rs2395182 rs7775228 rs2187668 rs4639334 rs7454108 rs4713586

Risk Variants	Your Variants
algorithm	GT TT CT GG TT AA

Your Risk

Medium

Gluten

Gluten is a protein found in wheat, barley, rye and products made from these grains. Some oats also contain gluten. Many foods that contain gluten provide fibre from whole grains and can be an excellent source of vitamins and minerals. However, for some people, gluten can cause severe digestive problems leading to nutrient malabsorption, anemia and many serious health problems. Several nutrient deficiencies are common in athletes with undiagnosed celiac disease, especially iron deficiency. Iron deficiency can significantly impair athletic performance since iron plays a large role in enhancing muscle function and work capacity. Gastrointestinal distress, or stomach upset, can also impair performance, so for athletes with gluten intolerance, following a strict gluten-free diet is crucial.*

*Tonutti E and Bizzaro N. Diagnosis and classification of celiac disease and gluten sensitivity. Autoimmunity Reviews. 2014;13:472-6.

Gluten Intolerance

Celiac disease represents the most severe form of gluten intolerance and affects about 1% of the population. People with celiac disease require a gluten-free diet for life. Non-celiac gluten sensitivity (NCGS) is a milder form of gluten intolerance that may affect 5% of the population. Individuals with NCGS often experience diarrhea, abdominal pain, fatigue and headaches when they consume gluten-containing foods. However, these adverse effects of gluten in individuals who do not have celiac disease are poorly understood and NCGS remains controversial.

HLA

The HLA genes produce a group of proteins called the human leukocyte antigen (HLA) complex, which are responsible for how the immune system distinguishes between the body's own proteins and foreign, potentially harmful proteins. Research has shown that the HLA genes are the most important genetic predictor of gluten intolerance. Approximately 99% of people with celiac disease and 60% of those with non-celiac gluten sensitivity* have the DQ2 or DQ8 risk version of HLA, compared to only 30% of the general population. Six variations in the HLA genes can be used to classify individuals into predefined risk groups for gluten intolerance.* Risk prediction is based upon a scale of low, medium or high risk.

*Mark Wolters VM and Wijmenga C. Genetic background of celiac disease and its clinical implications. American Journal of Gastroenterology. 2008;103:190-5.
Sapone A et al. Divergence of gut permeability and mucosal immune gene expression in two gluten-associated conditions: celiac disease and gluten sensitivity. BMC Medicine. 2011;9:23.
Monsuur AJ et al. Effective detection of human leukocyte antigen risk alleles in celiac disease using tag single nucleotide polymorphisms. PLoS ONE. 2008;3:e2270.

70% of the population — *Low Risk*

20% of the population — *Medium Risk*

10% of the population — *High Risk*

Nutrition Considerations when Following a Gluten-Free Diet

Gluten-free foods include all unprocessed vegetables, fruit, dairy products, meat, fish, poultry, nuts, legumes, seeds, fats and oils. Gluten-free grains include: rice, quinoa, corn, buckwheat, amaranth, and millet. For individuals who need to follow a gluten-free diet, foods to avoid include any products that are made with wheat, rye, barley or triticale. Pure oats should be consumed in moderation if tolerated, while regular oats (which contain wheat) should be avoided. For the vast majority of the population, consuming a gluten-free diet is unnecessary. Processed gluten-free products often have more calories, sodium, added sugar and fat and fewer nutrients compared to their gluten-containing counterparts. Despite a lack of evidence supporting the benefits of a gluten-free diet for athletic performance in individuals without celiac disease, athletes are more likely than the general population to follow a gluten-free diet. For athletes without celiac disease, adherence to a gluten-free diet is often unnecessary and can make it more difficult to meet their nutritional needs, especially for carbohydrates.

Sources of Gluten

Major Souces of Gluten	Hidden Sources of Gluten
Bread	Salad dressing
Pasta	Pudding
Cereal	Imitation crab
Crackers	Vegan meat substitute
Oats*	Potato chips
Baked goods	French fries
Malt	Soup stock
Soy sauce	Chocolate and candy
Gravy	Processed meat
Barley or wheat based-beer	Canned soup
Vinegars	Instant rice
Wheat - incl rye, spelt and barley	Ice cream

* Pure oats do not contain gluten; however, oats are often cross-contaminated with gluten-containing grains

Recommendation

You have a medium risk for developing celiac disease however this does not mean you have celiac disease. Speak to your healthcare professional if you experience diarrhea, steatorrhea, cramps, flatulence, fatigue or joint pain while consuming gluten-containing foods, or if you have a family member with celiac disease. Major dietary sources of gluten include bread, pasta, cereal and any baked good made with wheat, barley or rye. It is not recommended that you immediately attempt to remove gluten from your diet, as eliminating gluten may interfere with the accuracy of celiac disease diagnostic tests. Gluten-free foods include all unprocessed vegetables, fruit, dairy products, meat, fish, poultry, nuts, legumes, seeds, fats and oils. Gluten-free grains include: rice, quinoa, corn, buckwheat, amaranth and millet.

