



# HOMEOSTASIS DIET

# The DNA



## Genomic Nutritional Data

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I am so grateful that you have taken the time to read this message. Before you continue, I urge you to take a moment to deeply inhale and exhale. Allow yourself to relax and let go of any stress you may be holding onto. You are on the brink of a truly transformative discovery. We all yearn for something that can improve our lives in a meaningful way, and I believe that you have the potential to find just that here. Trust in yourself and keep moving forward and the answer you seek will find you.

Knowing your genetics can empower you to make informed decisions about your health. For instance, by understanding that you possess the CYP1A2 gene, you can take proactive steps to limit your caffeine intake and reduce your risk of heart disease. Similarly, if you have the HLA gene, you can avoid foods that may cause you discomfort, such as milk. Additionally, if you have the CD36 gene, you can tailor your diet to your specific taste preferences and individualized needs, which can make sticking to a healthy diet much easier. By understanding your genetics, you can unlock the key to truly personalized healthcare and improve your overall quality of life.

I urge you to take advantage of the valuable resources we have made available in our PDFs across this website. They are specifically designed to educate and provide complete transparency on various processes. By reading and utilizing the information provided, you will not only empower yourself with knowledge, but also contribute to building a brighter future for all of us. Together, we can achieve a world where all the answers you seek are within your reach. So, take the time to read and learn from these resources, and be a part of the positive change we are striving for.

If the genes fit, wear them.

# Our Process



## Genomic Nutritional Data

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The Nutritional Genomics Testing package includes the following:

- Three 60-minute sessions with a gut health nutritionist via Zoom.
- A comprehensive analysis of test results, a customized nutrition plan based on genetic data
- The opportunity to participate in the "reset button" program
- Grocery List based on gene profile
- Meal Plan based on gene profile
- Meal Ideas based on gene profile

The cost of this package is \$1,200.

If you want to add gut microbiome testing, the total cost is \$1,800.

Alternatively, you can purchase just the tests without professional review for \$600. If you are interested in this package or have any additional questions, you can click here to book a call.

<https://calendly.com/semc3/genomic>

# Results Summary

## Summary of Results

### Nutrient Metabolism

Dietary Component	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Recommendations
Vitamin A	BCMO1, rs11645428	GG	AG	Typical	Meet the RDA for vitamin A daily.
Vitamin B <sub>12</sub>	FUT2, rs601338	GG or GA	GG	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 GC, rs2282679	Algorithm	GA GT	Elevated	Consume 1000 IU (25 mcg) vitamin D daily.
Vitamin E	COMT, rs4680	GG	GA	Typical	Meet the RDA for vitamin E daily from food sources rich in vitamin E.
Folate	MTHFR, rs1801133	CT or TT	CC	Typical	Meet the RDA for folate daily.
Choline	MTHFD1, rs2236225 PMT, rs12325817	Algorithm	AG CG	Elevated	Meet the Adequate Intake (AI) level for choline daily.
Calcium	GC, rs7041 GC, rs4588	Algorithm	TG CA	Elevated	Consume 1200 mg of calcium daily.
Iron Overload	SLC17A1, rs17342717 HFE, rs1800562 HFE, rs1799945	Algorithm	CC GG CC	Low	Follow the recommendations provided in the Low Iron Status section.
Low Iron Status	TMPRSS6, rs4820268 TFR2, rs7385804 TF, rs3811647	Algorithm	GA AA GG	Typical	Meet the RDA for iron daily.

### Food Intolerances and Sensitivities

Dietary Component	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Recommendations
Lactose	MCM6, rs4968235	CC or CT	TT	Typical	Aim to consume 2-3 servings of dairy and/or dairy alternative products daily.
Gluten	HLA, rs2395182	Algorithm	GT	Low	Low risk for gluten intolerance.
	HLA, rs7775228		TT		
	HLA, rs2187668		CC		
	HLA, rs4639334		GG		
	HLA, rs7454108		TT		
Caffeine	ADORA2A, rs5751876	TT	CT	Typical	Follow the recommendations provided by the CYP1A2 gene section of this report.

### Cardiometabolic Health

Dietary Component	Gene, rs Number	Risk/Response Variant	Your Variant	Your Risk/Response	Recommendations
Caffeine	CYP1A2, rs472300	GA or AA	GG	Typical	Limit caffeine intake to 300 or 400 mg/day.
Whole Grains	TCF7L2, rs12295372	TT or GT	GG	Typical	Make at least half of grain products whole grain.
Sodium	ACE, rs4343	GA or AA	GA	Elevated	Limit sodium intake to the Adequate Intake level.
Omega-6 and Omega-3 Fat	FADS1, rs174547	CC or CT	TT	Typical	Meet the RDA for omega-6 LA fat and omega-3 ALA fat.
Physical Activity	LIPC, rs1800588	TT or CT	CC	Typical	Aim for 150 to 300 min/week of cardio and at least 2 days/week of muscle-strengthening activities.

### Weight Management and Body Composition

Dietary Component	Gene, rs Number	Response Variant	Your Variant	Your Response	Recommendations
Physical Activity	FTO, rs9939609 ADRB2, rs1042713	Algorithm	TA AA	Enhanced	Aim for at least 30-60 mins/day of cardio activity, 6 days/week, and muscle-strengthening activities at least 2 days/week.
Energy Balance	UCP1, rs1800592	GG or GA	GA	Diminished	For weight loss, aim for a daily energy deficit of 10-20% from your current energy needs plus an additional 150 kcal.
Protein	FTO, rs9939609	AA	TA	Typical	Consume 15-25% of energy from protein.
Total Fat	TCF7L2, rs7903146	TT	CC	Typical	Consume 20-35% of energy from fat.
Saturated Fat	APOA2, rs5082	CC	TC	Typical	Limit intake of saturated fat to no more than 10% of energy.
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	PPAR2, rs1801282	GG or GC	CC	Typical	Aim for a balance of saturated, monounsaturated and polyunsaturated fats to meet your total daily fat intake.

### Exercise Physiology, Fitness and Injury Risk

Dietary Component	Gene, rs Number	Risk/Response Variant	Your Variant	Your Risk/Response	Recommendations
Motivation to Exercise	BDNF, rs6265	AA or AG	GG	Typical	You have a typical innate motivation to exercise.
Exercise Behavior	CYP19A1, rs2470158 LEPR, rs12405556	Algorithm	GG GG	Typical	You have a typical likelihood of engaging in physical activity.
Power and Strength	ACTN3, rs1815739	TC or CC	TC	Enhanced	You have a slight genetic advantage to excel in power sports.
Endurance	NFIA-AS2, rs1572312	Algorithm	CC	Ultra	You have a genetic advantage to excel in endurance sports.
	ADRB3, rs4994		TC		
	NRF2, rs12594956		AA		
	GSTP1, rs1695 PGC1a, rs8192678		AG GA		
Muscle Damage	ACTN3, rs1815739	TC or TT	TC	Elevated	Follow an antioxidant-rich diet and allow longer recovery from strenuous exercise.
Pain	COMT, rs4680	GG or GA	GA	Enhanced	You have an enhanced pain tolerance and therefore tend to experience less pain.
Bone Mass	WNT16, rs2707466	TC or CC	TC	Elevated	You have an elevated risk for low bone mass.
Achilles Tendon Injury	COL5A1, rs12722	CT or TT	TT	Elevated	You have an elevated risk for Achilles tendon injury.

### Eating Habits

Dietary Component	Gene, rs Number	Risk/Response Variant	Your Variant	Your Risk/Response	Recommendations
Fat Taste Perception	CD36, rs1761667	GG or GA	GA	Enhanced	You have an enhanced ability to sense the fatty taste of foods.
Sugar Preference	GLUT2, rs5400	CT or TT	CC	Typical	Your preference for sugar is typical.
Eating between Meals	MC4R, rs17782313	CC or CT	TT	Typical	Your tendency to eat between meals is typical.



2in5

People with Risk Variant

### Your Results

Gene	Marker
BCMO1	rs11645428
Risk Variant	Your Variant
GG	AG

Your Risk

Typical

### Recommendation

Since you possess the AA or AG variant of the BCMO1 gene, you are a typical converter of beta-carotene into an active form of vitamin A. To support healthy immunity, vision and reproductive health, you should meet the RDA for vitamin A from various sources. Women should aim for 700 mcg RAE/day and men should aim for 900 mcg RAE/day.

Meet the RDA for vitamin A daily.

## Vitamin A (Beta-Carotene)

Vitamin A is a fat-soluble vitamin that is important for eye health and vision, a strong immune system and healthy reproduction. Beta-carotene is a precursor of active vitamin A (retinol) and is an antioxidant found in certain fruits and vegetables that are orange-red in color. Beta-carotene can be converted to preformed vitamin A 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 preformed 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.

\*Lutz G et al. Single nucleotide polymorphisms upstream from the beta-carotene 15,15'-monooxygenase gene influence pro-vitamin A conversion efficiency in female volunteers. *Journal of Nutrition*. 2012;142:1819-25.

### 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 preformed 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)		850
Sweet potato, boiled without skin (1/2 medium)		600
Light tuna (75g)	✓	530
Spinach, boiled (1/2 cup)		500
Butternut squash (1/2 cup)		410
Goat cheese, hard (50g)	✓	340
Eggs (2 large)	✓	220
Mackerel (75g)	✓	190

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

## Vitamin B<sub>12</sub>

Vitamin B<sub>12</sub> (cobalamin) is important for normal brain and nervous system functioning. It helps to keep blood cells healthy and prevent megaloblastic anemia, which can make you feel very weak and tired. Being deficient in vitamin B<sub>12</sub> is also associated with pallor (pale skin) and irritability. Research shows that some individuals are at a greater risk than others for vitamin B<sub>12</sub> deficiency based on the FUT2 gene.\* Since animal products are the primary sources of vitamin B<sub>12</sub>, individuals following a vegetarian diet are at an even greater risk of vitamin B<sub>12</sub> deficiency.

\*Hagena A et al. Common variants of FUT2 are associated with plasma vitamin B12 levels. *Nature Genetics*. 2008;40:1015-19.

### FUT2

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

### Sources of Vitamin B<sub>12</sub>

	Amount (mcg)
Clams, boiled or steamed (5 large)	59.0
Oysters, boiled or steamed (6 medium)	14.7
Atlantic herring (75g)	14.0
Fortified nutritional yeast (1 Tbsp)	3.9
Ground beef, lean (75g)	2.2
Fortified plant-based 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>



4in5

People with Risk Variant

### Your Results

Gene	Marker
FUT2	rs601338
Risk Variant	Your Variant
GG or GA	GG

Your Risk

Elevated

only when vitamin B12 intake is low

### Recommendation

Since you possess the GG or GA variant of the FUT2 gene, you have an elevated risk for vitamin B12 deficiency. It is, therefore, important for you 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 plant-based milks and 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. 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 an essential nutrient and powerful antioxidant. 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. Low blood levels of vitamin C have been associated with an elevated risk of cardiovascular disease, type 2 diabetes and cancer. 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. Studies have shown that the ability to process vitamin C efficiently depends on a gene called GSTT1.\*

\*Cao H et al. Functional genetic variants of glutathione S-transferase protect against serum ascorbic acid deficiency. *American Journal of Clinical Nutrition*. 2008;80:511-17. Hordijk AJ et al. Vitamin C levels in blood are influenced by polymorphisms in glutathione S-transferases. *European Journal of Nutrition*. 2011;50:627-34.

### 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 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 vitamin C intake compared to people who possess the insertion version (Ins) of the gene.

### Sources of Vitamin C

	Amount (mg)
Red pepper (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: SACO (ANICAMP), Canadian Nutrient File and USDA Nutrient Database

## Vitamin D

Vitamin D is essential to calcium metabolism and promotes calcium absorption in the gut. Low levels of vitamin D are associated with decreased bone mineral density and an increased risk of fractures. Vitamin D also contributes to normal functions of most cells in the body. Vitamin D can be synthesized by the skin from UV light or it can be obtained from the diet. Low blood levels of vitamin D can result in weak, brittle bones, poor muscle function, and decreased immunity. Life-long vitamin D insufficiency has also been linked to accelerated cognitive decline, autoimmune disorders, neuro-degenerative diseases and cardiovascular disease. Vitamin D deficiency is diagnosed by measuring the most common form of vitamin D in the blood, which is 25-hydroxyvitamin D. Research shows that variations in the CYP2R1 and GC genes can affect your risk for low circulating 25-hydroxyvitamin D levels.\*

\*Stattin H et al. Genetic Variants in CYP2R1 and GC Genes Associated With Vitamin D Deficiency Status. *Journal of Clinical Endocrinology*. 2010;102:111-16. Wang T et al. Common genetic determinants of vitamin D insufficiency: a genome-wide association study. *Lancet*. 2007;369:1068-75.

### 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 plant-based 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



6in7

People with Risk Variant(s)

### Your Results

Genes	Markers
CYP2R1 GC	rs10741657 rs2282679
Risk Variant	Your Variants
Algorithm	GA GT

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.



1in4

People with Risk Variant

### Your Results

Gene	Marker
COMT	rs4680
Risk Variant	Your Variant
GG	GA

Your Risk

Typical

### Recommendation

Since you possess the AA or GA variant of the COMT gene, current research shows that there is no elevated cancer risk associated with vitamin E supplementation. In fact, those who possess the AA variant of the COMT gene have a slightly lower cancer risk when taking vitamin E supplements. However, since an effective and safe dose of vitamin E in the form of supplements has not yet been established for cancer protection, increasing intakes of vitamin E rich foods is recommended. Therefore, aim to meet the vitamin E RDA of 15 mg per day (21 IU/day) through food sources only. Good food sources of vitamin E include almonds, sunflower seeds, sunflower oil, hazelnuts, and grapeseed oil. Consult your healthcare provider before taking vitamin E-containing supplements.

Meet the RDA for vitamin E daily from food sources rich in vitamin E.

## Vitamin E

Vitamin E is a fat-soluble antioxidant essential for building a strong immune system and supporting skin and eye health, and it may also help to reduce the risk of cardiovascular disease. Most vegetable oils, such as grapeseed, sunflower, canola and flaxseed oil, are excellent sources of vitamin E. Nuts and seeds are also great sources. Given its antioxidant properties, there has been much interest in the role for vitamin E supplementation in cancer prevention. While some studies have shown a protective effect of vitamin E supplementation on cancer risk, others have reported increased risk with higher vitamin E supplementation.\* The discrepancy in findings across studies may be partly related to genetic variants that modify the risk associated with vitamin E supplementation. Scientists have reported a genetic variant in COMT may modify the risk associated with vitamin E supplementation.

\*Nell KY et al. COMT and Alpha-Tocopherol Effects on Cancer Prevention: Gene-Supplemented Interactions in Two Randomized Clinical Trials. *J Natl Cancer Inst.* 2019;111:1330-1339.

### COMT

The COMT gene produces an enzyme called catechol-O-methyltransferase, which helps detoxify both substances produced by the body and environmental compounds such as drugs and harmful toxins. Variations in the COMT gene impact the enzyme activity of COMT, and research shows that this genetic variation may modify the way individuals respond to vitamin E supplementation as it relates to risk of cancer. Among individuals with the GG variant, a slightly increased cancer risk was observed with vitamin E supplementation compared to placebo. By contrast, those with the GA variant experienced no risk or benefit, and individuals with the AA variant had a slightly reduced cancer risk following vitamin E supplementation.

### 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
Avocado (1/2 fruit)	4.0
Peanut butter (2 Tbsp)	2.9
Peanuts, dry roasted (1/4 cup)	2.6
Flaxseed oil (1 Tbsp)	2.4
Canola oil (1 Tbsp)	2.4
Halibut (75g)	2.2
Eggs (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. 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 consequently may be at a greater risk for folate deficiency. Studies\* have shown that an individual's ability to process dietary folate efficiently depends on a gene called MTHFR.

\*Toussaint C et al. Folate Intake of USA Levels is Inadequate for Mexican American Men with the Methylenetetrahydrofolate Reductase (MTHFR) Gene Type. *Journal of Nutrition.* 2008; 138:2072.  
Sullivan CE et al. Methylenetetrahydrofolate Reductase (MTHFR) Variant Modulates Folate Status Response to Conjugated Folate Intake in Young Women. *Journal of Nutrition.* 2005;135:1279-1286.

### 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)
Lentils, cooked (3/4 cup)	265
Edamame (soybeans) (1/2 cup)	190
Spinach, cooked (1/2 cup)	130
Asparagus (6 spears)	128
Chickpeas (3/4 cup)	119
Black beans (3/4 cup)	108
Artichoke, boiled (1/2 cup)	106
Kale, raw (1 cup)	100
Avocado (1/2 fruit)	81

Source: Canadian Nutrient File and USDA Nutrient Database



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People with Risk Variant

### Your Results

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

Your Risk

Typical

### Recommendation

Since you possess the CC variant of the MTHFR gene, there is no increased susceptibility to folate deficiency. It is sufficient for you to meet the 400 mcg per day RDA for folate in order to mitigate the average population risk of deficiency and associated health effects. 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. Folate can also be consumed in supplement form.

Meet the RDA for folate daily.



3in5

People with Risk Variant(s)

### Your Results

Gene	Markers
MTHFD1 PEMT	rs2236225 rs12325817
Risk Variant	Your Variants
	AG CG

Your Risk

Elevated

only when choline intake is low

### Recommendation

Since you possess one or more of the risk variants you have a greater risk of choline deficiency if your choline intake is low. Therefore, it is important to meet the Adequate Intake (AI) level of 425 mg/day for women or 550 mg/day for men. Do not exceed the tolerable upper limit (UL) of 3.5 g/day. Foods rich in choline include meat, poultry, dairy products and eggs, as well as legumes, broccoli, brussels sprouts and quinoa. In addition, ensuring your level of dietary folate recommendations are met also helps lower your risk of choline deficiency (refer to the Folate section for your specific recommendations).

Meet the Adequate Intake (AI) level for choline daily.

## Choline

Choline plays numerous roles in the body. This essential nutrient is involved in multiple metabolic pathways, and is needed for the production of acetylcholine, a neurotransmitter implicated in memory, mood, and muscle control. Choline is found in all cells of the body, providing a vital structural component to cell membranes. Choline can also impact early brain development and regulate the function of genes or how they are "expressed". Although some choline is produced by the body, dietary sources of choline are necessary to meet daily needs. A number of factors contribute to individual choline needs, such as estrogen levels, pregnancy and lactation, age, athletic activity, as well as dietary methionine, betaine and folate. Research also shows that variation in the MTHFD1 and PEMT genes also impact dietary choline needs.\*

\*Toussaint C, Stovrova K, Foster VL, Lopez YS, Mahesh S, Lavinay J, et al. Genetic Impairments to Folate Enzymes Increase Dependence on Dietary Choline for Homocysteine Production at the Expense of Betaine. *Nutrients.* 2018; 10(12):2027-2038.  
Kaufman SE, de Cidra AC, Fowler LM, Zemel DH. Genetic variation of folate-mediated gene-silencing pathway predicts susceptibility to choline deficiency in humans. *PLoS Nutr.* 2019; 1(2):e0000011.  
de Cidra AC, Kaufman SE, Wang J, Galante JA, Fowler LM, Zemel DH. Common genetic polymorphisms affect the nutrient requirement for the nutrient choline. *FASEB J.* 2018; 32(10):1238-44.