Medium risk for gluten intolerance.

7in10

People with Response Variant

Your Results

Gene	Marker
CD36	rs1761667
Response Variant	**Your Variant**
GG or GA	AA

Your Response

Typical

Recommendation

Since you possess the AA variant of the CD36 gene, you are a 'low taster' of fats. This means that you require greater amounts of fat in your food to be able to detect the taste of fats as those who are 'super tasters'. In comparison, 'super tasters' are better able to detect the taste of fats at lower levels. Consuming too much fat, and the wrong types of fats (saturated vs. unsaturated) can be harmful for the heart and can lead to overweight and obesity. Refer to the 'Total Fats' section of your report for your recommended daily intake of fats.

Your ability to sense the fatty taste of foods is typical.

Fat Taste Perception

Food intake is largely determined by our taste perceptions and preferences for certain foods and beverages. The way that we perceive the taste of fatty foods is particularly important because our intake of fats can affect heart health and body composition. Fat is needed to absorb certain vitamins including vitamins A, D, E, and K. The health and performance benefits of vitamins A, D, and E are outlined in the Nutrient Metabolism section of this report. Fat provides 9 calories per gram, which is more than double the calories in a gram of protein or carbohydrate. Research shows that our preference for fatty foods can vary depending on which version of the CD36 gene we have*.

* Melis M, Sollai G, Muroni P, Crnjar R, Barbarossa IT. Associations between orosensory perception of oleic acid, the common single nucleotide polymorphisms (rs1761667 and rs1527483) in the CD36 gene, and 6-n-propylthiouracil (PROP) tasting. Nutrients 2015; 7(3): 2068-84.
Pepino MY et al. The fatty acid translocase gene CD36 and lingual lipase influence oral sensitivity to fat in obese subjects. Journal of Lipid Research. 2012;53:561-6.

CD36

The cluster of differentiation 36 (CD36) gene is also known as fatty acid translocase. It is found on the surfaces of many cells and is involved in the transport of fat from the blood. Several studies have now linked variations in the CD36 gene to differences in the perception of the taste and texture of fats and oils. 'Super tasters' tend to be able to detect the taste of fats and oils at lower levels than 'low tasters.'

Sources of High Fat Foods

	High in Healthy (Unsaturated) Fat	Amount (g)
Cheddar cheese (50g)		17
Avocado (1/2 fruit)	✓	15
Olive oil (1 Tbsp)	✓	14
Butter (1 Tbsp)		12
French fries (20-25)		12
Hamburger (1)		12
Croissant (1)		12
Salmon (75g)	✓	9
Ice cream, chocolate (1/2 cup)		8
Homogenized milk (1 cup)		8

Source: Health Canada's Nutrient Value of Some Common Foods

Sugar Preference

Sugar intake is partly determined by our sweet taste preference and cravings for certain foods and beverages. There is considerable variability in individuals' preferences and cravings for sweet foods and beverages. There are many factors that may impact your preference for sugary foods including the age that you are first introduced to sweets, and psychological associations between consuming these foods and certain life experiences or emotions. In the brain, there are even 'pleasure-generating' signals given off in response to eating or drinking something sweet. Research has shown that your intake of sweet foods can also be determined by your genes*.

* Eny KM et al. Genetic variant in the glucose transporter type 2 is associated with higher intakes of sugars in two distinct populations. Physiol Genomics. 2008;33:355-360.

GLUT2

Glucose transporter type 2 (GLUT2) is involved in regulating glucose (sugar) in the body. The expression of this gene has been found in areas of the brain that are involved in controlling food intake. Individuals who possess the TT or TC variant of this gene seem to have a greater preference for sweet foods and beverages and are more likely to over-consume sugar. For many athletes, longer training sessions, races and competitions often require sugar-containing sports drinks, gels, or chews to meet fuel needs. However, for optimal health, it is important to limit added sugars in your diet.