### MTHFD1 & PEMT

Methylene tetrahydrofolate dehydrogenase (MTHFD1) encodes an enzyme responsible for folate (also known as vitamin B9) metabolism. Choline's function is tightly linked to the metabolism of folate, as both share overlapping roles in the same metabolic pathways. Individuals who carry the A allele of the MTHFD1 gene are at higher risk of developing clinical signs of choline deficiency when choline intakes are very low in comparison to those who have the GG genotype. In addition, the phosphatidylethanolamine N-methyltransferase (PEMT) gene encodes a protein that allows the liver to produce choline. Individuals with the CG or CC variants of the PEMT gene are at a higher risk of experiencing clinical signs of choline deficiency compared to those with the GG variant if choline intake is low. Meeting the Adequate Intake (AI) for choline is especially important for individuals with the risk variants of these genes.

### Sources of Choline

	Amount (mg)
Egg (1)	147
Soybeans (1/2 cup)	107
Chicken breast (85g)	72
Ground beef (85g)	72
Atlantic cod (85g)	71
Shiitake mushrooms, cooked (1/2 cup)	58
Baked potato (1 large)	57
Wheat germ (2 Tbsp)	51
Kidney beans (1/2 cup)	45

Source: National Institutes of Health

## Calcium

Dietary 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 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. Research 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.* 2008;85:83-93.

### 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



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People with Risk Variant(s)

### Your Results

Gene	Markers
GC	rs7041 rs4588
Risk Variant	Your Variants
	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 1200 mg per day. Meeting intakes of 1200 mg per day 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. Calcium supplementation should not exceed 250 mg per day unless otherwise advised by your healthcare provider.

Consume 1200 mg of calcium daily.



**1in150**  
People with Risk Variant(s)

## 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.\*

\*Hahn KJ et al. Iron-overload-related disease in HFE hereditary hemochromatosis. *New England Journal of Medicine*. 2002;346:2271-81.  
\*Pietzer et al. Identification of a common variant in the TFR2 gene implicated in the physiological regulation of serum iron levels. *Human Molecular Genetics*. 2011;19:2229-41.

### HFE & 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 and important component of hemoglobin, the substance in red blood cells that carries oxygen from your lungs to transport it throughout your body. Iron supports a strong immune system and is also necessary to maintain healthy cells, skin, hair, and nails. 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, pale skin, weakness, shortness of breath and dizziness. Several genes can impact the risk of having low iron status including TMPRSS6, TFR2 and TF.\*

\*Hutter et al. Identification of a common variant in the TFR2 gene implicated in the physiological regulation of serum iron levels. *Human Molecular Genetics*. 2011;19:2237-45.  
\*Benjamin et al. Variants in TF and HFE explain approximately 50% of genetic variation in serum transferrin levels. *Am J Hum Genet*. 2008;83:65-74.

### TMPRSS6, TFR2 & TF

The TMPRSS6 gene codes for the protein matrilysin-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 (75g)	9.8
White beans, canned (1 cup)	8.0
Pumpkin seeds (2 Tbsp)	5.2
Spinach, boiled (1/2 cup)	3.4
Tofu, firm (1/2 cup)	3.0
Tahini (2 Tbsp)	2.7
Ground beef, extra lean (100g)	2.7
Chickpeas (3/4 cup)	2.4
Almonds (1/4 cup)	1.5
Lean ground chicken (75g)	1.2

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



**2in5**  
People with Risk Variant(s)

## Your Results

Genes	Markers
TMPRSS6 TFR2 TF	rs4820268 rs7385804 rs3811647

Risk Variants	Your Variants
	GA AA GG

Your Risk

Typical

## Recommendation

Since you do not possess any risk variants, you have a typical risk for low iron status. Meet the RDA for iron in order to promote healthy blood cells and energy levels. Men 19 years and older and women over 50 years of age should aim for 8 mg/day. Women 19-50 years old should aim for 18 mg/day.

Meet the RDA for iron daily.

## Your Results

Genes	Markers
SLC17A1 HFE HFE	rs17342717 rs1800562 rs1799945

Risk Variants	Your Variants
	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.



## 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 who do not digest lactose cannot tolerate any dairy 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 result in more severe symptoms.

### Lactose Intolerance

Individuals who are lactose intolerant cannot digest lactose. When lactose is not digested, it can cause uncomfortable symptoms such as stomach upset, gas, bloating, and/or loose stools. These symptoms can develop as early as one hour after you consume lactose-containing products. Typically, individuals with lactose intolerance may have to consume a lactose-free or lactose-reduced diet for life or consume dairy products with a meal to reduce the impact of lactose on the gastrointestinal system. Sometimes you can train your body to produce more lactase enzyme by gradually introducing lactose into your diet. Some lactose intolerant individuals can tolerate up to 12 g of lactose per day, which is equivalent to 1 cup of milk. Spreading out your intake over the course of a day and/or consuming lactose-containing foods with meals can help improve tolerance. Your risk for lactose intolerance depends in part on the MCM6 gene. Sometimes you can develop short-term lactose intolerance when you are sick.

### MCM6

MCM6 is part of the MCM complex that helps to regulate the expression of the LCT gene, which encodes lactase, the enzyme that plays a role in breaking down lactose. Variations in this gene can impact your ability to break down lactose, impacting your risk for lactose intolerance. Individuals who possess the CC or CT variant may produce some lactase, but in limited amounts. Individuals with the CC or CT variant have been shown to be at an increased risk for low calcium intake and blood calcium levels.\* This particular variant in MCM6 may not predict lactose intolerance risk for individuals who are not of European descent.

\*Sivarama Reddy et al. Identification of a variant associated with adult-type hypocalcaemia. *Nature Genetics*. 2002;30:229-31.  
\*Kuhle et al. The T-1393C polymorphism in the lactase phlorizin hydrolase gene is associated with differences in serum calcium levels and calcium intake. *Journal of Bone and Mineral Research*. 2012;27(9):1789-97.  
\*Djordjevic et al. Lactase persistence versus lactose intolerance: Is there an intermediate phenotype? *Genetic Epidemiology*. 2015; 39: 10-19.

## 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. If you have lactose intolerance, you can still get enough calcium and vitamin D in the diet through lactose-free milk as well as fortified milk alternatives such as soy and almond 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."

\*Kuhle et al. The T-1393C polymorphism in the lactase phlorizin hydrolase gene is associated with differences in serum calcium levels and calcium intake. *Journal of Bone and Mineral Research*. 2012;27(9):1789-97.

### Sources of Lactose

	Amount (g)
Cow's milk (1 cup)	12
Goat's milk (1 cup)	11
Flavoured 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: Diets of Canada, Food Sources of Lactose

## Recommendation

Since you possess the TT variant of the MCM6 gene, you have a low likelihood of lactose intolerance. To help meet your calcium and vitamin D needs, aim to consume between 2-3 servings of dairy products (equivalent to about 24 g of lactose) and/or calcium- and vitamin D-fortified dairy alternatives (such as soy and almond beverages) daily.

Aim to consume 2-3 servings of dairy and/or dairy alternative products daily.

# 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.



## Celiac Disease & Gluten Sensitivity

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.<sup>1</sup> 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.<sup>2</sup>

<sup>1</sup>Stark O and Blaser H. Diagnosis and classification of celiac disease and gluten sensitivity. *Autoimmunity Reviews*. 2013;12:577-86.

### 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<sup>3</sup> 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.

<sup>2</sup>Stark O and Blaser H. Genetic background of celiac disease and its clinical implications. *American Journal of Gastroenterology*. 2008;103:791-6.

<sup>3</sup>Stark O et al. Disruption of polymorphisms and structural protein gene expression in two gluten-associated candidate genes of celiac disease and gluten sensitivity. *BMC Medicine*. 2011;9:23.

<sup>4</sup>Mariani T et al. Effective detection of human leukocyte antigen risk alleles in celiac disease using tag single nucleotide polymorphisms. *PLoS ONE*. 2008;3:e23230.

### Your Results

Gene	Markers
HLA	rs2395182 rs7775228 rs2187668 rs4639334 rs7454108 rs4713586

Risk Variants	Your Variants
Algorithm	GT TT CC GG TT AA

Your Risk

Low

## 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.

### Sources of Gluten

Major Sources of Gluten	Hidden Sources of Gluten
Bread	Salad dressing
Pasta	Pudding
Cereal	Imitation crab meat
Crackers and chips	Vegan meat substitute
Oats*	Potato chips
Baked goods	French fries
Milk	Soup stock cubes
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

Since you possess this specific combination of variants in HLA, you do not possess the DQ2 or DQ8 risk genotype. This rules out celiac disease in almost all cases. Many foods that contain gluten provide fiber from whole grains and can be an excellent source of vitamins and minerals.

Low risk for gluten intolerance.

# Caffeine

## Anxiety

Many commonly consumed foods and beverages, such as coffee, tea, soft drinks and chocolate, as well as functional beverages such as energy drinks, contain caffeine. There are also hidden sources of caffeine found in pain medications, weight loss supplements, as well as chocolate or coffee-flavored beverages and food products. Caffeine is widely used to promote wakefulness and vigilance, reduce sleepiness and mitigate fatigue related to various shift-work occupations or travel across time zones. In the brain, the effects of caffeine are primarily due to its blocking action of adenosine, a neuromodulator that increases drowsiness and builds up over the day as bedtime approaches. Despite its widespread use, caffeine may cause anxiety in some people. A common variation in the ADORA2A gene contributes to the differences in subjective feelings of anxiety after caffeine ingestion,<sup>1</sup> especially in those who are habitually low caffeine consumers.<sup>2</sup>

<sup>1</sup>Chick E et al. Association between ADORA2A and DRD2 polymorphisms and caffeine-induced anxiety. *Neuropsychopharmacology*. 2008;33(10):2791-800.

<sup>2</sup>Ahne K et al. Association between A2A receptor gene polymorphisms and caffeine-induced anxiety. *Neuropsychopharmacology*. 2002;27(10):1589-1592.

<sup>3</sup>Hager R et al. Association of the adenosine and adenylyl effects of caffeine with ADORA2A and ADORA1 polymorphisms and habitual level of caffeine consumption. *Neuropsychopharmacology*. 2010; 35(18):1787-1803.

## ADORA2A

The ADORA2A (adenosine A2A receptor) gene encodes one of the main receptors for adenosine. Adenosine has many functions in the body, including promoting sleep and calmness and suppressing arousal. Caffeine blocks adenosine receptors, resulting in the stimulating effects of coffee, tea, chocolate and other caffeinated food products and supplements. Individuals who possess the TT variant of the ADORA2A gene are more sensitive to the stimulating effects of caffeine and experience greater increases in feelings of anxiety after caffeine intake than do individuals with either the CT or CC variant.

## Cardiometabolic Health

Caffeine is the most widely consumed stimulant in the world and coffee is the most significant source of caffeine, with tea, soda and chocolate also contributing to intakes. Research has shown that caffeine can influence cardiovascular health. However, the reported effects of coffee on the cardiovascular system have been inconsistent and at times have appeared contradictory. Some studies reported a link between high coffee consumption and an elevated risk of high blood pressure and heart disease, while other studies have shown no effect or even a protective effect with moderate intake. Two landmark studies<sup>1</sup> have now shown that the effect of coffee on cardiovascular disease depends on a variation in a gene called CYP1A2.

<sup>1</sup>Correia et al. Caffeine, CYP1A2 genotype, and risk of myocardial infarction. *Journal of the American Medical Association*. 2008;299:1708-11.

<sup>2</sup>Palmer et al. CYP1A2 genotype modifies the association between coffee intake and the risk of hypertension. *Journal of Hypertension*. 2008;27:1880-1881.

## 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 at which caffeine is broken down, which determines the impact of caffeine on heart health. 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. Those who have the GG variant actually have a lower risk of heart disease with moderate coffee consumption than those who consume no coffee at all.

## Sources of Caffeine

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

Source: Canadian Nutrient File and USDA Nutrient Database



1 in 2  
People with Risk Variant

### Your Results

Gene	Marker
CYP1A2	rs2472300
Risk Variant	Your Variant
GA or AA	GG

Your Risk

Typical

### Recommendation

Since you possess the GG variant of the CYP1A2 gene, there is no increased risk of hypertension or heart attack if consuming more than 200 mg of caffeine daily. Therefore, following Health Canada's recommendation to consume at most 300 mg per day for women of child-bearing age and at most 400 mg per day for other adults is appropriate. 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 300 or 400 mg/day.

Follow the recommendations provided by the CYP1A2 gene section of this report.



**1in2**  
People with Risk Variant

## Your Results

Gene	Marker
TCF7L2	rs12255372
Risk Variant	Your Variant
GT or TT	GG
Your Risk	
Typical	

## Recommendation

Since you possess the typical variant of the TCF7L2 gene, aim to make at least half of all daily grain products whole grain. To identify these foods, look for the words "whole grain" on the label and in the ingredient list. Products labeled with the words "multigrain" or "organic" are not necessarily whole grain.

Make at least half of grain products whole grain.

# Whole Grains

Whole grains are a low glycemic index carbohydrate that contain more fibre than refined grains. They also contain more essential micronutrients such as folic acid, magnesium and vitamin E. Years of research have demonstrated that whole grains may help reduce the risk of several diseases, particularly type 2 diabetes. Scientists have more recently shown that the benefits of consuming whole grains may be particularly important among individuals who have a variant in the TCF7L2 gene.\*

\*Cornelia M.C. et al. TCF7L2 dietary carbohydrate, and risk of type 2 diabetes in US women. *American Journal of Clinical Nutrition*. 2008;88:1238-42.

## 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	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. 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 shows that the effect of sodium intake on blood pressure is influenced by variations in a gene called ACE.\*

\*Pfeiler B. et al. Molecular basis of salt sensitivity in human hypertension: Evaluation of renin-angiotensin-aldosterone system gene polymorphisms. *Hypertension*. 2002;39:1022-6.

## 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. Studies have shown that a person's 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
Bagel with 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
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	GA
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 should help to reduce the risk. However, if you frequently sweat heavily during exercise, causing sodium losses, your sodium requirements may be higher. The AI is 1500 mg per day in adults 19-50 years of age, 1300 mg per day in adults 51-70 and 1200 mg per day in adults 71 years of age and older. The AI of 1500 mg per day is equivalent to 3/4 teaspoon of salt per day, which includes sodium that is found naturally in foods as well as salt that is added during processing and preparation. Foods that are high in sodium include canned soups and canned vegetables, potato chips, processed meats, soy sauce, ketchup and processed cheeses. Aim to choose lower sodium options of these high sodium foods.

Limit sodium intake to the Adequate Intake level.



**1in2**  
People with Risk Variant

## Your Results

Gene	Marker
FADS1	rs174547
Risk Variant	Your Variant
CC or CT	TT
Your Risk	
Typical	

## Recommendation

Since you possess the TT variant of the FADS1 gene, your HDL cholesterol levels are likely not impacted by the level of dietary omega-6 LA or your balance of omega-6 LA to omega-3 ALA intake. Meet the guidelines for healthy adults. Individuals should aim to consume between 5-10% of energy from omega-6 LA and between 0.6-1.2% of energy from omega-3 ALA. Limit intakes of omega-6 LA coming from baked goods, fried foods and other processed foods. For cooking, baking and salad dressings choose canola oil, which is an excellent source of omega-3 ALA. Other foods rich in omega-3 ALA include flax and chia seeds.

Meet the RDA for omega-6 LA fat and omega-3 ALA fat.

# Omega-6 and Omega-3 Fat

Higher consumption of polyunsaturated fats (PUFAs) is associated with reduced risk of cardiovascular disease. PUFAs include both omega-6 fat, such as linoleic acid (LA), and omega-3 fat, such as alpha-linolenic acid (ALA). Since our bodies cannot make omega-6 LA and omega-3 ALA, these essential fats must be obtained from our diets. However, consuming too much omega-6 LA and too little omega-3 ALA may have adverse health effects. Studies have shown that a gene involved in the metabolism of these PUFAs can adversely impact levels of HDL cholesterol ("good cholesterol") when dietary omega-6 LA intake is high,\* or when the ratio of omega-6 LA to omega-3 ALA is too high.\*\*

\*Li Y et al. Dietary omega-6 and omega-3 polyunsaturated fatty acid intake interacts with FADS1 genetic variation to affect HDL and HDL cholesterol concentrations in the Cardiovascular Health Study. *American Journal of Clinical Nutrition*. 2010; 92:289-93.

\*\*Mehdizadeh S et al. Intake levels of dietary long-chain PUFAs modify the association between genetic variation in FADS1 and LDL-C. *Journal of Lipid Research*. 2012; 53: 1182-1189.

## FADS1

The FADS1 gene directs the production of an enzyme called fatty acid desaturase 1. This enzyme converts omega-6 LA and omega-3 ALA to longer-chain PUFAs that participate in inflammatory and immune responses. Compared to those with the TT variant, individuals who have the CC or CT variant of the gene have lower levels of HDL cholesterol when consumption of omega-6 LA is high. Among those with the CC or CT variant, increasing the proportion of dietary omega-3 ALA to omega-6 LA promotes higher levels of HDL cholesterol.

## Sources of Omega-6 and Omega-3 Fats

	Omega-3 ALA (g)	Omega-6 LA (g)
Chia seeds (1 Tbsp)*	1.9	0.6
Flaxseeds (1 Tbsp)*	1.6	0.4
Canola oil (1 Tbsp)*	1.3	2.7
Walnuts (1/4 cup)	0.9	11
Edamame (1/2 cup)*	0.3	1.5
Salmon (75g)*	0.3	0.2
Sardines (75g)*	0.2	0.1
Corn oil (1 Tbsp)	0.2	7.3
Wheat germ cereal, toasted (1 Tbsp)*	0.1	0.4
Tahini (1 Tbsp)	0.1	3.5
Safflower Oil (1 Tbsp)	0.01	1.8
Sunflower Seeds (1/4 cup)	0.01	2.7
Sunflower Oil (1 Tbsp)	0.01	4

\*Values achieve a higher balance of omega-3 ALA to omega-6 LA. Source: Canadian Nutrient File

# Physical Activity

## for Cardiometabolic Health

Physical activity has important benefits for mental health, physical fitness, weight maintenance and the prevention of many chronic diseases. Indeed, exercise improves the function of your heart, lungs and blood vessels, and it also has beneficial effects on blood lipids. Scientists have demonstrated that the LIPC gene influences blood levels of HDL cholesterol (the "good" cholesterol). Research also shows that physical activity raises HDL cholesterol to a greater degree among individuals who have a particular variant of the LIPC gene, compared to those who do not.\*

\*Garrig M et al. The 282G>A promoter variant in hepatic lipase associates with elevated fasting serum high-density lipoprotein cholesterol modified by interaction with physical activity in a study of 10,788 Spanish subjects. *Journal of Clinical Endocrinology and Metabolism*. 2008; 92:2189-2195.

Almond A et al. Physical Activity Modifies the Effect of LIPC, LIPC, and CETP Polymorphisms on HDL-C Levels and the Risk of Myocardial Infarction in Women of European Ancestry. *Circulation Cardiovascular Genetics*. 2012;4:80.