Sources of High Sugar Foods

	Amount (g)
Iced cappucino (2 cups)	56
Cola (1 can)	36
Citrus juice, frozen, diluted (1 cup)	32
Sports beverage (2 cups)	28
Caramels (40g)	26
Milk chocolate (50g)	26
Maple syrup (2 Tbsp)	24
Jellybeans	20
Popsicle (75g)	10
Jam (1 Tbsp)	10

Source: Health Canada's Nutrient Value of Some Common Foods

1in5

People with Risk Variant

Your Results

Gene	Marker
GLUT2	rs5400
Risk Variant	**Your Variant**
CT or TT	CT

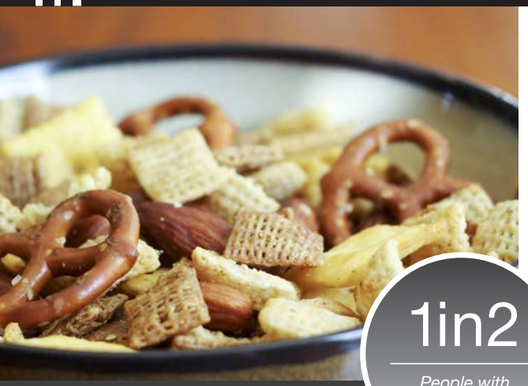
Your Risk

Elevated

Recommendation

Since you possess the CT or TT variant of the GLUT2 gene, you are at an increased risk of over-consuming sugar and may be more likely to enjoy sweet foods and beverages. Aim for less than 5% of your total daily energy intake from added sugar. There are key times when consuming simple sugars, such as those found in sports beverages, gels or chews can benefit athletic performance. For example, when high-intensity training is sustained for more than 60 minutes, sugar-containing foods and beverages can help to prevent depletion of muscle glycogen stores and maintain blood sugar levels. This can have a positive impact on performance. However, too much added sugar can lead to cardiometabolic disease and increased fat mass, which may hinder athletic performance.

You have a high preference for sugar.



1in2

People with Risk Variant

Your Results

Gene	Marker
MC4R	rs17782313

Risk Variant	Your Variant
CC or CT	TT

Your Risk

Typical

Recommendation

Since you possess the TT variant of the MC4R gene, you have a typical risk for eating between meals. To maintain a healthy metabolism, avoid going longer than six hours without eating during the day. Monitor and respond to hunger cues, which may include a lack of energy, mood changes, stomach growling, weakness, dizziness, or having a headache. Choose healthy snacks that are not excessive in calories.

Your tendency to eat between meals is typical.

Eating Between Meals

For many athletes, eating between meals (i.e. snacking) can be beneficial if snacks are healthful and necessary to meet energy expenditure needs. For others the extra calories might be in excess of those needed to maintain or achieve an ideal body composition. Healthy snacks can assist with regulating blood sugar levels and maintaining body weight, curb food cravings and provide fuel and recovery needs during training. However, for many busy athletes snacking is often an unhealthy habit due to snack-food choices and/or excessive calorie intake beyond one's needs. For your overall health and wellness, it is important to manage emotional eating (i.e. psychological reasons for snacking), and focus on more healthful snacking when you feel hungry or need fuel to train or compete. Some reasons for emotional eating may include boredom, habit (i.e. eating in front of the television, or at certain times), stress, frustration, anxiety or loneliness. Some athletes need to be reminded to include snacks, while others should snack less often or choose more healthful options. Scientists have also now discovered that variations in the MC4R gene are associated with the likelihood of eating between meals driven by the desire to eat more or less frequently depending on your genotype*.

* Stutzmann F et al. Common genetic variation near MC4R is associated with eating behaviour patterns in European populations. Int J Obes. 2009;33:373-378.

MC4R

The MC4R gene codes for the melanocortin 4 receptor, which is found in the hypothalamus region of the brain. This is an area of the brain that controls hunger and appetite. The MC4R gene plays an important role in appetite regulation and hunger cues. Research shows that individuals with the CC or CT version of the MC4R gene are more likely to eat between meals often and have a heightened appetite.

Replace these foods...	with these foods...
Potato chips and dip	Whole wheat pita with hummus
Muffin	Whole wheat English muffin with peanut butter
Ice cream with toppings	Low-fat yogurt with fresh berries
Trail mix with added oils or sweets	Fibre-rich cereal with milk/alternative
'Veggie' chips	Fresh vegetables with low-fat dip
Pasta salad	Mixed salad topped with chickpeas
Nachos and cheese dip	Whole wheat crackers with low-fat cheese
Potato chips	Natural popcorn
Pizza Slice	Half a turkey sandwich with veggies