## LIPC

The hepatic lipase gene, also known as LIPC, encodes an enzyme that plays a key role in blood lipid metabolism. LIPC helps transport HDL cholesterol to the liver, where further lipid processing takes place. Large studies conducted in both men and women show that a genetic variant in LIPC impacts the way HDL cholesterol levels increase in response to physical activity. Generally, individuals who are physically active tend to have higher HDL cholesterol concentrations than those who are sedentary. However, even among those who are physically active, individuals who carry the TT or CT variant in the LIPC gene display an enhanced HDL-raising response when engaging in physical activity, resulting in higher HDL cholesterol than individuals without this variant.

## Types of Cardiovascular Activities

Moderate-Vigorous Intensity	
Swimming	Race walking, jogging, running
Briskly walking (5 km/hour or faster)	Tennis
Biking	Water Aerobics

## Types of Muscle-Strengthening Activities

Lifting weights	Working with resistance bands
Heavy gardening (digging, shovelling)	Push-ups
Certain types of yoga	Sit-ups



**1in3**  
People with Response Variant

## Your Results

Gene	Marker
LIPC	rs1800588
Response Variant	Your Variant
TT or CT	CC
Your Response	
Typical	

## Recommendation

Since you possess the CC variant of LIPC, you have a typical HDL cholesterol-raising response to physical activity. At a minimum, meet general physical activity guidelines as this will have a positive impact not only on cholesterol levels, but also body composition, weight management, mental health, blood pressure, bone health, blood sugar, and many other health-related factors. Aim to get 150 to 300 minutes of moderate-to-vigorous intensity exercise per week. This can be met through 30 to 60 minutes of moderate-to-vigorous intensity aerobic exercise five days per week in bouts of 10 minutes or more. You should also include muscle strengthening activities at least 2 days per week.

Aim for 150 to 300 min/week of cardio and at least 2 days/week of muscle-strengthening activities.



**3in10**  
People with Response Variant

## Your Results

Genes	Markers
FTO ADRB2	rs9939609 rs1042713
Response Variant	Your Variants
Algorithm	TA AA

Your Response

**Enhanced**  
when physical activity is high

## Recommendation

Since you possess the enhanced response variants of the FTO and/or ADRB2 gene, you have an enhanced weight loss response from participation in higher levels of physical activity. Your physical activity recommendations, therefore, are to include at least 30-60 minutes/day of moderate-vigorous cardiovascular activity in bouts of 10 minutes or more, over at least 6 days of the week. You should also include muscle strengthening activities at least 2 days per week. These activities should involve major muscle groups. By meeting these physical activity recommendations, you are more likely to increase your lean mass, decrease your fat mass and decrease your body weight.

**Aim for at least 30-60 mins/day of cardio activity, 6 days/week, and muscle-strengthening activities at least 2 days/week.**



**1in5**  
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 weight loss response when consuming a moderate-to-high protein energy-restricted diet. Protein is important for building and maintaining muscle tissue, helping to heal wounds and keeping you feeling full. Consume 15-25% of your energy from protein sources as part of an energy-restricted diet.

**Consume 15-25% of energy from protein.**

# Physical Activity

## for Weight Loss

Physical activity has important benefits for mental health, physical fitness, weight maintenance and the prevention of many chronic diseases. Cardiovascular or aerobic conditioning exercises include those that elevate your heart rate for a sustained period of time, such as brisk walking, running, swimming and cycling. These aerobic exercises improve the function of your heart, lungs and blood vessels. Muscle conditioning exercises improve muscle strength and power as well as bone health and include activities such as weight-lifting or higher intensity yoga and Pilates. Most forms of physical activity are beneficial; however, some individuals can achieve greater weight loss than others based on the amount and type of physical activity they perform. Research shows that variants in the FTO gene can impact an individual's metabolic response to physical activity.\* Indeed, physical activity can reduce the effects of the FTO gene on risk of overweight and obesity by as much as 75%.\*\* In addition, a variant in the ADRB2 gene influences how much body fat you lose in response to cardiovascular exercise.\*\*\*

\*Kokkevi et al. Low physical activity exacerbates the effect of the FTO rs9939609 polymorphism on body fat accumulation. *Diabetes*. 2008;57:1918-1921.  
\*\*Kokkevi et al. Physical activity and genetic predisposition to obesity in a multietnic longitudinal study. *Scientific Research*. 2008;9:1-10.  
\*\*\*Stern et al. Effects of 2-Adrenergic Receptor Gene Variants on Adiposity: The HERITAGE Family Study. *Obesity Research*. 2003;11:1020-1026.

## FTO & ADRB2

The FTO gene is also known as the 'fat mass and obesity-associated gene', and has been consistently shown to impact weight management and body composition. The FTO 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 physical activity recommendations can substantially help with weight loss and weight maintenance in individuals with certain variants of the FTO gene.\* The ADRB2 gene encodes the Beta-2-Adrenergic Receptor, which belongs to a family of molecules that are involved in the fight-or-flight response to stress and response to substances like adrenaline. ADRB2 contributes to the breakdown and mobilization of fat cells, and its activity increases during exercise. A large study of obese, sedentary individuals found that variation in the ADRB2 gene predicted fat loss in response to cardiovascular exercise. Women who carried two copies of a specific ADRB2 variant had an enhanced response to a cardiovascular exercise program, losing over three times more body fat than women who had a typical response.\*\*\*

\*Kokkevi et al. A single FTO gene variant rs9939609 is associated with body weight reduction in a multietnic, actively obese population that underwent bariatric surgery. *Nutrition*. 2010;26:1242-1248.  
\*\*Stern et al. Effects of Beta-2-Adrenergic Receptor Gene Variants on Adiposity: The HERITAGE Family Study. *Obesity Research*. 2003;11:1020-1026.  
\*\*\*Stern et al. Effects of 2-Adrenergic Receptor Gene Variants on Adiposity: The HERITAGE Family Study. *Obesity Research*. 2003;11:1020-1026.

# Energy Balance

Energy is used to fuel all functions in the body. A calorie is a commonly used unit of measurement to quantify energy, which comes from the foods and beverages consumed. The body uses this energy to complete essential processes such as digestion, breathing, brain function and maintaining a normal body temperature. The energy expended during these essential processes is referred to as the Resting Metabolic Rate (RMR). Total energy output, on the other hand, 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. RMR can vary substantially between individuals, and can result from differences in muscle mass, weight, age and genetics. Research shows that variation in the UCP1 gene affects RMR.\*

\*Nagai R et al. UCP1 genetic polymorphism (3282A>G) diminishes resting energy expenditure and thermoregulatory sympathetic nervous system activity in young females. *Int J Obesity*. 2011;35:1039-1045.

## 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 body functions.

## Sources of High Energy Foods

	Amount (calories)
Pizza with pepperoni and cheese (1/2 of 12")	660
Fish, battered, fried (1 piece)	590
Meat and vegetable pie (1 individual pie)	450
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



**2in5**  
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 about 10% (or 150 kcal) lower compared to those who have the AA variant of the UCP1 gene. This 10% decrease is based on an average RMR of 1500 kcal per day, which may be higher or lower than your RMR. Therefore, to lose fat mass it may be helpful to reduce daily energy intake or increase energy expenditure through additional exercise, by an amount equal to 10-20% of your estimated energy needs plus an additional 150 kcal. For example, an individual consuming 2000 kcal per day for weight maintenance may choose an energy deficit of 200 kcal, plus an additional 150 kcal deficit per day, which totals a 350-kcal deficit for weight loss. These values will depend on several factors including physical activity levels, and time needed to reach your goal.

**For weight loss, aim for a daily energy deficit of 10-20% from your current energy needs plus an additional 150 kcal.**



**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 an energy-restricted diet.

**Consume 20-35% of energy from fat.**

# Protein

Protein is an essential nutrient for muscle building, wound healing, healthy hair, skin and nails and proper immune function. Protein is best known for supporting the building and repairing of muscle tissue, which helps to build and maintain strength. Protein has also been shown to regulate appetite by filling you up and allowing you to feel more satisfied with fewer calories. For individuals at risk for overweight and obesity based on the FTO gene, a high protein diet can help with weight loss and weight maintenance over both the short-term and long-term.

## 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. In individuals who have undergone bariatric surgery for weight loss, variation in the FTO gene can help predict their long-term weight loss success, which can have significant implications for nutrition care plans.\* Research shows that in comparison to individuals with the TA or TT variant, those with the AA variant lose more body weight, including fat mass, when consuming a moderate-to-high protein diet, but not when consuming a lower protein diet.\*\*

\*Kokkevi et al. A single FTO gene variant rs9939609 is associated with body weight reduction in a multietnic, actively obese population that underwent bariatric surgery. *Nutrition*. 2010;26:1242-1248.  
\*\*Zhang et al. FTO genotype and 2-year change in body composition and fat distribution in response to weight-loss diets: The POLAND LOST trial. *Diabetes*. 2012;61(7):2008-11.

## 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

# Total Fat

Fat is an essential part of a healthy diet, and is needed for the absorption of the fat-soluble vitamins including vitamins A, D, E, and K. Each gram of fat provides more than double the amount of calories as carbohydrates or protein on a gram per gram basis. This makes fat the most energy-dense nutrient. The total amount and types of fats that you consume can affect heart health and body composition. 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 for weight loss.\*

\*Zhou K et al. TCF7L2 rs7903146 modulates the effect of dietary fat intake on body weight changes in body composition during a weight-loss intervention. *International Journal of Clinical Nutrition*. 2008;81:219-28.

## 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 or obese. Furthermore, possessing the TT variant puts you at an increased risk for insulin resistance (reduced 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 reducing insulin resistance.

## Sources of Fat

	Amount (g)
Bacon (75g)	32
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 beef mince (75g)	11
Goat cheese (50g)	11
Yoghurt, 2-4% M.F. (3/4 cup)	8
Sockeye salmon (75g)	8

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



1in7

People with Response Variant

## Your Results

Gene	Marker
APOA2	rs5082
Response Variant	Your Variant
CC	TC

Your Response

Typical

## Recommendation

Since you possess the typical risk variant of the APOA2 gene, aim to meet the general guidelines for limiting 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 fatty meats (lamb, pork and beef), processed meats (bacon, salami), butter, cheese, fried foods and coconut and palm oils often found in processed foods and baked goods. Suitable alternatives low in saturated fat include olive and vegetable oils, lean meats, low-to-moderate fat dairy products, fish, and plant protein sources such as beans, lentils, nuts/seeds or plant-based proteins such as soy beverages and tofu.

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



1in4

People with Response Variant

## Your Results

Gene	Marker
PPARy2	rs1801282
Response Variant	Your Variant
GG or GC	CC

Your Response

Typical

## Recommendation

Since you possess the CC variant of the PPARy2 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.

# Saturated Fat

Saturated fats, such as those found in red meat, processed meats 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<sup>1</sup> have now shown that the effect of saturated fat on obesity can be influenced by variations in a gene called APOA2.

<sup>1</sup>Corleis D et al. APOA2, dietary fat, and body mass index: application of gene-diet interaction in a European population. *Archives of Internal Medicine*. 2008;168:1887-892.

## 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. There are different variations in the APOA2 gene present in the human population and these different versions of the gene interact with saturated fat in unique ways to influence energy balance and ultimately the risk of obesity. Those people who have the CC variant of the gene are at a higher risk of developing 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)	5
Homogenized milk (1 cup)	5

Source: Canadian Nutrient File and USDA Nutrient Database

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# Monounsaturated Fat

Monounsaturated fats such as those found in olive oil, almonds and avocados have been associated with reduced risk for heart disease. 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 lower body fat composition in some individuals based on their PPARy2 gene.<sup>1</sup>

<sup>1</sup>Stancak M et al. PPARy2 Polymorphisms with fat intake for density and weight loss in a behavioral treatment based on the Mediterranean diet. *Molecular Nutrition and Food Research*. 2011;25:1771-9.

## PPARy2

The PPARy2 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, PPARy2 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
Pumpkin and squash seeds, dried (1/4 cup)	5
Soybeans, boiled (3/4 cup)	3
Hummus (1/4 cup)	2

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

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# 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 dairy products as well as prepared foods such as pizza, baked goods, and many desserts. A diet high in saturated fat has long been associated with health conditions such as diabetes, cardiovascular disease and obesity. Unsaturated fats, including monounsaturated and polyunsaturated fats, such as those found in olive oil, almonds and grape seed oil, may help to decrease the risk of diabetes, cardiovascular disease and obesity. Research shows that variation in the FTO gene can impact the body's response to saturated and unsaturated fat.<sup>1</sup>

<sup>1</sup>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;142:20-21.

## 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. In individuals who have undergone bariatric surgery for weight loss, variation in the FTO gene can help predict their long-term weight loss success, which can have significant implications for nutrition care plans.<sup>2</sup> Research shows that 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.<sup>3</sup>

<sup>2</sup>Nogueira M et al. A single FTO gene variant (rs9939609) is associated with body weight evolution in a bariatric extremely obese population that underwent bariatric surgery. *Nutrition*. 2016;31:1310-16.

## 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

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# 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. It 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.<sup>1</sup>

## CD36

The cluster of differentiation 36 (CD36) gene is also known as fatty acid translocase. It is found on the surfaces of many cells, including taste bud cells in the tongue, 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."<sup>2</sup>

## 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
Chips (20-25)		12
Hamburger (1)		12
Croissant (1)		12
Salmon (75g)	✓	9
Ice cream (1/2 cup)		8
Homogenized milk (1 cup)		8

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

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3in5

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 overweight, weight gain, and fat around your middle.

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



7in10

People with Response Variant

## Your Results

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

Your Response

Enhanced

## Recommendation

Since you possess the GG or GA variant of the CD36 gene, you are a "super taster" of fats. This means that you are better able to sense the taste of fats at lower levels. In comparison, "low tasters" need higher levels of fats in their foods to achieve the same sense of fatty taste. Consuming too much fat, and the wrong types of fats (saturated vs. unsaturated) can increase the risk of obesity and cardiometabolic disease. Refer to the Total Fats section of your report for your recommended daily intake of fats.

You have an enhanced ability to sense the fatty taste of foods.



1in4

People with Risk Variant

## Your Results

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

Your Risk

Typical

## Recommendation

Since you possess the CC variant of the GLUT2 gene, you have a typical risk of over-consuming sugar. However, it is still important to try to keep your intake of added sugar below 5% of your total daily energy intake. A high intake of added sugars is linked to overweight & obesity, cardiometabolic disease and dental caries risk.

Your preference for sugar is typical.

# 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 addition to 'pleasure-generating' signals in the brain given off in response to eating or drinking something sweet, there are specialized areas in the brain that regulate both food intake and glucose (sugar) levels in the body. Research has shown that your intake of sweet foods can be determined by a genetic variant that regulates blood glucose levels in your body. People who carry the variant associated with higher sugar intake are also at higher risk of dental caries (cavities).

## 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.\* In addition, those who have the variant associated with higher sweet food intake, have also been shown to have a higher risk of dental caries.\*\*

\*Ray AM et al. Genetic variant in the glucose transporter type 2 is associated with higher intakes of sugars in two distinct populations. *Physical Genomics*. 2018;2(2):100-105.  
\*\*Khanam GS et al. Association of GLUT2 and TNO10 genotypes with risk for dental caries. *Caries Research*. 2012;47:278-284

## Sources of High Sugar Foods

	Amount (g)
Iced cappuccino (2 cups)	56
Cola (1 can)	36
Citrus juice, frozen, diluted (1 cup)	32
Caramels (40g)	26
Milk chocolate (50g)	26
Maple syrup (2 Tbsp)	24
Jellybeans (10 beans)	20
Caramel-coated popcorn (1 cup)	20
Popsicle (75g)	10
Jam (1 Tbsp)	10

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

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# Eating between Meals

Eating between meals (i.e. snacking) can be beneficial if snacks are healthful and the extra calories are not in excess of those needed to maintain a healthy weight. Healthy snacks can assist with regulating blood sugar levels and weight control, curb food cravings and boost energy levels. However, for many people 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 (psychological reasons for snacking), and focus on more healthful snacking when you feel hungry. 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. Scientists have also 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.\*

\*Blanchard P et al. Common genetic variation near MC4R is associated with eating behaviour patterns in European populations. *PLoS ONE*. 2008;3:3173-3178

## 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...
Chips	Whole wheat pita with hummus
Muffin	Whole wheat English muffin with peanut butter
Ice cream with toppings	Low-fat yogurt with fresh berries
Trial 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

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2in5

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.



1in3

People with Response Variant

## Your Results

Gene	Marker
BDNF	rs6265
Response Variant	Your Variant
AA or AG	GG

Your Response

Typical

## Implications

Since you possess the GG variant of the BDNF gene, your enjoyment and positive mood changes from exercise are typical. Your perceived effort during physical activity is also typical. These responses result in a typical motivation to exercise and typical likelihood that you will continue to exercise regularly. To help increase your motivation and likelihood of maintaining an active lifestyle, try measuring and recording your activity level through objective measures, such as step counts, heart rate, calories burned, or time spent being active. You may also find exercising with a friend or listening to your favorite music great motivation boosters.

You have a typical innate motivation to exercise.

# Motivation to Exercise

Your attitude toward exercise and the effect it has on your mood can greatly impact your likelihood of starting or maintaining a physically active lifestyle. Research shows that individuals who possess the AA or AG variant of the BDNF gene are more likely to experience positive mood changes and exercise for enjoyment. They also perceive their effort and exertion level as lower during exercise compared to individuals who possess the GG variant.\* All of these factors impact motivation to exercise. Being physically active has a multitude of benefits including improved cognitive function, and a lowered risk of many diseases, through improvements in body fat levels, blood sugars, blood pressure, blood lipid profiles, and mental health.

\*Wegman A et al. A transdisciplinary model integrating genetic, physiological, and psychological correlates of voluntary exercise. *Health Psychol*. 2007;26:32-38.  
\*Cahoon Hooper A et al. What keeps a body moving? The brain-derived neurotrophic factor (BDNF) polymorphism and intrinsic motivation to exercise in humans. *J Behav Med*. 2014;37(1):110-120.

## 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 PHYSIOLOGY FITNESS AND INJURY RISK | PAGE 36

# Exercise Behavior

Participating in physical activity 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.\*

\*de Moor MH et al. Genome-wide association study of exercise behavior in Dutch and American adults. *Med Sci Sports Exerc*. 2008;41:1887-96.

## 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.

EXERCISE PHYSIOLOGY FITNESS AND INJURY RISK | PAGE 37



1in12

People with Response Variant

## Your Results

Genes	Markers
CYP19A1 LEPR	rs2470158 rs12405556
Response Variant	Your Variants
Algorithm	GG GG

Your Response

Typical

## Implications

Based on your LEPR and CYP19A1 variants, you have a typical likelihood of engaging in physical activity. Set monthly SMART (specific, measurable, 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.

# Power and Strength

Strengthening activities, as the name implies, are activities that strengthen your muscles and bones. Research shows that muscle-building exercises can also benefit your brain, help with regulating blood sugars, improve posture and help achieve and maintain a healthy body weight. Examples of these activities include body weight exercises such as push-ups, sit-ups, and lunges as well as lifting weights, using gym machines and working with resistance bands. Some activities of daily living or household chores are also considered strengthening activities such as strenuous gardening, carrying heavy groceries or running up stairs. Research shows that the ACTN3 gene plays a major role in your genetic predisposition to excelling in strength and power-based activities.\*

\*Ma P et al. The association of sport performance with ACE and ACTN3 genetic polymorphisms: a systematic review and meta-analysis. *PLoS One*. 2013;8(4):e61865.