Starch

Carbohydrates are the main source of energy for our brain and working muscles. There are three main types of carbohydrates: sugar, starch, and fiber. Healthful sources of carbohydrates in the diet include minimally processed starches such as whole grain breads and cereals, rice, root vegetables, beans, lentils, chickpeas, fruits, and low-fat dairy products, when they are consumed in moderation. Unhealthy sources of carbohydrates include refined grains, sugar-sweetened beverages and certain baked goods. However, there are times when consuming simple carbohydrates, which are found in sports beverages, gels and chews can benefit athletic performance. Research now shows that your ability to digest starch depends partially on the AMY1 gene. Having the AA variant of the AMY1 gene decreases your ability to break down starch and your blood sugar control after eating starchy foods. Individuals with the AA variant have a greater risk for insulin resistance when consuming a high-starch diet.*

*Mandel AL and Breslin PA. High endogenous salivary amylase activity is associated with improved glycemic homeostasis following starch ingestion in adults. Journal of Nutrition. 2012;142:853-858.

AMY1

AMY1 is a gene that codes for the amylase enzyme that helps digest starch. Salivary amylase is the enzyme found in your saliva, which begins the process of digesting starch that you consume. Levels of this enzyme are linked to the AMY1 gene. Certain populations that traditionally consume higher carbohydrate (starch) diets tend to possess the TT or AT variant of the AMY1 gene, compared to populations that traditionally consume lower carbohydrate (starch) diets. The TT or AT variant of the AMY1 gene is associated with a greater number of copies of the gene, so individuals with these variants produce more of the enzyme. Research now shows that when you have the AA variant, you may have a decreased ability to digest starches compared to those with the TT or AT variant.

Sources of Starch

	Amount (g)
Spaghetti, cooked (1 cup)	35
Medium baked potato (150g)	30
Long-grain white rice (1/2 cup)	25
Tortilla (20 cm)	23
Sweet potato, cubed (1 cup)	17
Oats, uncooked (1/3 cup)	15
Navy beans (1/2 cup)	14
Sweet potato, without skin (60g)	12
Corn kernels (1/2 cup)	10
Bread (1 slice)	10

Source: http://nutritiondata.self.com

1in10

People with Response Variant

Your Results

Gene	Marker
AMY1	rs4244372

Response Variant	Your Variant
AA	AT

Your Response

Typical

Recommendation

Since you possess the TT or AT variant of the AMY1 gene, you have a typical ability to digest and metabolize starches. Aim to meet your carbohydrate needs through healthy sources of carbohydrates such as whole grains, fruits and vegetables. Consume high-starch foods only in moderation.

Your ability to metabolize starch is typical.

2in3

People with Response Variant

Your Results

Gene	Marker
BDNF	rs6265

Response Variant	Your Variant
AA or AG	AA

Your Response

Enhanced

Implications

Since you possess the AA or AG variant of the BDNF gene, you are more likely to experience greater enjoyment and positive mood changes from exercise or training. You also tend to perceive your exertion level during exercise to be lower than individuals with the GG variant. These responses to exercise result in a heightened motivation to exercise and greater likelihood that you will continue to follow your training regime. Therefore, you are at a genetic advantage when it comes to motivation to begin or continue regular exercise.

You have an enhanced innate motivation to exercise.

Motivation to Exercise

Your attitude toward exercise and the effect it has on your mood can greatly impact your training and performance. Research shows that individuals who possess the AA or AG variant of the BDNF gene are more likely to experience positive mood changes from working out. They also perceive their effort and exertion level as lower during exercise compared to individuals who possess the GG variant,* which can help to enhance training and, therefore, benefit performance during competition. These factors impact motivation to exercise. Enhanced motivation to exercise can have a multitude of physical and psychological benefits including improvements in body fat levels, blood sugars, and attitude.

* Bryan A et al. A transdisciplinary model integrating genetic, physiological, and psychological correlates of voluntary exercise. Health Psychol. 2007;26:30-39.
Caldwell Hooper A et al. What keeps a body moving? The brain-derived neurotrophic factor val66met polymorphism and intrinsic motivation to exercise in humans. J Behav Med. 2014;37(6):1180-92.

BDNF

The brain-derived neurotrophic factor is a protein that is encoded by the BDNF gene. This protein works in regions of the brain to influence the nervous system, musculature, and blood vessels, all of which are important to exercise. Because of the complexity of mental stamina and the psychological response to exercise, the BDNF gene is only one of many possible genetic factors that may influence responses to exercise and future exercise behavior. Nevertheless, research shows that those with the AA or AG variant of the BDNF gene derive greater enjoyment or pleasure and improvements in mood from exercise and a lower perception of effort during exercise compared to those without this variant.

Exercise Behavior

Following a strength and endurance training program can lower blood pressure, lower blood sugars, improve cholesterol levels, decrease depression and improve mood, among many other positive outcomes. Research shows that genetic differences influence the likelihood of engaging in physical activity. The CYP19A1 and LEPR genes have been identified as being key contributors to one's probability of participating in physical activity/training*.