## Your Results

Gene	Marker
ACTN3	rs1815739
Response Variant	Your Variant
CC or TC	TC

Your Response

Enhanced

## Implications

Since you possess the TC variant of the ACTN3 gene, you have a genetic advantage to excel in strength and power-based activities. These activities are important for building and maintaining muscle mass. Aim to participate in strengthening activities at least two days per week.

You have a slight genetic advantage to excel in power sports.

# Endurance

Endurance activities refer to aerobic, or "cardio" exercises that cause your heart rate to increase, such as brisk walking, jogging, biking, swimming, or dancing. Your VO2 max, or maximal aerobic capacity, measures the maximum amount of oxygen that your body can process during 1 minute of exercise, and it is a marker of physical fitness. A higher VO2 max generally results in a performance advantage when it comes to endurance activities, although many factors play a role. Research shows that multiple genes impact your genetic predisposition to excelling in endurance activities.\*\* In some of these genes, certain versions of the gene have also been shown to improve your endurance capacity in response to endurance training more effectively.\*\*

\*\*Marrero J et al. Genome-wide association study identifies three novel markers associated with elite endurance performance. *Med Sport*. 2013;2013:6. doi:10.1007/s12013-013-0468-8.  
 \*Barclay C et al. Training performance in ADRB3 gene is associated with elite endurance performance. *British Journal of Sports Medicine*. 2011;45:147-9.  
 \*\*Zemke R et al. The GGT1 c.1224G>C polymorphism influences the cardiorespiratory response to aerobic training. *Med Sport*. 2012;2012:289-296.  
 de Groot M. NRF2 polymorphisms improve endurance capacity in response to training. *Int J Sport Med*. 2007; 28:171-175.  
 Shinar D et al. Genetic Variations in PFKFB3 and PFKFB3A Determine Mitochondrial Function and Change in Aerobic Lifetime Intervention. *J Clin Endocrinol Metab*. 2007; 97: 1827-1833.



## NFI-AS2, ADRB3, NRF2, GSTP1 & PGC1a

NFI-AS2, ADRB3, NRF2, GSTP1 and PGC1a are all involved in physiological processes that impact your endurance abilities. Individuals with the CC variant in the NFI-AS2 gene tend to have greater VO2 max, which is advantageous for endurance exercise. Variations in the ADRB3 gene are more common among world-class endurance athletes compared to non-athlete controls. The NRF2 gene plays an important role in the production of mitochondria, the powerhouses of the cell, and those with the AA variant improve their endurance in response to exercise training. Variation in the GSTP1 gene is also associated with differences in VO2 max responses to aerobic training and individuals with the GG and GA variants have greater improvements. Finally, the GG variant of the PGC1a gene is associated with improved aerobic fitness in response to endurance training. Together, these genes can predict your genetic advantage for excelling in endurance activities and sports.

## Your Results

Genes	Markers
NFI-AS2	rs1572312
ADRB3	rs4994
NRF2	rs12594956
GSTP1	rs1695
PGC1a	rs8192678
Response Variants	Your Variants
	CC TC AA AG GA

Your Response

Ultra

## Implications

Based on your DNA, you have a substantial genetic advantage to excel in endurance activities. To optimize this advantage, aim to increase your intensity, duration or frequency of aerobic exercise to improve your endurance capacity and performance. Aim to include 150 to 300 minutes (equivalent to 2.5 to 5 hours) of moderate-intensity exercise per week.

You have a genetic advantage to excel in endurance sports.

# Muscle Damage

Delayed onset muscle soreness (DOMS) is commonly experienced in the days following unaccustomed or strenuous exercise, and it is characterized by tender, stiff muscles which also cause a temporary reduction in strength and range of motion. DOMS is a result of exercise-induced muscle damage, which at low levels is a positive stimulus for muscle growth and increased strength. However, excessive damage or inadequate recovery may cause persistent and unnecessary soreness which can impede strength gains and increase the risk of developing over-use injuries. DOMS is caused by oxidative stress, inflammation, and muscle protein degradation. There is considerable variability in an individual's response to muscle-damaging exercise, due to factors such as age, exercise history and genetics. Research shows that variation in the ACTN3 gene influences one's susceptibility to muscle damage after prolonged, strenuous or unaccustomed exercise.\* The type of activity inducing the greatest muscle damage is most often high-intensity resistance or power-type exercise.

## ACTN3

The ACTN3 gene encodes the alpha-actin 3 protein, which plays a key role in the contraction of fast-twitch or power-type muscle fibers during short bursts of intense activities, such as sprinting or lifting heavy objects. Genetic variation in ACTN3 affects the expression of the resulting protein in fast-twitch fibres, and individuals who carry at least one copy of the T variant produce a lower functioning ACTN3 protein that has been linked to increased risk of muscle damage. For example, a recent study showed that experienced endurance athletes with the TC or TT variant had higher levels of markers of muscle damage after a competitive marathon than individuals with the CC variant, and a similar trend was observed in a study where healthy young men performed knee extension exercises, working the quadriceps, in a laboratory setting.\*\*

\*Del Coso A. ACTN3 genotype influences exercise-induced muscle damage during a marathon competition. *European Journal of Applied Physiology*. 2013;112:609-616.  
 \*\*Hickel et al. Risk factors of upper-limb DOMS in the response to an acute muscular exercise bout. *Journal of Applied Physiology*. 1996; 79: 208-212.



## Your Results

Gene	Marker
ACTN3	rs1815739
Risk Variant	Your Variant
TC or TT	TC

Your Risk

Elevated

## Implications

Since you possess the risk variant of the ACTN3 gene, you have an increased susceptibility to muscle damage after strenuous or unaccustomed exercise. You are also at greater risk of developing over-use injuries if you do not properly recover from your exercise sessions. Be sure to make time for adequate warm up and cool down in your exercise sessions and include some stretching. Rest and recovery are also important – if you experience extremely sore muscles after a workout, take a break from working that particular muscle group or choose a lighter intensity for that session. Ensure adequate intakes of protein for muscle repair and consume plenty of antioxidant-rich plant foods such as fruits, vegetables, nuts and seeds to help reduce inflammation and negative effects of oxidative stress caused by muscle damage.

Follow an antioxidant-rich diet and allow longer recovery from strenuous exercise.

# Pain

Pain is an unpleasant feeling triggered by the nervous system that can be mild to severe. Pain threshold is a term that refers to the point where you begin to feel pain that causes discomfort to the extent that it becomes difficult for you to withstand. It is a threshold at which you cannot continue to exercise at a certain intensity level due to an intolerable level of discomfort. Pain tolerance refers to the maximum amount of pain that someone can withstand. 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 shows that variations in the COMT gene impact how we feel and perceive pain.\*

\*Zubala et al. COMT val158met genotype affects p-Cytidyl Neurotransmitter Responses to a Pain Stimulus. *Sci*. 2003;299:1249-1253.  
 \*Gendreau A. Methyltransferase (COMT) gene polymorphism and chronic human pain: a systematic review and meta-analysis. *Pharmacogenomics*. 2012;13(9):879-91.

## 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.



## 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, meaning that you tend to experience less pain. To increase your pain tolerance even further, there are several strategies that you can use such as practicing deep breathing and changing negative thoughts to positive thoughts when you are undergoing pain. For example, if you are out running, try to shift your focus away from the discomfort you may be feeling in your muscles, and focus on how the running is positively impacting your health. Exercising more often to build tolerance to discomfort can also help to decrease pain perception during physical activity. Be sure not to exercise through pain as this may cause injury.

You have an enhanced pain tolerance and therefore tend to experience less pain.



4in5

People with Risk Variant

## Your Results

Gene	Marker
WNT16	rs2707466
Risk Variant	Your Variant
CC or TC	TC
Your Risk	

Elevated

## Implications

Since you possess the CC or TC variant of the WNT16 gene, you have an elevated risk for low BMD and bone fracture. Exercise protocols that produce high mechanical forces in the skeleton can increase bone density and strength. For example, sports such as basketball and volleyball, or fitness classes that include running or jumping can all help to improve bone density. In addition, resistance exercise using your own body weight, free weights or machines has been shown to strengthen bones. Daily activities such as running up stairs, carrying heavy groceries or gardening also help to maintain bone strength. Aim to engage in both weight-bearing and resistance exercises most days of the week. Be sure to seek expert guidance before trying new or more challenging exercises. It is also important to ensure adequate intakes of protein, calcium, vitamin D and antioxidants for optimal bone health.

You have an elevated risk for low bone mass.

# Bone Mass

Osteoporosis and osteopenia are common bone diseases that occur more often in older adults but can develop at any age. Both involve a deterioration of tissue, resulting in low bone mineral density (BMD) and compromised bone strength. Osteoporosis can develop without any signs or symptoms and is characterized by low BMD and a high risk of bone fracture. Osteopenia is also characterized by reduced BMD and can predict later development of osteoporosis and fracture risk. Fractures are associated with hospitalization, as well as reduced mobility and independence. Our bones support us, protect our organs, and enable us to move. We also store minerals such as calcium and phosphorus in our bones, which keep them strong, and we release them into the circulation when they are needed by other tissues. Peak bone mass is reached by early adulthood, and gradually declines with age. The rate of bone loss is influenced by factors such as nutrition and exercise, with some forms of exercise slowing the rate of loss and even increasing BMD and bone strength. Genetic variation also contributes to differences in BMD levels across individuals. Research shows that a genetic variant in the WNT16 gene is associated with a greater risk of low BMD and increased risk of fracture.\*

\*Zhang et al. WNT16 influences bone mineral density, cortical bone thickness, bone strength, and osteoporosis fracture risk. *PLoS Genetics*. 2012;8:e1002716.