* De Moor MH et al. Genome-wide association study of exercise behavior in Dutch and American adults. Med Sci Sports Exerc. 2009;41:1887-95.

CYP19A1 & LEPR

The CYP19A1 gene helps to make the enzyme aromatase, which is involved in hormone conversion. The exact physiological pathway by which this gene impacts exercise behavior is unknown. However, current research shows that those who have the AA or GA variant of the CYP19A1 gene are more likely to exercise compared to those with the GG variant. The LEPR gene helps to make the leptin receptor protein, which helps to regulate body weight. The precise relationship between variations in the LEPR gene and exercise behavior may stem from this gene's involvement in regulating energy balance. Those who have the TT or GT variant of the LEPR gene are more likely to participate in physical activity compared to those who have the GG variant.

1in5

People with Response Variant

Your Results

Genes	Markers
CYP19A1 LEPR	rs2470158 rs12405556

Response Variants	Your Variants
algorithm	GG GT

Your Response

Typical

Implications

Based on your LEPR and CYP19A1variants, you have a typical likelihood of engaging in physical activity. Athletes should be mindful of maintaining physical activity levels during the entire year. To sustain your active lifestyle, set monthly SMART (specific, measureable, attainable, realistic, timely) goals and consider using mental imagery; these can further enhance your motivation. Having an exercise partner can also enhance your likelihood of participating in physical activity.

You have a typical likelihood of engaging in physical activity.

Your Results

Gene	Marker
ACTN3	rs1815739

Response Variant	Your Variant
CC or TC	TT

Your Response

Typical

Implications

Since you possess the TT variant of the ACTN3 gene, your genetics do not put you at an advantage for strength and power-based sports. You may need higher intensities or volumes of strength/resistance training to achieve the same level of strength and power as an individual with a genetic advantage. Strength/resistance exercises remain important for strengthening bones, muscle and connective tissue, reducing injury risk and improving athletic performance. Aim to participate in strength/resistance training at least two days per week.

Your potential to excel in power sports is typical.

Power and Strength

Strength training and resistance exercises are considered a fundamental part of both endurance and strength/power athletes' training programs. The benefits of strength and resistance training in both competitive and recreational athletes have been well documented and include improvement in athletic performance, reduced risk of injury and positive impacts to muscle, bone and connective tissue. Strength/resistance exercises also help to maintain or achieve a lean physique and an ideal body composition for optimal sport performance. Different forms of strength/resistance exercises include free weights, weight machines, resistance bands and your own body weight. Research shows that the ACTN3 gene plays a major role in your genetic predisposition to excelling in strength and power based activities*.

* Ma F et al. The association of sport performance with ACE and ACTN3 genetic polymorphisms: a systematic review and meta-analysis. PLoS One. 2013;8:e54685.

ACTN3

There are two types of muscle fibers: slow twitch and fast twitch. Both fiber types are needed in all sports and exercises, however, there will be a higher use and demand for one fiber type versus the other depending on the sport. Fast twitch muscle fibers contract with greater speed and force, which are needed for short bursts of intense activities including sprinting, jumping and acceleration and change of direction in team sports. Slow twitch fibers contract for longer periods and at lower intensities and are used in activities such as longer distance endurance sports like cross-country skiing, running, swimming and cycling. The ACTN3 gene encodes the alpha-actin 3 protein, which is only expressed in fast twitch muscle fibers. Therefore, certain variations in this gene can be beneficial for exercises or sports requiring strength and power. In particular, individuals with the CC variant of ACTN3 are more likely to excel at power or strength-based sports. Those with the TC variant have a slightly enhanced power and strength potential.*

*Garton and North. The effect of heterozygosity for the ACTN3 null allele on human muscle performance. Med Sci Sports Exerc. 2015 [Epub ahead of print].

Endurance

Endurance sports include running, cycling, swimming, rowing, dancing and many team sports. These sports require effort over a longer sustained period of time as opposed to shorter duration anaerobic sports requiring large bursts of power. Your VO2 max or maximal aerobic capacity is a measurement of the maximum amount of oxygen that your body is able to process during 1 minute of exercise and is a marker of physical fitness. A higher VO2 max generally results in a performance advantage when it comes to endurance sports, although many factors play a role. Research shows that there are several genes that impact your genetic predisposition to excelling in endurance sports*.

* Ahmetov I et al. Genome-wide association study identifies three novel genetic markers associated with elite endurance performance. Biol Sport. 2015;32(1):3-9. doi:10.5604/20831862.1124568.
Zarebska A et al. The GSTP1 c.313A>G polymorphism modulates the cardiorespiratory response to aerobic training. Biol Sport. 2014;31:261-266.
He et al. NRF2 genotype improves endurance capacity in response to training. Int J Sport Med. 2007;28:717-721.
Santiago C et al. Trp64Arg polymorphism in ADRB3 gene is associated with elite endurance performance. British Journal of Sports Medicine. 2011;45:147-9.

1in4 people — *Enhanced*

1in20 people — *Ultra*

ADRB3, NRF2, GSTP1 & NFIA-AS2

ADRB3, NRF2, GSTP1 and NFI-AS2 are all involved in physiological processes that impact your endurance abilities. The ADRB3 gene codes for the beta-3 adrenergic receptor, which is involved in energy metabolism as well as body temperature regulation. Variations in this gene have been linked to enhanced endurance performance. The NRF2 gene codes for the nuclear respiratory factor, and has also been linked to athletic performance status. This is related to its role in the formation of mitochondria – the part of the cell responsible for respiration and energy production. For the NFIA-AS2 gene, individuals with the CC variant tend to have greater VO2 max, which is advantageous for endurance exercise such as running, swimming, rowing, cycling, and many team sports. The GSTP1 gene, which codes the enzyme glutathione S-transferase P1, has also been linked to greater improvements in VO2 max in response to aerobic training in the GG and GA variants. Together, these genes can predict your genetic advantage for excelling in endurance sports.

Your Results

Genes	Markers
NFIA-AS2 ADRB3 NRF2 GSTP1	rs1572312 rs4994 rs12594956 rs1695

Response Variants	Your Variants
algorithm	CC TT CA AG

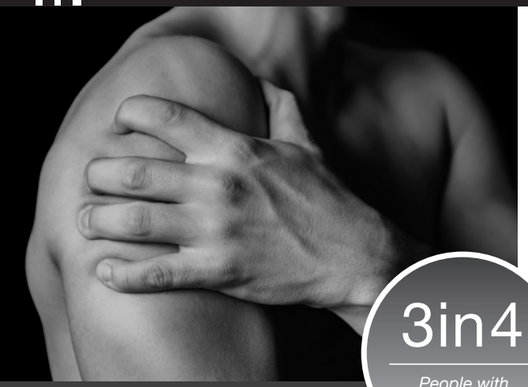
Your Response

Typical

Implications

Based on your DNA, your endurance potential is typical. You may need higher levels of training to train more to achieve the same level of cardiovascular fitness as an individual with a genetic advantage. Your can review your baseline endurance activity recommendation is outlined in the Physical Activity section of this report. Your detailed training recommendations are sport-specific and should be reviewed with your coach or trainer.

Your endurance potential is typical.



3in4

People with Response Variant

Your Results

Gene	Marker
COMT	rs4680

Response Variant	Your Variant
GG or GA	GA

Your Response

Enhanced

Implications

Since you possess the GG or GA variant of the COMT gene, you have enhanced pain tolerance, which can be beneficial for training and performance. To increase your pain tolerance even further, try practicing deep breathing, and changing negative thoughts to positive thoughts when you are undergoing pain. For example, when you are training, try to shift your focus away from the discomfort you may be feeling in your muscles, and focus on how the intensity is preparing you to push yourself during competition. Getting yourself accustomed to feelings of discomfort by pushing yourself during your training sessions more often may help you to decrease pain perception over time.

You have a heightened pain tolerance.

Pain

Pain is an unpleasant feeling triggered by the nervous system that can be mild to severe, and athletes are often exposed to both acute and chronic pain through high intensity training as well as recovery from heavy training. Pain tolerance refers to the maximum amount of pain that someone can withstand. Pain threshold refers to the point where you begin to feel pain that causes discomfort to the extent that it becomes difficult for you to withstand or continue to exercise or train at a certain intensity due to an intolerable level of discomfort. There are substantial differences in the way, or the degree to which people feel pain. Overall, men tend to have higher pain tolerances than women. Research now shows that variations in the COMT gene also impact how we feel and perceive pain*.

* Zubieta et al. COMT val[sup158]met genotype affects μ-Opioid Neurotransmitter Responses to a Pain Stressor. Sci. 2003;299:1240-1243.
Tammimäki A, Männistö PT. Catechol-O-methyltransferase gene polymorphism and chronic human pain: a systematic review and meta-analysis. Pharmacogenet Genomics. 2012;22(9):673-91.