## WNT16

WNT16 encodes a protein belonging to the WNT family of genes, which is involved in the regulation of bone formation. WNT16 has been associated with bone mass and structure across all life stages, and it is an important determinant of BMD, bone strength, and risk of fracture. Individuals who possess the CC or TC version of the WNT16 gene are predisposed to having a lower BMD and higher risk of bone fracture, compared to those with the TT variant. It is particularly important for individuals with the CC or TC variant to engage in weight-bearing exercises and to ensure they consume adequate amounts of protein, vitamin D and calcium, which are essential nutrients for bone health.

### Types of Weight Bearing Activities

Walking	Running
Hiking/hiking	Tennis
Jogging	Team Sports

### Types of Resistance Activities

Lifting weights	Working with resistance bands
Using weight machines	Push-ups
Squats	Lunges

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# Achilles Tendon Injury

Your Achilles tendon is one of the largest and strongest tendons in the human body. It starts at the bones in your heels and continues up to your calf muscles. 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 doing exercises that require a sudden surge of energy. 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.\*

\*Soderstrom et al. Variants within the COL5A1 gene are associated with Achilles tendinopathy in two populations. *BMJ Sport Med*. 2008;02:017-020.

## 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. Given the role of the COL5A1 gene in the creation of connective tissue, scientists have studied the link between this gene and Achilles tendon injury risk. Research has shown that individuals with the CT or TT variant of COL5A1 gene have a higher risk for developing an Achilles tendon injury.

### Dynamic Stretching Warm-up

Side lunges	Warrior pose
Heel raises	Tip-toe walking
Walking lunges with rear leg extension	Mountain climbers

### Lower Leg Strengthening Exercises

Seated calf raises	Weighted toe raises
Standing calf raises	Anterior tibialis isometrics

### Higher Risk Exercises for Achilles Tendon

Box jumping	Hill sprints
Plyometrics	Sled pushes

EXERCISE PHYSIOLOGY, FITNESS AND INJURY RISK | PAGE 43



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People with Risk Variant

## Your Results

Gene	Marker
COL5A1	rs12722
Risk Variant	Your Variant
CT or TT	TT
Your Risk	

Elevated

## Implications

Since you possess the CT or TT variant of the COL5A1 gene, you have an elevated risk of developing an Achilles tendon injury. To decrease your risk, be mindful of activities requiring a surge of energy or overextension of this tendon through certain exercises such as 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 an elevated risk for Achilles tendon injury.

# Additional Genetic Insights for Health and Wellness

The table below includes genetic markers that provide additional insights for health and wellness. These insights come from research studies on genetic variation and its association with health-related outcomes, such as the association for a genetic marker with having a higher level of a nutrient circulating in the blood. This section differs from the previous sections in the report, which focus on genetic markers that modify the way we respond to diet or exercise to impact health outcomes. Therefore, currently, no personalized diet or fitness recommendations are given for the markers in the following table. Talk to your healthcare provider about general strategies you can implement to optimize your health given these additional health-related insights.

Gene, rs Number	Gene Function	Risk/Response Variant	Your Variant	Your Risk/Response	Implications
Nutrients					
Magnesium	TRPM6, rs11144134	TRPM6 is a magnesium transporter	TT or CT	TT	Elevated You have an elevated risk of low levels of magnesium.
Zinc	SLC30A3, rs11126936	SLC30A3 is a zinc transporter	CC	AC	Typical You have a typical risk of low levels of zinc.
Starch	AMY1, rs4244372	AMY1 is a salivary starch enzyme	AA	AT	Typical Your ability to metabolize starch is typical.
Vitamin E	Intergenic - rs12272004	APOA5 is a component of HDL	CC or CA	CC	Elevated You have an elevated risk of low vitamin E levels.
Inflammation and Antioxidant Capacity					
Adiponectin	ADIPOQ, rs17365568	Adiponectin is an anti-inflammatory hormone	GA or AA	GA	Diminished Your levels of adiponectin are likely to be diminished.
Interleukin 6	IL6, rs180795	IL6 is an inflammation biomarker	GG or GC	GC	Elevated Your levels of interleukin 6 are likely to be higher than normal.
Superoxide Dismutase 2	SOD2, rs4880	SOD2 is an antioxidant	TT or CT	TT	Diminished Your SOD2 enzymatic activity, which affects antioxidant capacity, is diminished.
Nitric Oxide	NOS3, rs179983	NOS3 is involved in producing antioxidants	GT or TT	GG	Typical Your plasma nitric oxide levels are likely to be typical.
Eating Habits					
Hunger	NME, rs1051168	NME regulates eating behaviour	TT	GG	Typical You have a typical susceptibility to hunger.

Gene, rs Number	Gene Function	Risk/Response Variant	Your Variant	Your Risk/Response	Implications
Weight Management					
Maintenance of Long-Term Weight Loss	ADIPOQ, rs17300539	Adiponectin regulates fat metabolism and insulin sensitivity	AA or AG	GG	Typical You have a typical ability to maintain weight loss in the long term.
Sleep and Lifestyle					
Short Sleep Duration	CLOCK, rs1901260	CLOCK regulates the circadian rhythm	CC or TC	TC	Elevated You have an increased risk of short sleep duration.
Alcohol Sensitivity	ALDH2, rs671	ALDH2 is involved in alcohol metabolism	AA or AG	GG	Typical You have a typical sensitivity to the effects of drinking alcohol.
Cardiometabolic Health					
Total Cholesterol	APOA5, rs62799	APOA5 is a component of HDL	CC or TC	TT	Typical You have a typical risk of high total cholesterol.
LDL Cholesterol	ABCG8, rs6544713	ABCG8 is involved in cholesterol transport	TT or CT	CT	Elevated You have an increased risk for high LDL cholesterol.
HDL Cholesterol	ABCA1, rs1883025	ABCA1 is involved in cholesterol transport	TT or TC	CC	Typical You have a typical risk of low HDL cholesterol.
Triglycerides	ANGPTL3, rs10689353	ANGPTL3 is involved in regulating lipid metabolism	AA or CA	CA	Elevated You have an increased risk of high triglycerides.
Fasting Glucose	ADCY5, rs11708057	ADCY5 is involved in insulin secretion	AA or GA	GA	Elevated You have an increased risk for high fasting glucose.
Insulin	IRS1, rs2943641	IRS1 is involved in insulin signaling	CT or CC	CT	Elevated You have an increased risk for high insulin concentrations.
Injury					
Rotator Cuff Injury	MMP1, rs1799750 MMP3, rs3025058	MMP1 and MMP3 are involved in tissue remodeling	Algorithm	GDel DelA	Elevated You have an elevated risk of having a rotator cuff injury.

# Hormone Metabolism and Methylation

The table below shows genetic markers that provide additional insights for health and wellness. Included are markers that affect the function of enzymes involved in the metabolism of important hormones such as estrogen and androgens and detoxification of their by-products. Also included are markers that affect the function of enzymes involved in DNA methylation, a crucial process for adequate cell development. This section differs from previous sections in the report, which focus on genetic markers that modify the way we respond to diet or exercise to impact health outcomes. Currently, no personalized diet or fitness recommendations are given for the markers in the following table. Talk to your healthcare provider about general strategies you can implement to optimize your health given these additional insights.

Enzyme	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Implications
Hormone Metabolism					
Cytochrome P450 17A1	CYP17A1, rs743572	AG or GG	AG	Elevated	You have an elevated risk of high estrogen levels.
Aromatase	CYP19A1, rs10046	CT or TT	CT	Medium	You have a medium risk of elevated estrogen levels, and an increased estrogen:androgen ratio.
Cytochrome 1B1	CYP1B1, rs1056836	GC or GG	GG	Elevated	You have an elevated risk of tissue damage due to high levels of estrogen by-products.
UDP-Glucuronosyl-transferase 2B15	UGT2B15, rs1902023	TG or GG	TT	Typical	You have a typical risk of high dihydrotestosterone (DHT) levels.
Mitochondrial Superoxide Dismutase 2	SOD2, rs4880	CT or TT	TT	Elevated	You have an elevated risk of cell oxidative damage.
Catechol-O-Methyltransferase	COMT, rs4680	GA or AA	GA	Medium	You have a medium risk of high dopamine levels.
Glutathione S-transferase P1	GSTP1, rs1695	AG or GG	AG	Medium	You have a medium risk of tissue damage due to a moderate rate of estrogen clearance.
Glutathione S-transferase T1	GSTT1, rs2266633	Del	Ins	Typical	You have a typical risk of tissue damage due to a higher rate of estrogen clearance.

Enzyme	Gene, rs Number	Risk Variant	Your Variant	Your Risk	Implications
Methylation					
Methionine Reductase	MTR, rs1805087	GG or AG	AA	Typical	You have a typical risk for high homocysteine levels, and a typical risk for low circulating folate.
Methionine Synthase Reductase	MTRR, rs1801394	AG or GG	GG	Elevated	You have an elevated risk for high homocysteine levels, and an elevated risk for low circulating folate.
Methylene-Tetrahydrofolate Reductase A	MTHFR (A1298C), rs1801131	AC or CC	AC	Elevated	You have an elevated risk for high homocysteine levels, and an elevated risk for low circulating folate.
Methylene-Tetrahydrofolate Reductase B	MTHFR (C677T), rs1801133	CT or TT	CC	Typical	You have a typical risk for high homocysteine levels, and a typical risk for low circulating folate.



## HOMEOSTASIS DIET

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