COMT

The Catechol-O-methyltransferase (COMT) gene is involved in pathways in the body that process pain signals. Because of this, researchers have studied how variations in this gene can impact our perception of pain. Studies show that the COMT gene is a significant predictor of pain tolerance. Specifically, individuals with the GG or GA variant tend to experience less pain compared to those with the AA variant.

Achilles Tendon Injury

Your Achilles tendon starts at the bones in your heels and continues up to your calf muscles. It is one of the largest and strongest tendons in the human body. This tendon gives you the ability to point your toes and extend your foot. Unfortunately, injuries to the Achilles tendon are common. They typically arise from training exercises that require a sudden surge of energy such as plyometric training and uphill sprinting and are more common in athletes compared to the general population. Symptoms of an Achilles tendon injury include extreme pain, tenderness, swelling, or stiffness along the back of your foot and above your heel. Your risk of developing an Achilles tendon injury depends in part on the COL5A1 gene*.

* September AV et al. Variants within the COL5A1 gene are associated with Achilles tendinopathy in two populations. Brit J Sport Med. 2009;43:357–365.

COL5A1

The COL5A1 gene directs the body to produce a protein called collagen alpha-1(V) chain, which plays an important role in the creation of collagen. Collagen is the protein that is used to make connective tissues in the body. Because of the COL5A1 gene's role in the creation of connective tissue, scientists have studied the link between this gene and Achilles tendon injury risk. It is now understood that individuals with the CT or TT variant of COL5A1 have a higher risk for developing an Achilles tendon injury.

1in5

People with Risk Variant

Your Results

Gene	Marker
COL5A1	rs12722

Risk Variant	Your Variant
CT or TT	CC

Your Risk

Typical

Implications

Since you possess the CC variant of the COL5A1 gene, you have a typical risk of developing an Achilles tendon injury. To decrease your risk, be mindful of exercises requiring a surge of energy or overextension of this tendon through certain exercises such as plyometrics and uphill running. Preventive measures also include additional stretching of your calf muscles and increasing the duration of your warm up and cool down during exercise sessions.

You have a typical risk for Achilles tendon injury.

International Science Advisory Board

Ahmed El-Sohemy, PhD

Dr. Ahmed El-Sohemy is the Founder of Nutrigenomix Inc. and serves as the President and Chief Scientific Officer. He also serves as Chair of Nutrigenomix's International Science Advisory Board (SAB), which consists of key opinion leaders in the field of nutrigenomics. Dr. El-Sohemy obtained his PhD from the University of Toronto and completed a postdoctoral fellowship at the Harvard School of Public Health. He currently holds a Canada Research Chair in Nutrigenomics at the University of Toronto and serves on Health Canada's Science Advisory Board. Dr. El-Sohemy has published in the top scientific and medical journals with more than 120 peer-reviewed publications and has given more than 150 invited talks around the world. He is on the editorial board of 8 journals, and has served as an expert reviewer for more than 30 different scientific and medical journals and 12 research granting agencies. He has been a member of international expert advisory panels and scientific advisory boards of several organizations.

David Castle, PhD

David Castle is Professor and Chair of Innovation in the Life Sciences at the University of Edinburgh. His research focuses on social aspects of life science innovation including democratic engagement, regulation and governance, and intellectual property and knowledge management. Prof. Castle is a world-renowned expert on the social, ethical and legal aspects of nutrigenomics. He is author of a book entitled Science, Society, and the Supermarket: The Opportunities and Challenges of Nutrigenomics, and has published extensively on the social dimensions of science, technology and innovation. Prof. Castle has held several major research awards and has considerable experience leading strategic research initiatives and research project management. Prof. Castle has consulted widely to government and industry on issues such as the impact of national technology transfer policies and programs, intellectual property and knowledge management strategies, and the role of non-scientific considerations in the regulation of science and technology.

Lynnette R Ferguson, D.Phil. (Oxon.), DSc

Dr. Lynn Ferguson is Program Leader of Nutrigenomics New Zealand. She obtained her D.Phil. from Oxford University working on DNA damage and repair. After her return to New Zealand, she began working as part of the Auckland Cancer Society Research Centre, using mutagenicity testing as a predictor of carcinogenesis. In 2000, she took on a 50% role as Head of a new Discipline of Nutrition at The University of Auckland. She has recently been investigating the interplay between genes and diet in the development of chronic disease, with particular focus on Inflammatory Bowel Disease. As Program Leader of Nutrigenomics New Zealand she is working with a range of others to bring nutrigenomics tools to the New Zealand science scene. She has supervised more than 30 students and has more than 300 peer reviewed publications. Dr. Ferguson serves as one of the managing Editors for Mutation Research: Fundamental and Molecular Mechanisms of Mutation, as well as on the Editorial Boards of several other major journals.

J. Bruce German, PhD

Bruce German is the Director of the Foods for Health Institute at the University of California Davis, and is Professor of Food Science and Technology (http://ffhi.ucdavis.edu/). Dr German received his PhD from Cornell University and joined the faculty at the University of California (Davis) in 1988. In 1997, he was named the first John E. Kinsella Endowed Chair in Food, Nutrition and Health. His research interests in personalized nutrition include the structure and function of dietary lipids, the role of milk components in food and health and the application of metabolic assessment to personalizing diet and health. Dr German has published more than 350 papers and holds a number of patents related to various technologies and applications of bioactive food components. The research articles from his lab rank in the top 5 most cited in the field.

David Jenkins, MD, DSc, PhD

Dr. Jenkins earned his MD and PhD at Oxford University, and is currently a Professor in both the Departments of Medicine and Nutritional Sciences at the University of Toronto. He is also a staff physician in the Division of Endocrinology and Metabolism and the Director of the Clinical Nutrition and Risk Factor Modification Center, St. Michael's Hospital. Dr Jenkins has published over 300 peer reviewed articles and given hundreds of invited talks around the world. He has served on numerous international committees to set guidelines for the treatment of diabetes and most recently on the new joint United States Canada DRI system (RDAs) of the National Academy of Sciences. His team was the first to define and explore the concept of the glycemic index of foods and demonstrate the breadth of metabolic effects of viscous soluble fiber. He has received many national and International awards in recognition of his contribution to nutrition research. Dr Jenkins currently holds a Canada Research Chair in Nutrition and Metabolism.

Jose Ordovas, PhD

Jose M. Ordovas is Professor of Nutrition and Director of the Nutrigenomics Laboratory at the United States Department of Agriculture, Human Nutrition Research Center on Aging at Tufts University in Boston. After obtaining his PhD from the University of Zaragoza, Spain, he completed postdoctoral work at Harvard, MIT and Tufts University. Dr Ordovas' major research interests focus on the genetic factors predisposing to cardiovascular disease and their interaction with environmental factors. Dr Ordovas has published ~700 articles in peer reviewed journals, and written numerous reviews and edited 5 books on nutrigenomics. He has been an invited speaker at hundreds of International meetings all over the world and is currently a member of the Institute of Medicine's Food and Nutrition Board (National Academies). He serves as Editor for Current Opinion in Lipidology (Genetics Section), and on the Editorial Board of numerous journals. Dr Ordovas is a Member of Honor of the Spanish Society of Atherosclerosis and has received other awards for his contributions to the field of nutrigenomics.

Ben van Ommen, PhD

Dr. Ben van Ommen is Director of the Nutrigenomics Organisation (NuGO) and Principal Scientist at TNO, one of the largest independent research organisations in the area of nutrition world-wide. He is also Director of the TNO systems biology program and leading the activities on nutrigenomics, nutritional systems biology, personalized health and personalized medicine. His research applies systems biology to metabolic health and metabolic disease, focusing on understanding all relevant processes involved in maintaining optimal health and causing specific disease sub-phenotypes, developing new biomarkers and treatment strategies.

Nanci Guest, RD, MSc, CSCS, PhD(c)

Nanci Guest is a registered dietitian (sport), certified personal trainer and a certified strength and conditioning specialist, and she has been working in private practice in this field for two decades. She is currently completing her doctoral research in the area of nutrigenomics and athletic performance at the University of Toronto. She completed her BSc in agriculture and dietetics, and her MSc in nutritional sciences with a sport focus at the University of British Columbia. She has published her research in top journals, presented at international meetings and has given dozens of invited talks around the world. Ms Guest is a global consultant to professional and amateur athletes and teams. She was the Head Dietitian at both the Vancouver 2010 Olympics and the Toronto 2015 Pan Am games, and served as a consultant to a variety of international athletes in preparation for the Sochi 2014 and Rio 2016 Olympics. She was also involved in creating past nutrition guidelines for athletes for the International Olympic Committee.

This report is for information purposes only and is not intended to be used as medical advice. The advice in this report is not intended to treat, diagnose or cure any medical condition or disease. It is intended for general health and wellness purposes only and is not specific to clients who require a specific nutrition care plan based on a certain disease or condition. Clients with medical conditions should not change or stop their medications or medical care without consulting with their physician first. The advice in this report is not intended for children or for women who are pregnant or nursing. The Nutrigenomix Health and Wellness panel has not been cleared or approved by the United States Food and Drug Administration. If you have any questions, please ask your healthcare provider or contact us at info@nutrigenomix.com. For Terms of Use and Privacy information please visit our website at www.nutrigenomix.com.